STATE MODEL SYLLABUS FOR UNDER GRADUATE
COURSE IN ECONOMICS
(Bachelor of Arts Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course structure of UG Economics Honours

Semester	Course	Course Name	Credits	Total marks
I	AEC-I	AEC-I	04	100
	C-I	Introductory Microeconomics	06	100
	C-II	Mathematical Methods for Economics I	06	100
	GE-I	Indian Economy	06	100
			22	
II	AEC-II	AEC-II	04	100
	C-III	Introductory Macroeconomics	06	100
	C-IV	Mathematical Methods for Economics II	06	100
	GE-II	Indian Economy II	06	100
			22	
III	C-V	Microeconomics I	06	100
	C-VI	Macroeconomics I	06	100
	C-VII	Statistical Methods for Economics	06	100
	GE-III	Introductory Microeconomics	06	100
	SEC-I	SEC-I	04	100
			28	

Semester	Course	Course Name	Credits	Total marks
IV	C-VIII	Microeconomics II	06	100
	C-IX	Macroeconomics II	06	100
	C-X	Research Methodology	06	100
	GE-IV	Introductory Macroeconomics	06	100
	SEC-II	SEC-II	04	100
			28	
Semester	Course	Course Name	Credits	Total marks
V	C-XI	Indian Economy I	06	100
	C-XII	Development Economics I	06	100
	DSE-I	1. Economic History of India (1857-1947) 2. Introductory Econometrics 3. Odisha Economy 4. Public Economics 5. Money and Banking	06	100
	DSE-II		06	100
			24	
VI	C-XIII	Indian Economy II	06	100
	C-XIV	Development Economics II	06	100
	DSE-III	1. Environmental Economics 2. International Economics 3. Agricultural Economics 4. History of Economic Thought	06	100
	DSE-IV		06	100

		5. Project		
	OR			
	DSE-IV	Dissertation	06	100*
			24	

Discipline Specific Elective Papers: (Credit: 06 each) (4 papers to be selected by students of Economics Honours): DSE 1-IV

DSE Group I

1. Economic History of India (1857-1947)
2. Introductory Econometrics
3. Odisha Economy
4. Public Economics
5. Money and Banking

DSE Group II

1. Environmental Economics
2. International Economics
3. Agricultural Economics
4. History of Economic Thought
5. Project *Dissertation (can be opted as alternative of DSE-IV only and of 6 credits. **Dissertation content: 50, Seminar: 30, Viva: 20)**

ECONOMICS

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers (out of the 6 papers suggested)
Generic Elective for Non Economics students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm : 20 marks, End term : 80 marks, Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 50 hours + 10 hours tutorial

Core Paper I

INTRODUCTORY MICROECONOMICS

Introduction:
This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Unit I: Exploring the Subject Matter of Economics, Markets and Welfare

The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of Assumptions; Economic Models; Why economists disagree; Graphs in Economics

The Market Forces; Markets and Competition; The Demand and Supply curves – Market vs Individual curves, Shifts in Demand and Supply Curves; Market Equilibrium and changes there in; Price Elasticity of Demand – determinants and computation; Income and Cross Elasticity of Demand; The Price Elasticity of Supply – determinants and computation; Consumer and Producer Surplus.

Unit II: Theory of Consumer Choice

The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of Indifference Curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and Substitution Effect; Derivation of Demand Curve; Three applications – Demand for Giffen goods, Wages and Labour Supply, Interest rate and Household saving.

Unit III: The Firm and Market Structures

Cost concepts; Production and Costs; The various measures of cost – Fixed and Variable cost, Average and Marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in Competitive Markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run

Unit IV: The Input Markets

The Demand for Labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the Labour Market; Other factors of production: Land and Capital; Linkages among factors of production.

Text Book:
- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi

Reference Book:
- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.
  Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc

Core Paper II

MATHEMATICAL METHODS FOR ECONOMICS I

Introduction:
This is the first of a compulsory two-course sequence. The objective of this sequence is to transmit the body of basic mathematics that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomic theory, statistics and econometrics set out in this syllabus. In this course, particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general. The level of sophistication at which the material is to be taught is indicated by the contents of the prescribed textbook.

Unit I: Preliminaries and Functions of one Real Variable

Sets and set operations; Cartesian product; relations; functions and their properties; Number systems

Types of Functions- constant, polynomial, rational, exponential, logarithmic; Graphs and graphs of functions; Limit and Continuity of functions; Limit theorems

Unit II: Derivative of a Function

Rate of change and derivative; Derivative and slope of a curve; Continuity and differentiability of a function; Rules of differentiation for a function of one variable; Application- Relationship between total, average and marginal functions

Unit III: Functions of two or more Independent Variables

Partial differentiation techniques; Geometric interpretation of partial derivatives; Partial derivatives in Economics; Elasticity of a function – demand and cost elasticity, cross and partial elasticity

Unit IV: **Matrices and Determinants**

Matrices: concept, types, matrix algebra, transpose, inverse, rank; Determinants: concept, properties, solving problems using properties of determinants, solution to a system of equations - Crammer's rule and matrix inversion method.

Text Book:
- A. C. Chiang and K. Wainwright (2005): *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition.

Reference Book:
- K. Sydsaeter and P. J. Hammond (2002): *Mathematics for Economic Analysis*. Pearson Educational Asia

<div align="center">

Core Paper III

INTRODUCTORY MACROECONOMICS

</div>

Introduction:
This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics

Macro vs. Micro Economics; Limitations of Macroeconomics; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income;

Unit II: Measurement of Macroeconomic Variables

Output, Income and Expenditure Approaches; Difficulties of Estimating National Income; National Income Identities in a simple 2-sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector economies; National Income and Economic Welfare; Green Accounting.

Unit III: Money and Changes in its Value

Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices
Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measurers, Depression and Stagflation; Inflation vs. Deflation

Unit IV: Determination of National Income
The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption- Saving – Investment Functions, The Keynesian Approach – Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier

Text Book:
- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:
- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Core Paper IV

MATHEMATICAL METHODS FOR ECONOMICS II

Introduction:
This course is the second part of a compulsory two-course sequence. This part is to be taught in Semester II following the first part in Semester I. The objective of this sequence is to transmit the body of basic mathematics that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomic theory, statistics and econometrics set out in this Syllabus. In this course, particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general. The level of sophistication at which the material is to be taught is indicated by the contents of the prescribed textbook.

Unit I: **Linear models:**

Input- Output Model: Basic concepts and structure of Leontief's open and static Input-Output model; Solution for equilibrium output in a three industry model; The closed model

Unit II: Second and Higher Order Derivatives and Integration:

Technique of higher order differentiation; Interpretation of second derivative; Second order derivative and curvature of a function; Concavity and convexity of functions; Points of inflection, Derivative of Implicit Function; Higher Order Partial Derivative

Indefinite Integrals; Rules of Integration; Techniques of Integration: Substitution Rule, Integration by parts, and Partial Fractions; Definite Integral – Area Interpretation

Unit III: Single and Multivariable Optimization:

Optimum values and extreme values; Relative maximum and minimum; Necessary versus sufficient conditions - First and Second derivative tests (using Hessian Determinants); Economic applications thereof, First and second order condition for extrema of multivariable functions; Convex functions and convex sets

Unit IV: Optimization with Equality Constraints:
Effects of a constraint; Finding stationary value – Lagrange-Multiplier method (Two variable single constraint case only): First and second order condition; The Bordered Hessian determinant

Text Book:
- A. C. Chiang and K. Wainwright (2005): *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition.

Reference Book:
- K. Sydsaeter and P. J. Hammond (2002): *Mathematics for Economic Analysis*. Pearson Educational Asia

Core Paper V

MICROECONOMICS I

Introduction:
The course is designed to provide a sound training in microeconomic theory to formally analyze the behavior of individual agents. Since students are already familiar with the quantitative techniques in the previous semesters, mathematical tools are used to facilitate understanding of the basic concepts; this course looks at the behavior of the consumer and the producer and also covers the behavior of a competitive firm.

Unit I: Consumer Theory I

Preferences and Utility, Axioms of Rational Choice, Utility, Trades and Substitutions, Indifference curves; Mathematics of Indifference curves, Utility functions for specific preferences, the many good case; Utility Maximization and choice: the 2-good case (graphical analysis), the n-good case, Indirect utility function, the Lump sum principle, Expenditure minimization, properties of expenditure function

Unit II: Consumer Theory II

The Income and Substitution Effects: Demand function, changes in income, changes in a goods price- Direct and Indirect Approaches (Slutsky), the Individual's Demand Curve, Compensated (Hicksian) demand curves and functions, demand elasticity, Consumer Surplus, Demand relationships among goods, the 2-good case, substitutes and complements, Net (Hicksian) substitutes, and Complements, Substitutability with many goods

Unit III: Production Theory and Costs

Production Functions: Marginal productivity, Production with One Variable Input (labour) and with Two-Variable Inputs, Isoquant Maps and the Rate of Technical Substitution, Returns to Scale, Elasticity of Substitution, Some Simple Production Functions: Linear, Fixed Proportions, Cobb-Douglas; Technical Progress
Definition of Cost and its properties, Cost minimizing input choices (Optimization principles, Expansion Path), Cost Functions and Shift in Cost Curves, Long-Run versus Short-Run Cost Curves

Unit IV: Profit Maximization

The Nature and Behavior of Firms, Marginal Revenue – Relationship between Average and marginal revenue, Short-Run Supply by a Price-Taking Firm, Profit Functions and its Properties, Profit maximization – General conditions, Input demands

Text Book:
- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India

Reference Books:
- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems

MACROECONOMICS I

Introduction:
This course introduces the students to formal modeling of a macro-economy in terms of analytical tools. It discusses various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context. It also introduces the students to various theoretical issues related to an open economy.

Unit I: Consumption and Investment

Consumption – Income Relationship, Propensities to Consume and the Fundamental Psychological Law of Consumption; Implications of Keynesian Consumption Function; Factors Influencing Consumption Function; Measures to Raise Consumption Function; Absolute, Relative, Permanent and Life – Cycle Hypotheses
Autonomous and Induced Investment, Residential and Inventory Investment, Determinants of Business Fixed Investment, Decision to Invest and MEC, Accelerator and MEI, Theories of Investment.

Unit II: Demand for and Supply of Money

Demand for Money – Classical, Neoclassical and Keynesian Approaches, The Keynesian Liquidity Trap and its Implications, Supply of Money, The Theory of Money Supply Determination and Money Multiplier, Measures of Money Supply in India

Unit III: Aggregate Demand and Aggregate Supply

Derivation of Aggregate Demand and Aggregate Supply Curves in the IS-LM Framework; Nature and Shape of IS and LM curves; Interaction of IS and LM curves and Determination of Employment, Output, Prices and Investment; Changes in IS and LM curves and their Implications for Equilibrium

Unit IV: Inflation, Unemployment and Expectations, and Trade Cycles

Inflation – Unemployment Trade off and the Phillips Curve – Short run and Long run Analysis; Adaptive and Rational Expectations; The Policy Ineffectiveness Debate; Meaning and Characteristics of Trade Cycles; Hawtrey's Monetary Theory, Hayek's Over-investment Theory and Keynes' views on Trade Cycles

Text Book:
- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:
- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Core Paper VII

STATISTICAL METHODS FOR ECONOMICS

Introduction:
This is a course on statistical methods for economics. It begins with some basic concepts and terminology that are fundamental to statistical analysis and inference. It is followed by a study and measure of relationship between variables, which are the core of economic analysis. This is followed by a basic discussion on index numbers and time series. The paper finally develops the notion of probability, followed by probability distributions of discrete and continuous random variables and introduces the most frequently used theoretical distribution, the Normal distribution.

Unit I: **Data Collection and Measures of Central Tendency and Dispersion**
Basic concepts: population and sample, parameter and statistic; Data Collection: primary and secondary data, methods of collection of primary data; Presentation of Data: frequency distribution; cumulative frequency; graphic and diagrammatic representation of data; Measures of Central Tendency: mean, median, mode, geometric mean, harmonic mean, their relative merits and demerits; Measures of Dispersion: absolute and relative - range, mean deviation, standard deviation, coefficient of variation, quartile deviation, their merits and demerits; Measures of skewness and kurtosis.

Unit II: Correlation and Regression Analysis

Correlation: scatter diagram, sample correlation coefficient - Karl Pearson's correlation coefficient and its properties, probable error of correlation coefficient, Spearman's rank correlation coefficient. Two variable linear regression analysis - estimation of regression lines (Least square method) and regression coefficients - their interpretation and properties, standard error of estimate

Unit III: Time Series and Index Number

Time Series: definition and components, measurement of trend- free hand method, methods of semi-average, moving average and method of least squares (equations of first and second degree only), measurement of seasonal component; Index Numbers: Concept, price relative, quantity relative and value relative; Laspeyer's and Fisher's index, family budget method, problems in construction and limitations of index numbers, test for ideal index number.

Unit IV: Probability Theory and Sampling

Probability: Basic concepts, addition and multiplication rules, conditional probability; Meaning of Sampling, Types of Sampling: Probability Sampling verses Non-Probability Sampling; Simple

Random Sampling and its selection, Systematic Sampling, Multi-stage Sampling, Quota Sampling; Error: Sampling and Non-sampling

Text books:
- S. C. Gupta (2017): *Fundamentals of Statistics*, Himalaya Publishing House, Delhi
Reference Book:
- Murray R. Speigel (2017): *Theory & Problems of Statistics*, Schaum's publishing Series.

Core Paper VIII

MICROECONOMICS II

Introduction:
This course is a sequel to Microeconomics I. The emphasis will be on giving conceptual clarity to the student coupled with the use of mathematical tools and reasoning. It covers Market, general equilibrium and welfare, imperfect markets and topics under information economics.

Unit I: Firm Supply and Equilibrium

Market Environments; Pure competition; Supply decision of a competitive firm and Exceptions; Inverse Supply Function; Profits and Producer's Surplus; Long Run Supply Curve of a Firm; Long Run Average Costs; Short Run and Long Run Industry Supply; Industry Equilibrium in Short and Long Run; Meaning of Zero Profits; Economic Rent

Unit II: General Equilibrium, Efficiency and Welfare

The Edge worth Box; Trade; Pareto Efficient Allocations; Existence of equilibrium and efficiency; The Welfare Theorems and their implications; The Firm; Production and the Welfare Theorems ; Production possibilities, comparative advantage and Pareto efficiency

Unit III: Market Imperfections: Monopoly and Oligopoly

Barriers to Entry, Profit Maximization and Output Choice, Monopoly and resource Allocation, Monopoly, Product Quality and Durability, Price Discrimination, Second Degree Price Discrimination through Price Schedules, Regulation of Monopoly, Dynamic Views of Monopoly Oligopoly – Choosing a strategy; Quantity and price leadership; Simultaneous Quantity Setting; Example of Cournot Equilibrium; Simultaneous Price Setting; Collusion

Unit IV: Game Theory

The Payoff Matrix of a Game; Nash Equilibrium; Mixed Strategies ;The Prisoner's Dilemma; Repeated Games; Enforcing a cartel; Sequential Games; A Game of entry deterrence.

Text Book:
- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems.

Reference Book:
- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India.
- Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc

Core Paper IX

MACROECONOMICS II

Introduction:
This course is a sequel to Macroeconomics I. In this course, the students are introduced to the long run dynamic issues like growth and technical progress. It also provides the micro-foundations to the various aggregative concepts used in the previous course.

Unit I: Modeling Economic Growth

Accumulation of Capital in the basic Solow Model; supply and demand for goods, growth in the capital stock and the steady state, Golden rule level of capital: Comparing steady states, transition to the golden rule steady state with too much and too little capital, Population Growth, Technological Progress- Solow version, Beyond Solow Model and Endogenous Growth

Unit II: Open Economy and Macroeconomic Policy

Balance of payments- concept; meaning of equilibrium and disequilibrium in balance of payments; Determination of foreign exchange rate- the balance of payments theory; Fixed versus flexible exchange rates; Short-run open economy model- the basic Mundell-Fleming model;
Macroeconomic Policies – Fiscal policy, Crowding –out and Crowding – in; Monetary policy and instruments, the Transmission Mechanism; Effectiveness of macroeconomic policies in open and closed economies

Unit III: Classical and Keynesian Macroeconomics Thoughts

Keynes verses classics: Classical macroeconomics, Employment and output determination, Say's law, the quantity theory of money, Keynes's General theory: Keynes's main propositions; analysis of the labour market, Keynes's critique of Say's law and Quantity theory of money, the orthodox Keynesian school, underemployment equilibrium in the Keynesian model, the Phillips curve and orthodox Keynesian school

Unit IV: Monetarist and New Classical Macroeconomic Thoughts

The orthodox monetarist school, the Quantity Theory of Money approach, the expectations augmented Phillips curve analysis, the orthodox monetarist school and stabilization policy
New Classical Economics: The influence of Robert e Lucas Jr, the structure of new classical models: the Rational Expectations hypothesis; and policy implications

Text Book:
- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:
- Brian Snowdon and Howard R Vane (2005): Modern Macroeconomics: Its Origins, Development and Current State, Edward Elgar

Core Paper X

Research Methodology

Introduction:
The course is to develop a research orientation among the students and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis.

Unit I: Basics of Research

Introduction to Research: Meaning, Objectives, Motivation, Types, Approaches, Significance, Research Process, Criteria of Good Research; Qualities of a Good Researcher, Research as a Career

Unit II: Research Problem

Defining the Research Problem: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem; Research Design: Meaning, Need, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

Unit III: Issues in Research

Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Techniques of Measurement Tools, Scaling and Important Scaling Technique
Research Ethics: codes and ethics, permissions to research, responsibilities, confidentiality, feedback, participatory research; Research Proposal and literature review: research proposal, review of literature, levels of analysis, using the library and internet, abstracting, word processing, plagiarism, Concept of IPR

Unit IV: Actions in Research

English in report writing: words, sentences, paragraph, writing style; The Report: improving quality, sections, drawing conclusions, evaluation checklists, persistence; Common Citation Styles

Text Book:
- Kothari, C. R. (2004): Research Methodology: Methods and Techniques, New Age International Private Limited Publishers, New Delhi.

Reference Books:
- Guthrie, G. (2010): Basic Research Methods, Sage Publications India Private Limited, New Delhi.

Core Paper XI

INDIAN ECONOMY I

Introduction:
Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in India in the post-Independence period, with particular emphasis on paradigm shifts and turning points. Given the rapid changes taking place in India, the reading list will have to be updated annually.

Unit I: Basic Characteristics of Indian Economy as a Developing Economy

Indian Economy in the Pre-British Period; The Structure and Organization of Villages and Towns; Industries and Handicrafts in Pre-British India; Colonialism; Economic Consequences of British Rule; Decline of Handicrafts and Progressive Ruralization; The Land System and Commercialization of Agriculture; Industrial Transition; Colonial Exploitation and Impacts – Underdevelopment; Colonization and Modernization; State Policies and Economic Underdevelopment; The Current State of Indian Economy

Unit II: Population and Human Development

Population Growth and Economic Development – size, growth and future of population; Causes of rapid population growth; Population and economic development; Population policy; Demographic issues – Sex and Age Composition of population; Demographic Dividend; Urbanization and Migration; Human Resource Development – Indicators and importance of Human Resource Development; Education policy; Health and nutrition.

Unit III: National Income in India – The Growth Story and Current Challenges

Trends in national and per capita income; Changes in sectoral composition of national income; Regional disparities in Growth and Income; Savings and Investment and Economic Growth – The

Linkage; Poverty – Estimation and Trends, Poverty Alleviation Programs – MGNREGA, NRLM, SJSRY; Inequality – Measures and trends in India; Unemployment – Nature, Estimates, Trends, Causes and Employment Policy

Unit IV: Economic Planning in India
Rationale, Features, Objectives, Strategies, Achievements and Assessment of Planning in India; Eleventh Five Year Plan – Objectives, Targets and Achievements; Twelfth Five Year Plan – Vision and Strategy; From Planning to NITI – Transforming India's Development Agenda.

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai
  Reference Books:
- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Indian Economy Datt and Sundharam, GauravDatt and AshwaniMahajan, S Chand Publications, 7th Revised Edition
- Indian Economy Since Independence, ed by Uma Kapila, Academic Foundation, Revised Nineteenth Edition 2008-09
- Government of India (Current Year): Economic Survey, Ministry of Finance, New Delhi

Core Paper XII

DEVELOPMENT ECONOMICS I

Introduction:
This is the first part of a two-part course on economic development. The course begins with a discussion of alternative conceptions of development and their justification. It then proceeds to aggregate models of growth and cross-national comparisons of the growth experience that can help evaluate these models. The axiomatic basis for inequality measurement is used to develop measures of inequality and connections between growth and inequality are explored. The course ends by linking political institutions to growth and inequality by discussing the role of the state in economic development and the informational and incentive problems that affect state governance.

Unit I: Study of Economic Development

Development Economics as a subject; economic growth and economic development; Characteristics of underdeveloped countries – vicious cycle of poverty and cumulative causation; obstacles to economic development; measures of economic development – national and per capita income, basic needs approach, capabilities approach, three core values of development, PQLI, HDI, HPI, MDPI, GDI; capital formation and economic development

Unit II: Theories of Economic Growth and Development

Classical theory, Marxian theory; Schumpeterian theory; Rostow's stages of economic growth; Solow model and convergence with population growth and technical progress

Unit III: Poverty, Inequality, Agriculture, Industry and Development:

Measuring poverty: Head Count Ratio, Poverty Gap Ratio, Squared Poverty Ratio, FGT Ratio; Measuring Inequality – Lorenz curve and Kuznets' inverted U hypothesis; Growth, poverty and inequality; Policy options – some basic considerations
Agriculture, Industry and Economic Development: Role of agriculture; Transforming traditional agriculture; Barriers to agricultural development; Role of industrialization; Interdependence between agriculture and industries – A model of complementarities between agriculture and industry; terms of trade between agriculture and industry; functioning of markets in agrarian societies; interlinked agrarian markets

Unit IV: Institutions and Economic Development:

Role of institutions in economic development; Characteristics of good institutions and quality of institutions; The pre-requisites of a sound institutional structure; Different measures of institutions – aggregate governance index, property rights and risk of expropriation; The role of democracy in economic development; Role of markets and market failure; Institutional and cultural requirements for operation of effective private markets; Market facilitating conditions; Limitations of markets in LDCs; Corruption and economic development – tackling the problem of corruption

Text book:
- Todaro, Michael P and Stephen C Smith (2006): *Economic Development*, 8th Edition, Pearson

Reference Books:
- Debraj Ray (2009): *Development Economics,* Oxford University Press.
- Thirlwall, A P (2011): *Economics of Development*, 9th Edition, Palgrave Macmillan

Core Paper XIII

INDIAN ECONOMY II

Introduction:
This course examines sector-specific polices and their impact in shaping trends in key economic indicators in India. It highlights major policy debates and evaluates the Indian empirical evidence. Given the rapid changes taking place in the country, the reading list will have to be updated annually.

Unit I: Agricultural Development in India

Indian Agriculture: nature, importance, trends in agricultural production and productivity, factors determining production, land reforms, new agricultural strategies and green revolution, rural credit; Agricultural marketing and warehousing.

Unit II: Industrial Development in India

Trends in industrial output and productivities; Industrial Policies of 1948, 1956, 1977 and 1991; Industrial Licensing Policies – MRTP Act, FERA and FEMA; Growth and problems of SSIs, Industrial sickness; Industrial finance; Industrial labour.

Unit III: Tertiary Sector, HRD and the External Sector

Tertiary Sector: growth and contribution of service sector to GDP of India, share of services in employment; Human development – concept, evolution, measurement; HRD: indication, importance, education in India, Indian educational policy; Health and Nutrition.
Foreign Trade: role, composition and direction of India's foreign trade, trends of export and import in India, export promotion verses import substitution; Balance of Payments of India; India's Trade Policies; Foreign Capital – FDI, Aid and MNCs.

Unit IV: Indian Economy and Environment

Environmental Policies in India: The Environment (Protection) Act 1986, The Environment (Protection) Rules 1986, The National Forest Policy 1988, Policy statement for Abatement of Pollution 1992, National Conservation Strategy and Policy Statement on Environment and Development 1992, The National Environment Appellate Authority Act 1997, National Environmental Policy 2006; Global deal with Climate Change: Introduction, Intergovernmental Panel for Climate Change (IPCC), Impact of Climate Change on India, Global Response on Climate Change, Possible Role of India.

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Books:
- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Indian Economy Datt and Sundharam, GauravDatt and AshwaniMahajan, S Chand Publications, 7th Revised Edition
- Indian Economy Since Independence, ed by Uma Kapila, Academic Foundation, Revised Nineteenth Edition 2008-09
- Government of India (Current Year): Economic Survey, Ministry of Finance, New Delhi

DEVELOPMENT ECONOMICS II

Introduction:
This is the second unit of the economic development sequence. It begins with basic demographic concepts and their evolution during the process of development. The structure of markets and contracts is linked to the particular problems of enforcement experienced in poor countries. The governance of communities and organizations is studied and this is then linked to questions of sustainable growth. The course ends with reflections on the role of globalization and increased international dependence on the process of development.

Unit I: Population and Development

Demographic concepts : birth and death rates, age structure, fertility and its determinants, the Malthusian population trap and the microeconomic household theory of fertility; costs and benefits of population growth and the model of low level equilibrium trap; rural-urban migration – the Harris Todaro migration model and policy implications

Unit II: Dualism and Economic Development

Dualism – geographic, social and technological; the theory of cumulative causation (Myrdal); the regional inequalities in the context of economic development; the inverted U relationship; international inequality and the centre periphery thesis; dependency, exploitation and unequal exchange; the dualistic development thesis and its implications

Unit III: Environment and Development

Basic issues of environment and development – Development and environment inter-linkage; Poverty, environmental degradation and externalities; common property resources, renewable and non-renewable resources; concept of sustainable development; basics of climate change

Unit IV: International Trade and Economic Development and Financing Economic Development

Trade and economic development; export led growth; terms of trade and economic growth – the Prebisch Singer Hypothesis; trade strategies for development – import substitution vs. export promotion; international commodity agreements; trade vs aid.
Saving, capital formation and economic development; financial sector and economic development; taxation, public borrowing and economic development; inflation, foreign finance, investment and foreign aid – controversies and opportunities

Text Book:
- Todaro, Michael P and Stephen C Smith (2006): *Economic Development*, 8th Edition, Pearson

Reference Book:

- Thirlwall, A P (2011): *Economics of Development*, 9th Edition, Palgrave Macmillan

(A student has to choose any two from group I under DSE-1& DSE - 2)

Discipline Specific Elective Paper-1

ECONOMIC HISTORY OF INDIA 1857-1947

Introduction:
This course analyses key aspects of Indian economic development during the second half of British colonial rule. In doing so, it investigates the place of the Indian economy in the wider colonial context, and the mechanisms that linked economic development in India to the compulsions of colonial rule. This course links directly to the course on India's economic development after independence in 1947.

Unit I: Introduction: Colonial India: Background and Introduction and Macro trends;

Overview of colonial economy**,** National Income; population; occupational structure

Unit II: Agriculture

Agrarian structure and land relations; agricultural markets and institutions – credit, commerce and technology; trends in performance and productivity; famines

Unit III: Railways and Industry

Railways; the de-industrialization debate; evolution of entrepreneurial and industrial structure; nature of industrialization in the interwar period; constraints to industrial breakthrough; labor relations

Unit IV: Economy and State in the Imperial Context

The imperial priorities and the Indian economy; drain of wealth; international trade, capital flows and the colonial economy – changes and continuities; government and fiscal policy

Text Book:
- Tirthankar Roy, *The Economic History of India 1857-1947*, Oxford University Press, 3rd edition, 2011.

Discipline Specific Elective Paper-2

INTRODUCTORY ECONOMETRICS

Introduction:
This course provides a comprehensive introduction to basic econometric concepts and techniques. It covers statistical concepts of hypothesis testing, estimation and diagnostic testing of simple and multiple regression models. The course also covers the consequences of and tests for misspecification of regression models.

Unit I: Introduction

Definition, Nature and scope of econometrics; Theoretical Probability Distributions: Binomial, Poisson and Normal distributions: their properties
Theory of Estimation: Estimation of parameters; properties of estimators – small sample and asymptotic properties; point and interval estimation

Unit II: Hypothesis Testing

Testing of hypotheses: defining statistical hypotheses; Simple and composite hypotheses; Null and alternative hypothesis; Type I and Type II errors, Critical region; Neyman-Pearson lemma; Power of a test; Test statistics: z, chi square, t and F

Unit III: Linear Regression Analysis

Two variable linear regression model – Assumptions; Least square estimates, Variance and co-variance between Least square estimates; BLUE properties; Standard errors of estimates; Co-efficient of determination; Inference in a two variable linear regression model; ANOVA; Forecasting. Introduction to multiple regression models.

Unit IV: Violation of Classical Assumptions
Heteroscedasticity, Multicollinearity and Auto-correlation: Meaning, consequences, tests and remedies.

Text Book:
- Gujarati, D & Sangeetha (2007); "Basic Econometrics", McGraw Hill Book Co.

Discipline Specific Elective Paper-3

ODISHA ECONOMY

Introduction:
Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in Odisha in pre- and post-Independence period, with particular emphasis on

paradigm shifts and turning points. Given the rapid changes taking place in Odisha, the reading list will have to be updated annually.

Unit I: Odisha Economy before 1947

Orissa's Economy in the Nineteenth Century: Benevolence or Exploitation, Forces of Nature, Animal Power, The Company Steps in, Public Works and Public Health, Education, Disintegration of Village Economy, New Social Environment, Changing Position of Social Classes, The Moneylenders, The Borrowers, Money-flows from Village to Metropolis, Pauperization of Peasantry, The Wage Earners, Demographic Changes, Profiting from Rural Adversity; Diarchy in 1919 and Separation of Provincial Finances from Central Government in 1937; Emergence of Federal Finance (Ref.: Das 1976a and 1976b, GoO 2016)

Unit II: Macro Economy of Odisha

A macro glance of Odisha economy: aggregate income, broad sectoral decomposition, performance of districts, employment, child labour and bonded labour, employment programmes, consumption expenditure, cost of living; Odisha State public finances (Chapter 14 and 15 of Ref 1; & Chapter 2 and 9 of Ref 2)

Unit III: Agriculture, Industry, Infrastructure and Environment in Odisha

Agriculture: land ownership and land tenure, agricultural wages and rural unemployment, production and productivity of major crops, agricultural inputs, agricultural policy; Animal Husbandry; Fisheries (Chapter 1 to 3 of Ref 1; & Chapter 3 of Ref 2)
Industry: Investment, industrial policy, and the growth of large industries, mining and quarrying; Construction; tertiary sector: tourism, transport and power; Water Resources, Forest Resources (Chapter 4 to 8 of Ref 1; & Chapter 4 & 5 of Ref 2)

Unit IV: Social Sector in Odisha

Poverty: income poverty and inequality; health sector: outcomes, infrastructure, finance, public health, NRHM; education: Literacy, Primary education, secondary education, higher education, SSA; human development (Chapter 9 to 13 of Ref 1; & Chapter 7 & 8 of Ref 2)

Text Book:

- Nayak, P., Panda, S. C., Pattanaik, P. K. (2016): **The Economy of Odisha: A Profile**, Oxford University Press, New Delhi

Reference Book:
- GoO (Latest): Odisha Economic Survey, Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar
- GoO (2004): *Human Development Report 2004 Orissa*, Planning and Coordination Department, Government of Odisha, Bhubaneswar

- GoO (2018): 80 Years Odisha Budget: Commemorative Volume, Department of Finance, Bhubaneswar

Discipline Specific Elective Paper-4

MONEY, BANKING AND FINANCIAL MARKET

Introduction:

This course exposes students to the theory and functioning of the monetary and financial sectors of the economy. It highlights the organization, structure and role of financial markets and institutions. It also discusses interest rates, monetary management and instruments of monetary control. Financial and banking sector reforms and monetary policy with special reference to India are also covered.

Unit I: Money

Definition and functions of money; Types of money: legal tender money and bank money, near money; Value of money and index number; construction of index number; WPI, CPI, PPI, GDP deflator, Cost of living index

Demand for money- Classical and Keynesian approaches, Patinkin and the Real Balance Effect; Friedman's Quantity theory of money. Supply of Money- Measures of money supply: M_1, M_2, M_3 and M_4; High powered money and money multiplier.

Unit II: Commercial Banking

Meaning and types; Functions of commercial banks; the process of credit creation and its limitations; Balance sheet and portfolio management, Banking sector reforms in India; Lessons from Global Financial Crisis and Policy Response in India.

Unit III: Central Banking

Functions of a central bank; Quantitative and qualitative methods of credit control; Central Bank's Supervision and prudential measures for Financial stability; current monetary policy of India, liquidity adjustment facility (LAF) through Repo and reverse repo operation, MSF.

Unit IV: Financial Markets

Financial Market, Meaning, Types, Money market and Capital Market, Primary and Secondary Market, Stock Exchanges, SEBI; Role of Financial Markets for Economic Development.

Text Book

- L. M. Bhole and J. Mahukud, *Financial Institutions and Markets,* Tata McGraw Hill, 5th edition, 2011.

Discipline Specific Elective Paper-5

PUBLIC ECONOMICS

Introduction:
Public economics is the study of government policy from the points of view of economic efficiency and equity. The paper deals with the nature of government intervention and its implications for allocation, distribution and stabilization. Inherently, this study involves a formal analysis of government taxation and expenditures. The subject encompasses a host of topics including public goods, market failures and externalities.

Unit I: Introduction to Public Finance and Public Budgets

Public Finance: meaning and scope, distinction between public and private finance; public good verses private good; Principle of maximum social advantage; Market failure and role of government; Public Budget: kinds of budget, economic and functional classification of the budget; Balanced and unbalanced budget; Balanced budget multiplier; Budget as an instrument of economic policy

Unit II: Public Expenditure

Meaning, classification, principles, cannons and effects, causes of growth of public expenditure, Wagner's law of increasing state activities, Peacock-Wiseman hypotheses

Unit III: Public Revenue

Sources of Public Revenue; Taxation - meaning, cannons and classification of taxes, impact and incidence of taxes, division of tax burden, the benefit and ability to pay approaches, taxable capacity, effects of taxation, characteristics of a good tax system, major trends in tax revenue of central and state governments in India

Unit IV: Public Debt

Sources, effects, debt burden – Classical/ Ricardian views, Keynesian and post-Keynesian views; shifting - intergenerational equity, methods of debt redemption, debt management, tax verses debt

Text Books:
- J. Hindriks and G. Myles (2006): *Intermediate Public Economics*, MIT Press.

Reference Book:
- R. A. Musgrave and P. B. Musgave(1989): *Public Finance in Theory and Practices.* McGraw Hill
- Bhatia H L (2018): *Public Finance.* Vikas Publishing House.

DSE Group II
(A student has to choose any two from group II under DSE-3 & DSE- 4)

Discipline Specific Elective Paper- 1

Environmental Economics

Introduction:
This course introduces the students to the basics of environmental economics to understand the fundamentals of environmental concerns and develop insights into valuation of environment.

Unit I: Economy and Environment

Nature and Scope of Environmental Economics- Environment and Economy interaction; Environment as a public good- Serious environmental problems of Developing Countries – Air pollution, water pollution and deforestation.
Global environmental problems, trade and environment, International Cooperation for Environmental Protections, Montreal and other protocols.

Unit II: The Economics of Pollution and Climate change

Pollution as externality, The market Approach to optimal pollution, Property rights and market bargain theorems, Coase theorem; Pigouvian Taxation, Subsidies and optimal pollution; Climate change – concept, causes, effects and management.

Unit III: Valuation of Environmental Damage

Methods and difficulties of environmental valuation, Economic value, Use value, Option value, Existence value; Direct and Indirect Valuation of Environmental Goods: The hedonic price approach, Contingent valuation, Travel cost approach.

Unit IV: Natural Resources and Sustainable Development

Natural resources- Renewable and exhaustible; Tragedy of commons, People's Participation in the management of common property resources; Sustainable Development Concepts, Sustainability rules, Indicators of sustainability, Solow/Hartwick, Natural capital stock, Safe Minimum Standard.

Text Book:
* Bhattacharya, R. N. (2002): Environmental Economics: An Indian Perspectives, OUP, New Delhi

Reference Book:
* Kolstad, C.D (1999); Environmental Economics Oxford University Press, New Delhi

Discipline Specific Elective Paper-2

INTERNATIONAL ECONOMICS

Introduction:
This course introduces the students to international trade and finance to understand the theories of international trade and develop insights into trade policy and balance of payments. The course also develops insight into international financial system and the trade policy of India.

UNIT I: Importance of Trade and Trade Theories

Importance of the study of International Economics; Inter-regional and international trade; Theories of Trade-absolute advantage (Adam Smith), comparative advantage (David Ricardo) and opportunity cost (Haberler); Heckscher-Ohlin theory of trade — its main features, assumptions and limitations (Leontief Paradox) Factor Price Equalization theorem.

UNIT II: Trade Policy and International Economic Institutions

Concepts of terms of trade and their importance; Doctrine of reciprocal demand – Offer curve technique; Gains from trade ;Trade as an Engine of Growth and Concept of immiserizing growth, Tariffs and quotas – their impact in partial equilibrium analysis; General Equilibrium analysis of tariff and the concept of optimum tariff, Functions of IMF (Conditional Clause), Role of IMF in international liquidity, Reforms for the emergence of international monetary system; World Bank and WTO; Their achievements and failures; Their Role from the point of view of India

UNIT III: Exchange Rate

Concept and Types of Exchange Rate (bilateral vs. trade-weighted exchange rate, cross exchange rate, spot, forward, futures), Demand for and Supply of foreign exchange, Exchange Rate Determination: Mint Parity Theory, Purchasing-Power Parity Theory, Fixed versus Flexible exchange rate

UNIT IV: Balance of Trade and Payments

Concepts and components of balance of trade and balance of payments; Disequilibrium in balance of payments; Various measures to correct deficit in BOPs (Expenditure switching and expenditure reducing policies, Direct control), Depreciation Vs. Devaluation; Elasticity approach to devaluation, Foreign trade multiplier- Concept and implications.

Text Book:
- Mannur H. G (Recent Edition) *International Economics*, Vikash Publishing

Reference Books:
- SalvatoreDominick, *InternationalEconomics*,WileIndia.
- SoderstenBo andReedJ, *InternationalEconomics*, McMillanPublisher

Discipline Specific Elective Paper-3

AGRICULTURAL ECONOMICS

Course description

This course introduces students to the significance of agriculture in the Indian economy and helps to understand the role agriculture in economic development. It is designed to develop insights into changing agricultural practices in India and assess the significance of agriculture in the era of liberalization.

UNIT I: Agriculture and Economic Growth

Role of Agriculture in Economic Development, sectoral changes and agriculture, agriculture in rural development, farm and non-farm employment issues, inter-linkages between agriculture and industry; empirical evidence of inter-dependence between agriculture and industry; Schultz's hypothesis on traditional agriculture – its criticisms; Mechanization of Indian Agriculture; Case for and against farm mechanization; Green revolution and trends of mechanization in India

UNIT II: Agricultural Price and Marketing

Agricultural price policy for a developing economy – objectives and effectiveness of agricultural price policy, elements of agricultural price policy, features of an ideal agricultural price policy, agricultural price policy in India and public distribution system
Agricultural marketing – need and criteria for assessing efficiency, agricultural marketing system in India, development of a national agricultural marketing platform

UNIT III: Risk and Uncertainty in Agriculture

Difference between risk and uncertainty, types of uncertainty in agriculture, measures for mitigating risk and uncertainty in agriculture, new agricultural insurance scheme of India
Rural credit in India, importance and estimates, agencies for rural credit, review of progress of institutional finance in rural India since independence

UNIT IV: Agriculture in India

Agriculture in Indian Planning, Globalization and Indian agriculture, Case for and against privatization of agriculture, WTO and India's trade in agricultural commodities

Text Book
- Sony, R. N. (2006), Leading Issues in Agricultural Economics, Vishal Publishing, Jalandhar.

Reference Book:
- Sadhu, A N and A Singh (2008), Fundamentals of Agricultural Economics, Himalaya Publishing House, Mumbai.

Discipline Specific Elective Paper-4

HISTORY OF ECONOMIC THOUGHT

Introduction:
This course provides a perspective to our intellectual history, development of economic thought and helps relate this thought to the current thinking. It introduces the students to the philosophers and economists who developed economic reasoning and modeling of economic activities. It also helps create critical abilities and attitudes.

UNIT I: Introduction and Early Economic Thought

Mercantilism-main characteristics, Thomas Mur's views ; Physiocracy- main features, Tableau Economique, taxation; Early Classicism: Adam Smith- Theory of Value, Division of labour, capital accumulation, distribution, views on trade and economic progress; David Ricardo-theory of value, theory of rent, distribution, ideas on international trade and development.

UNIT II: Classicism Vs Marxism

Thomas Malthus- population theory, glut theory; Karl Marx-dynamic of social change, theory of value, surplus value, theory of profit, crisis of capitalism, Johns Stuart Mill- ideas on value, distribution, views as a synthesizer.

UNIT III: The Marginalists' Revolution

Economic ideas of Jevons, Walras and Menger, Bohm-Bowerk, Wicksell ; Marshall – Role of time element in price determination, ideas on consumer surplus, Marshal as a synthesizer

UNIT IV: Indian Economic Thought

Main themes of Kautilya's Arthasashtra; Modern Economic Ideas: Dada Bhai Naoroji, M.K. Gandhi, village swaraj, non-violence, machines and labour, cottage industries; Comparison of Indian Economic thought with western Economic thought.

Text Book
- Gide, Charles and Rist, Charles (1973): A History of Economic Doctrines, Oxford University Press.
- Dasgupta, A K (1986): Epochs of Economic Theory, Oxford University Press, New Delhi

Reference Book:
- O'Brien, D P (1975): Classical Economists, Oxford, Clarendon Press.
- Ekelund, Robert B. and Robert F. Hebert (1990): A History of Economic Theory and Method, third edition, New York: McGraw Hill
- Henry W. Spiegel (1991): The Growth of Economic Thought, 3rd ed. Durham: Duke University Press
- Tom Bottomore (1980): Dictionary of Marxist Thought, Basic Blackwell Publishers.
- Roll, Eric, History of Economic Thought, Faber and Faber Ltd.

- L N Rangarajan (1992): Kautilya: The Arthasastra, edited, rearranged, translated and introduced; Penguine books, New Delhi

DSE Paper –4
DISSERTATION / RESEARCH PROJECT
(College can give this choice only for students with above 60% aggregate marks)

Introduction : The project is intended to establish the connection between Economics as confined to the text books and class rooms and Economics at play in the ground. It is expected to give an empirical content to the subject. Economics is defined as the study of mankind in the ordinary business of life. It studies individual as well as group behavior.

Project work at the undergraduate level is an in-depth study on a topic chosen by the student. The objective of the project work for the students at undergraduate level is to expose students to the social and real world contexts in which the subjects taught in the classroom have applications. Therefore, the topic must be related to the field of study the student is enrolled. It is undertaken with the guidance of a faculty supervisor, and involves a prolonged period of investigation and writing. The supervisor is supposed to help the student and mentor him/her throughout, from selection of the topic to submission of the project report.
The project output will be a project report written on the topic, chosen by the student and approved by the guide, in about 10000 words.

The process of project preparation typically comprises of an investigation of a particular topic, based on the application of philosophical and theoretical knowledge available in the already existing scientific literature and other published sources of information. The student may use already available data (texts, documents, artworks or existing data sets) or she may go for collection of data from the field. The final report should ideally have the following sections.
(1) Abstract (in about 500 words) containing a summary of the entire report.
(2) Introduction of the topic, arguments for choosing such a topic and the key investigation propositions.
(3) A review of the existing knowledge on the topic
(4) Information on the data and data treatment tools used in the study
(5) An analysis of data and findings
(6) Conclusions
(7) References

A good research project requires sincere efforts and honest dedication from students. Moreover, it requires an engagement of the student with an issue under probe for a fairly long period of time compared to their preparations of subjects for the examination.

A successful completion of the project report has several positive learning outcomes for the student. It empowers the student with the life skill of patience and persistence. It also helps the student to locate her theoretical understandings in the context of socio-economic and political realities.

Generic Elective Paper I

INDIAN ECONOMY

Introduction: This paper introduces the students to the essentials of Indian economy with an intention of understanding the basic feature of the Indian economy and its planning process. It also aids in developing an insight into the agricultural and industrial development of India. The students will understand the problems and policies relating to the agricultural and industrial sectors of India and current challenges of Indian economy.

Unit I: Introduction to Indian Economy and Current Challenges

Colonialism & British Rule: Exploitation and under-development in India; Basic features of India Economy; Indian Economy as a developing economy; Demographic trends in India - Size and growth of population, Occupational structure, Sex composition, Age structure and demographic dividend; Causes of population growth and population policy; The problem of unemployment and recent policies for employment generation; The problem of inequality in income distribution and its causes, Policies to address inequality.

Unit II: Indian Agriculture

Role of Agriculture in Indian Economy; Cause of low productivity, Green Revolution and Land Reforms, Agricultural Finance-Sources and Problems; Agricultural Marketing in India

Unit III: Industrial Development in India

Role of Industrialization in Indian Economy; Small Scale & Cottage Industries: Meaning, Role, Problems and Remedies; Industrial Policies of 1948, 1956, 1977 and1991; Problems of Industrial Development in India; Industrial Sickness

Unit IV: Service Sector in India

Growth & Contribution to GDP; Composition and relative importance of service sector; Factors determining growth of the sector; ICT and IT – Spread and Policy; Sustainability of services led growth

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Book
- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.

INDIAN ECONOMY II

Introduction: : This paper is the part II of Indian economy deals with the external sector, financial markets in India, Indian Public Finances and Economic Reforms. This paper also throws some light on current challenges of Indian Economy.

Unit I: External Sector in India
Trends, Composition & Direction in exports from and imports of India; Problems of Balance of Payment: Causes of deficit in BOP & measures to correct it; Trade Policy- Export Promotion Vs Import Substitution; Foreign Trade Policy of India; WTO and India

Unit II: Financial Markets in India
Commercial Banking in India- Nationalization of Banks; Lead bank scheme and branch expansion; RBI - Functions, Monetary Policy; Development Banking- IFCI,IDBI, SIDBI and NABARD

Unit III: Indian Public Finance
Public Expenditure-Growth and Composition, Causes of Growth of Public Expenditure in India: Tax Revenue of Central and State Governments; Concept of VAT; Deficit Financing in India- Revenue, Budget, Fiscal and Primary Deficits; Purpose and Effects of Deficit Financing; India's Fiscal Policy-Objectives

Unit IV: Current Challenges Facing Indian Economy
Inflation – Causes, Consequences and Anti-inflationary Policy; Poverty – Poverty line and Estimates, Major Poverty Alleviation Programmes; Environmental Degradation – Growth and Environment; Population Growth and Environment; Environment Policy; Economic Reforms- Globalization, Macroeconomic Stabilization, Structural Reforms, and their impact on the Indian Economy; Foreign capital and MNCs-Role and consequences

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Book
- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Basu, Kaushik (2016): An Economist in the Real World: The Art of Policy Making in India, enguin

Generic Elective Paper III

INTRODUCTORY MICROECONOMICS

Introduction:
This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situation.

Unit I: Exploring the Subject Matter of Economics, Markets and Welfare

The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of assumptions; Economic Models; Why economists disagree; Graphs in Economics

The market forces; Markets and competition; The demand and supply curves – Market vs. individual curves, Shifts in demand and supply curves; Market equilibrium and changes there in; Price elasticity of demand – determinants and computation; Income and cross elasticity of demand; The price elasticity of supply – determinants and Computation; Consumer and Producer Surplus

Unit II: Theory of Consumer Choice

The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of indifference curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and substitution effect; Derivation of demand curve; Three applications – Demand for Giffen goods, Wages and Labour Supply, Interest rate and Household saving

Unit III: The Firm and Market Structures

Cost concepts; Production and costs; The various measures of cost – Fixed and variable cost, average and marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in competitive markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run

Unit IV: The Input Markets

The demand for labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the labour market; Other factors of production: Land and capital; Linkages among factors of production.

Text Book:
- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi

Reference Book:
- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.

- Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc

Generic Elective Paper IV

INTRODUCTORY MACROECONOMICS

Introduction:
This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics
Macro vs. Micro Economics; Limitations of Macroeconomics ; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics ; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income

Unit II: Measurement of Macroeconomic Variables
Output, Income and Expenditure Approaches ; Difficulties of Estimating National Income; National Income Identities in a simple 2- sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector; economies; National Income and Economic Welfare; Green Accounting

Unit III: Money and Changes in its Value
Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices. Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measurers, Depression and Stagflation; Inflation vs. Deflation

Unit IV: Determination of National Income
The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption- Saving – Investment Functions, The Keynesian Approach – Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier

Text Book:
- N. Gregory Mankiw (2010):*Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

■■■

Course structure of UG Economics Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Principles of Microeconomics I	06	100
II	DSC-II	Principles of Microeconomics II	06	100
III	DSC-III	Principles of Macroeconomics I	06	100
IV	DSC-IV	Principles of Macroeconomics II	06	100
V	DSE-I	1. Economic Development and Policy in India 2. Economic History of India 1857-1947	06	100
VI	DSE-II	1. Odisha Economy 2. Money and Banking	06	100
			30	**600**

ECONOMICS Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers

 Marks per paper - Midterm : 20 marks, End term : 80 marks, Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 50 hours + 10 hours tutorial

Discipline Specific Core Paper I

PRINCIPLES OF MICROECONOMICS- I

Introduction:
This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Unit I: Exploring the subject matter of Economics, Markets and Welfare

The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of assumptions; Economic Models; Why economists disagree; Graphs in Economics

The market forces; Markets and competition; The demand and supply curves – Market vs individual curves, Shifts in demand and supply curves; Market equilibrium and changes there in; Price elasticity of demand – determinants and computation; Income and cross elasticity of demand; The price elasticity of supply – determinants and Computation; Consumer and Producer Surplus.

Unit II: Theory of Consumer Choice

The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of indifference curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and substitution effect; Derivation of demand curve; Three applications – Demand for Giffen goods, wages and labour supply, Interest rate and household saving.

Unit III: The Firm and Market Structures

Cost concepts; Production and costs; The various measures of cost – Fixed and variable cost, average and marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in competitive markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and

the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run

Unit IV: The Input Markets

The demand for labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the labour market; Other factors of production: Land and capital; Linkages among factors of production.

Text Book:
- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi

Reference Book:
- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.

<div align="center">

Discipline Specific Core Paper II

PRINCIPLES OF MICROECONOMICS II

</div>

Introduction:
The course is designed to provide a sound training in microeconomic theory to formally analyze the behavior of individual agents. Since students are already familiar with the quantitative techniques in the previous semesters, mathematical tools are used to facilitate understanding of the basic concepts; this course looks at the behavior of the consumer and the producer and also covers the behavior of a competitive firm.

Unit I: Consumer Theory I

Preferences and Utility, Axioms of Rational Choice, Utility, Trades and Substitutions, Indifference curves; Mathematics of Indifference curves, Utility functions for specific preferences, the many good case; Utility Maximization and choice: the 2-good case (graphical analysis), the n-good case, Indirect utility function, the Lump sum principle, Expenditure minimization, properties of expenditure function.

Unit II: Consumer Theory II

The income and substitution effects: Demand function, changes in income, changes in a goods price- Direct and Indirect Approaches (Slutsky), the Individual's Demand Curve, Compensated (Hicksian) demand curves and functions, demand elasticity, Consumer Surplus, Demand relationships among goods, the 2-good case, substitutes and complements, Net (Hicksian) substitutes, and Complements, Substitutability with many goods.

Unit III: Production Theory and Costs

Production Functions: Marginal productivity, Production with One Variable Input (labour) and with Two-Variable Inputs, Isoquant Maps and the Rate of Technical Substitution, Returns to Scale, Elasticity of Substitution, Some Simple Production Functions: Linear, Fixed Proportions, Cobb-Duglas; Technical Progress.
Definition of Cost and its properties, Cost minimizing input choices (Optimisation principles, expansion path), Cost Functions and Shift in Cost Curves, Long-Run versus Short-Run Cost Curves.

Unit IV: Profit Maximization

The Nature and Behavior of Firms, Marginal Revenue – Relationship between Average and marginal revenue, Short-Run Supply by a Price-Taking Firm, Profit Functions and its Properties, Profit maximization – General conditions, Input demands.

Text Book:
- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India

Reference Books:
- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems

<div align="center">

Discipline Specific Core Paper III

PRINCIPLES OF MACROECONOMICS I

</div>

Introduction:
This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics

Macro vs. Micro Economics; Limitations of Macroeconomics ; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics ; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income;

Unit II: Measurement of Macroeconomic Variables

Output, Income and Expenditure Approaches ; Difficulties of Estimating National Income; National Income Identities in a simple 2- sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector; economies; National Income and Economic Welfare; Green Accounting.

Unit III: Money and Changes in its Value

Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices
Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measurers, Depression and Stagflation; Inflation vs. Deflation

Unit IV: Determination of National Income

The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption- Saving – Investment Functions, The Keynesian Approach – Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier

Text Book:
> N. Gregory Mankiw (2010):*Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:
> Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Discipline Specific Core Paper IV

PRINCIPLES OF MACROECONOMICS II

Introduction:
This course introduces the students to formal modeling of a macro-economy in terms of analytical tools. It discusses various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context. It also introduces the students to various theoretical issues related to an open economy.

Unit I: Consumption and Investment

Consumption – Income Relationship, Propensities to Consume and the Fundamental Psychological Law of Consumption; Implications of Keynesian Consumption Function; Factors Influencing

Consumption Function; Measures to Raise Consumption Function; Absolute, Relative, Permanent and Life – Cycle Hypotheses

Autonomous and Induced Investment, Residential and Inventory Investment, Determinants of Business Fixed Investment, Decision to Invest and MEC, Accelerator and MEI, Theories of Investment.

Unit II: Demand for and Supply of Money

Demand for Money – Classical, Neoclassical and Keynesian Approaches, The Keynesian Liquidity Trap and its Implications, Supply of Money – Classical and Keynesian Approaches, The Theory of Money Supply Determination and Money Multiplier, Measures of Money Supply in India

Unit III: Aggregate Demand and Aggregate Supply

Derivation of Aggregate Demand and Aggregate Supply Curves in the IS-LM Framework; Nature and Shape of IS and LM curves; Interaction of IS and LM curves and Determination of Employment, Output, Prices and Investment; Changes in IS and LM curves and their Implications for Equilibrium

Unit IV: Inflation, Unemployment and Expectations, and Trade Cycles

Inflation – Unemployment Trade off and the Phillips Curve – Short run and Long run Analysis; Adaptive and Rational Expectations; The Policy Ineffectiveness Debate; Meaning and Characteristics of Trade Cycles; Hawtrey's Monetary Theory, Hayek's Over-investment Theory and Keynes' views on Trade Cycles

Text Book:
- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:
- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Discipline Specific Elective Paper I
DSE Group I
(A student has to choose any one from group I under DSE-1)

1. ECONOMIC DEVELOPMENT AND POLICY IN INDIA

Introduction: : This paper introduces the students to the essentials of Indian economy with an intention of understanding the basic feature of the Indian economy and its planning process. It also aids in developing an insight into the agricultural and industrial development of India. The students will understand the problems and policies relating to the agricultural and industrial sectors of India and current challenges of Indian economy.

Unit I: Introduction to Indian Economy and Current Challenges

Colonialism & British Rule: Exploitation and under-development in India; Basic features of India Economy; Indian Economy as a developing economy; Demographic trends in India - Size and growth of population, Occupational structure, Sex composition, Age structure and demographic dividend; Causes of population growth and population policy; The problem of unemployment and recent policies for employment generation; the problem of inequality in income distribution and its causes, Policies to address inequality.

Unit II: Indian Agriculture

Role of agriculture in Indian Economy; Cause of low productivity, Green Revolution and Land Reforms, Agricultural Finance-Sources and Problems; Agricultural Marketing in India

Unit III: Industrial Development in India

Role of Industrialization in Indian Economy; Small Scale & Cottage Industries: Meaning, Role, Problems and Remedies; Industrial Policies of 1948,1956,1977 and1991; Problems of Industrial Development in India; Industrial Sickness

Unit IV: Service Sector in India

Growth & Contribution to GDP; Composition and relative importance of service sector; Factors determining growth of the sector; ICT and IT – Spread and Policy; Sustainability of services led growth

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Book
- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.

Discipline Specific Elective Paper I

2. ECONOMIC HISTORY OF INDIA 1857-1947

Introduction:
This course analyses key aspects of Indian economic development during the second half of British colonial rule. In doing so, it investigates the place of the Indian economy in the wider colonial context, and the mechanisms that linked economic development in India to the compulsions of colonial rule. This course links directly to the course on India's economic development after independence in 1947.

Unit I: Colonial India: Background and Introduction

Overview of colonial economy, Macro trends in national Income; population; occupational structure

Unit II: Agriculture

Agrarian structure and land relations; agricultural markets and institutions – credit, commerce and technology; trends in performance and productivity; famines

Unit III: Railways and Industry

Railways; the de-industrialization debate; evolution of entrepreneurial and industrial structure; nature of industrialization in the interwar period; constraints to industrial breakthrough; labor relations

Unit IV: Economy and State in the Imperial Context

The imperial priorities and the Indian economy; drain of wealth; international trade, capital flows and the colonial economy – changes and continuities; government and fiscal policy

Text Book:
- Tirthankar Roy, *The Economic History of India 1857-1947*, Oxford University Press, 3rd edition, 2011.

Discipline Specific Elective Paper II
DSE Group II
(A student has to choose any one from group II under DSE - 2)

1. ODISHA ECONOMY

Introduction

Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in Odisha in pre- and post-Independence period, with particular emphasis on paradigm shifts and turning points. Given the rapid changes taking place in Odisha, the reading list will have to be updated annually.

Unit I: Odisha Economy before 1947

Orissa's Economy in the Nineteenth Century: Benevolence or Exploitation, Forces of Nature, Animal Power, The Company Steps in, Public Works and Public Health, Education, Disintegration of Village Economy, New Social Environment, Changing Position of Social Classes, The

Moneylenders, The Borrowers, Money-flows from Village to Metropolis, Pauperization of Peasantry, The Wage Earners, Demographic Changes, Profiting from Rural Adversity; Diarchy in 1919 and Separation of Provincial Finances from Central Government in 1937; Emergence of Federal Finance (Ref.: Das 1976a and 1976b, GoO 2016).

Unit II: Macro Economy of Odisha

A macro glance of Odisha economy: aggregate income, broad sectoral decomposition, performance of districts, employment, child labour and bonded labour, employment programmes, consumption expenditure, cost of living; Odisha State public finances (Chapter 14 and 15 of Ref 1; & Chapter 2 and 9 of Ref 2)

Unit III: Agriculture, Industry, Infrastructure and Environment in Odisha

Agriculture: land ownership and land tenure, agricultural wages and rural unemployment, production and productivity of major crops, agricultural inputs, agricultural policy; Animal Husbandry; Fisheries (Chapter 1 to 3 of Ref 1; & Chapter 3 of Ref 2)
Industry: Investment, industrial policy, and the growth of large industries, mining and quarrying; Construction; tertiary sector: tourism, transport and power; Water Resources, Forest Resources (Chapter 4 to 8 of Ref 1; & Chapter 4 & 5 of Ref 2)

Unit IV: Social Sector in Odisha

Poverty: income poverty and inequality; health sector: outcomes, infrastructure, finance, public health, NRHM; education: Literacy, Primary education, secondary education, higher education, SSA; human development (Chapter 9 to 13 of Ref 1; & Chapter 7 & 8 of Ref 2)

Text Book:

- Nayak, P., Panda, S. C., Pattanaik, P. K. (2016): The Economy of Odisha: A Profile, Oxford University Press, New Delhi

Reference Book:
1. GoO (Latest): Odisha Economic Survey, Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar
2. GoO (2004): *Human Development Report 2004 Orissa*, Planning and Coordination Department, Government of Odisha, Bhubaneswar
3. GoO (2018): 80 Years Odisha Budget: Commemorative Volume, Department of Finance, Bhubaneswar

Discipline Specific Elective Paper II

2. MONEY AND BANKING

Introduction: This paper intends to explain the ideas and institutions concerning money and banking. It will help the students to understand the meaning, functions and theories of money the working of different types of banks in an economy.

Unit I: Money

Money: Meaning, functions and classification; Gresham's law; Monetary standards: Metallic and paper systems of note issue; Value of money: (Uses and limitations of index number); Construction of price index number – its limitations.

Unit II: Quantity theory of money

Quantity theory of money - Cash transaction approach, cash balance approach, Keynesian approach; Inflation: meaning, types, causes – demand pull and cost push, effects, measures to control inflation, Trade-off between inflation and unemployment; Stagflation and deflation: meaning; Phillip's curve.

Unit III: Banking

Banking: meaning and types; Commercial banks: evolution, functions, the process of credit creation and its limitations, liabilities and assets of banks; A critical appraisal of the progress of commercial banking in India after nationalization; Recent reforms in banking sector in India

Unit IV: Central Bank

Central Bank: Functions, Quantitative and qualitative methods of credit control - bank rate policy, open market operations, variable reserve ratio and selective methods; Relative efficacy of quantitative and qualitative methods of credit control.
Reserve Bank of India: Role and functions; Repo rate and reverse repo rate; Components of money supply in India; Objectives and limitations of monetary policy with special reference to India

Text Book:
- Paul R.R. (2017) Money Banking and Public Finance, Kalyani Publishers

Reference Book:
- Reserve Bank of India – The Reserve Bank of India, functions and working, Bombay, 1983.

****

SKILL ENHANCEMENT COURSES (SEC)

Optional for SECC II paper

Total Marks- 100

Skill Enhancement Courses (SECC II Option-I)

DATA ANALYSIS AND COMPUTER APPLICATION

Introduction:
The purpose of this course is to introduce basic computer skills to students at UG level in non-technical subjects. After completion of this course, the students are expected to acquire some basic knowledge about computers and to develop some basic skills in using computers for data storage, compilation, analysis and presentation.

Unit I: Introduction to Computers and Networks

Introduction to computer- Components of Computer System, concepts of Hardware and Software, Classifications of computers; Concepts of data processing, Basic data types, Storage of data/Information as files, operating system and The User Interface (windows, Linux), Windows Setting- Control Panels, Accessories (windows)
Basic of Computer networks- LAN and WAN, Internet, Service on Internet; WWW and Web Browsers, Web Browsing software, Surfing the Internet, Chatting on Internet, Email-Basic of electronic mail, Using Emails, Document handling in Email.

Unit II: Basic Word Processing

Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats

Unit III: Spreadsheets and Basic Data Analysis

Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings- maintaining invoices/budgets, basic practical data analysis works (Maintaining daily and monthly sales reports)

Unit IV: Basic Presentations
Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides

Text Book:
- C.S. French "Data Processing and Information Technology", BPB Publications 1998

Reference Books:
- P.K Sinha, Computer Fundamentals, BPB Publications, 1992

Skill Enhancement Courses (SECC II Option-II)

FINANCIAL ECONOMICS

Introduction:
This course intends to explain the ideas on financial system in India. It will help the students to enhance their knowledge on concepts like financial institutions, instruments and markets, their functioning and usage in real world.

Unit I: Financial System

The structure of the financial system- Functions of the financial sector-Indicators of financial development; Financial System and Economic Development; financial inclusion: concept and its evolution; policy initiatives on financial inclusion.

Unit II: Interest Rate Policy

Theories of interest rate determination-Level of interest rates-Long period and short period rates-Administered interest rates; Deregulation of interest rates; financial sector reforms in India.

Unit III: Money and Capital Market

Money Market: features; objectives; and importance of money market; composition of money market; money market institutions and instruments; features and problems of Indian money market. Capital market: composition; Primary and secondary market for securities. Functions of new issue and secondary market; organizations of stock exchanges in India; defects in Indian stock exchange; SEBI; its objectives and functions

Unit IV: Non-Banking Financial Companies

Non-Banking Financial Companies: Hire purchase Companies-Venture Capital Companies. Insurance Sector: objectives, functions, life insurance and general insurance; IRDA and its role and functions in financial markets.

Text Book:
- L.M.Bhole: Financial institutions and Market, Tata McGraw hill, New Delhi.

Reference Books:
- Gorden & Natrajan: Financial Market and institutions, Himalaya Publishing house.

STATE MODEL SYLLABUS FOR UNDERGRADUATE COURSE IN BOTANY

(Bachelor of Science Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course Structure of U.G. Botany Honours				
Semester	**Course**	**Course Name**	**Credit**	**Total marks**
Semester-I	AECC-I		4	100
	C-1 (Theory)	Microbiology and Phycology	4	75
	C-1 (Practical)	Microbiology and Phycology	2	25
	C-2 (Theory)	Biomolecules and Cell Biology	4	75
	C-2 (Practical)	Biomolecules and Cell Biology	2	25
	GE -1A (Theory)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	4	75
	GE -1A(Practical)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	2	25
Semester-II	AECC-II		4	100
	C-3 (Theory)	Mycology and Phytopathology	4	75
	C-3 (Practical)	Mycology and Phytopathology	2	25
	C-4 (Theory)	Archegoniate	4	75
	C-4 (Practical)	Archegoniate	2	25
	GE -2A (Theory)	Plant Physiology &Metabolism	4	75
	GE -2A(Practical)	Plant Physiology &Metabolism	2	25
Semester-III	C-5 (Theory)	Anatomy of Angiosperms	4	75
	C-5 (Practical)	Anatomy of Angiosperms	2	25
	C-6 (Theory)	Economic Botany	4	75
	C-6 (Practical)	Economic Botany	2	25
	C-7 (Theory)	Genetics	4	75
	C-7 (Practical)	Genetics	2	25
	SEC-1		4	100
	GE -1B (Theory)	Plant Ecology & Taxonomy	4	75
	GE -1B (Practical)	Plant Ecology & Taxonomy	2	25
Semester-IV	C-8 (Theory)	Molecular Biology	4	75
	C-8 (Practical)	Molecular Biology	2	25
	C-9 (Theory)	Plant Ecology & Phytogeography	4	75

	C-9 (Practical)	Plant Ecology & Phytogeography	2	25
	C-10 (Theory)	Plant Systematics	4	75
	C-10 (Practical)	Plant Systematics	2	25
	SEC II		4	100
	GE-2B (Theory)	Plant Anatomy , Embryology & Biotechnology	4	75
	GE-2B(Practical)	Plant Anatomy , Embryology & Biotechnology	2	25
Semester-V	C-11 (Theory)	Reproductive Biology of Angiosperms	4	75
	C-11 (Practical)	Reproductive Biology of Angiosperms	2	25
	C-12 (Theory)	Plant Physiology	4	75
	C-12 (Practical)	Plant Physiology	2	25
	DSE - 1 (Theory)	Analytical Techniques in Plants Sciences	4	75
	DSE - 1 (Practical)	Analytical Techniques in Plants Sciences	2	25
	DSE - 2 (Theory)	Natural Resource Management	4	75
	DSE - 2 (Practical)	Natural Resource Management	2	25
Semester-VI	C-13 (Theory)	Plant Metabolism	4	75
	C-13 (Practical)	Plant Metabolism	2	25
	C-14 (Theory)	Plant Biotechnology	4	75
	C-14 (Practical)	Plant Biotechnology	2	25
	DSE - 3 (Theory)	Horticulture Practices & Post Harvest Technology	4	75
	DSE-3 (Practical)	Horticulture Practices & Post Harvest Technology	2	25
	DSE – 4 (Theory+Practical) /Project work**	Industrial & Environmental Microbiology /Project Work** Dissertation	6	100
		Total	**148**	**2600**

BOTANY

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers
Generic Elective for Non Botany students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm: 15 marks, End term: 60 marks (Theory) + 25 marks (Practical), Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 10 hours (practical)

Core Paper I

MICROBIOLOGY AND PHYCOLOGY

Unit-I
Introduction to microbial world, microbial nutrition, growth and metabolism. **Viruses:-** Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.

Unit–II
    (i) Bacteria: - Discovery, general characteristics, types- archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

    (ii) Cyanobacteria:-Ecology and occurrence, cell structure, heterocyst, reproduction, economic importance; role in biotechnology. Morphology and life-cycle of Nostoc. General characteristics of prochlorophyceae, Evolutionary significance of Prochloron.

Unit–III
    (i) Algae:- General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; and methods of reproduction, classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Role of algae in the environment, agriculture, biotechnology and industry.

    (ii) Chlorophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium and Coleochaete.

Unit-IV

(i) Charophyta:- General characteristics; occurrence, morphology, cell structure and life-cycle of Chara; evolutionary significance.

(ii) Xanthophyta:- General characteristics; Occurrence, morphology and life- cycle of Vaucheria.

(iii)Phaeophyta:-Characteristics, occurrence, cell structure and reproduction. Morphology and life-cycles of Ectocarpus and Fucus.

(iv)Rhodophyta:-General characteristics, occurrence, cell structure and

(v) reproduction. Morphology and life-cycle of Polysiphonia.

PRACTICAL

Microbiology
(i) Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.

(ii) Types of Bacteria to be observed from temporary/permanent slides/photographs.

(iii) Examination of bacteria from natural habitat(curd) by simple staining

(iv) Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule (live materials and photographs).

(v) Gram staining.

Phycology
Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,Procholoron, Diatoms through electron micrographs, temporary preparations and permanent slides (based on availability of materials).

Text Books:

1. Singh, Pandey and Jain (2017). Microbiology and Phycology, Rastogi Publication, Meerut.

Reference Books:
1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.

2. Prescott, L.M., Harley J.P., Klein D. A. (2010). Microbiology, McGraw-Hill, India. 8th edition.

3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.

4. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.

5. Pelczar et al. (2011) Microbiology, 8th edition, Tata McGraw-Hill Co, New Delhi.

6. Willey, Sherwood and Christopher. Laboratory exercises in Microbiology. McGraw-Hill, India. 9th edition.

7. P. R. Vasista (2017) Botany for Degree student, Algae, S. Chand Publication, New Delhi.

8. B. K. Mishra (2018)Microbiology and Phycology, Kalynai Publishers, New Delhi.

Core Paper II

BIOMOLECULES AND CELL BIOLOGY

Unit-I

(i) Biomolecules and Bioenergenetics: Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions.

(ii) Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

(iii) Carbohydrates: Nomenclature, classification and function of Monosaccharides; Disaccharides, Oligosaccharides and polysaccharides

Unit –II

(i) Lipids: Definition and major classes of storage and structural lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.

(ii) Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins.

(iii) Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit –III

(i) The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

(ii) Cell division: Eukaryotic cell cycle, different stages of mitosis and meiosis. Cell cycle, Regulation of cell cycle.

(iii) Cell wall and plasma membrane: Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit-IV

(i) Cell   organelles: Nucleus; Structure-nuclear   envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

(ii) Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

(iii) Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Endoplasmic Reticulum, Golgi Apparatus, Lysosomes,

PRACTICAL

(i) Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.

(ii) Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*

(iii) Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.

(iv) Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).

(v) Study the phenomenon of plasmolysis and deplasmolysis.

(vi) Study different stages of mitosis and meiosis using aceto carmine and aceto orcine method.

Text Books:
1. V. B. Rastogi (2016). Introductory Cytology, KedarNath & RamNath, Meerut
2. P. K. Gupta (2017). Biomolecules and Cell Biology, Rastogi Publication, Meerut.

Reference Books:
1. K. Sahoo (2017)Biomolecules and Cell Biology, Kalynai Publishers, New Delhi.
2. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
3. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
4. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

Core Paper III

MYCOLOGY AND PHYTOPATHOLOGY

Unit-I

(i) Introduction to true fungi: Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

(ii) Zygomycota: General characteristics; Ecology; Thallus organisation; Life cycle with reference to *Rhizopus*.

(iii) Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to *Saccharomyces, Aspergillus*, *Penicillium,*and *Neurospora.*

(iv) Basidiomycota: General characteristics; Ecology and Classification; Life cycle of *Puccinia* and *Agaricus*.

Unit-II

(i) Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

(ii) Oomycota: General characteristic; Ecology; Life cycle and classification with reference to *Phytophthora,* and *Albugo.*

(iii) Symbiotic associations: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Unit-III

Applied Mycology: Role of fungi in biotechnology, Mushroom cultivation, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit-IV

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships;disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot disease of Cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Loose and covered smut.

PRACTICAL

(i) Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, asocarps & basidiocarps).

(ii) *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.

(iii) *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.

(iv) *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, and fairy rings are to be shown.

(v) *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study throughsection/ temporary mounts and sexual structures through permanent slides.

(vi) Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: Mosaic disease of ladies finger, papaya, cucurbits, moong, black gram, Fungal diseases: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and White rust of crucifers.

Text Books:

1. B. K. Mishra (2017), Mycology and Phytopathology, Kalynai Publishers, New Delhi.

Reference Books:

1. Sharma, P. D. (2017). Mycology and Phytopathology Rastogi Publication, Meerut.
2. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
3. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley &Sons (Asia) Singapore. 4th edition.
4. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
5. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan PublishersIndia Ltd.
6. Mehrotra, R. S.(2011). Plant Pathology. Tata McGraw-Hill Publishing Company Limited, New Delhi

Core Paper IV

ARCHEGONIATE

Unit-I
   (i) Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations. General characteristics; Origin of land plants and Adaptations to land habit;

   (ii) Bryophytes : Origin and Classification; Range of thallus organization.Classification (up to family). Reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes.

Unit-II
   Pteridophytes: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum* and *Pteris*. Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution and economic importance.

Unit-III
   Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus, Ginkgo*and *Gnetum*.(Developmental details not to be included).Ecological and economic importance.

Unit-IV
   Palaeobotany: Geological time scale,fossilsand fossilization process. Morphology, anatomy and affinities of Rhynia, Calamites, Lepidodendron, Lyginopteris, Cycadeoidea and Williamsonnia.

PRACTICAL

   (i) Morphology of thallus and anatomy of *Riccia, Marchantia*, *Anthoceros, Funaria*-

   (ii) *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).

   (iii) *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll

(temporary slides), longitudinal section of strobilus (permanent slide).

(iv) *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

(v) Study from permanent slides of *Ophioglossum* (L.S. of spike), *Marselia* (L.S. of sporocarp) and *Lycopodium* (L.S. of strobilus).

(vi) *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

(vii) *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll and meghaspore, T.S root, leaflet

(viii)Pinus- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and femalecones), T.S. Needle, stem, L.S. male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), L.S.of female cone

(ix) *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

(x) Study of some fossil slides / photographs as per theory.

(xi) Botanical excursion/study tour.

Text Books:
1. P. R. Vasista (2017) Botany for Degree student, Bryophyta, S. Chand Publication, New Delhi.
2. Singh, Pandey and Jain (2017). Archegoniate, Rastogi Publication, Meerut.

Reference Books:
1. B. S. Acharya (2017), Archegoniate, Kalynai Publishers, New Delhi.
2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. New Delhi, India.
3. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers,New Delhi, India.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.

Core Paper V

ANATOMY OF ANGIOSPERMS
Unit-I
(i) Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy.
(ii) Tissues: Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances.

Unit-II

  (i) Stem: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Anatomy of dicot and monocot stem. Vascular Cambium: Structure, function and seasonal activity of cambium; secondary growth in stem (normal and anomalous).

  (ii) Leaf: Anatomy of dicot and monocot leaf, Kranz anatomy.

Unit-III

  (i) Root: Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescentcentre; Root cap; Anatomy of dicot and monocot root; Endodermis, exodermis and origin of lateral root. Secondary growth in roots.

  (ii) Wood: Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology.

  (iii)Periderm: Development and composition of periderm, rhytidome and lenticels.

Unit –IV

  (i) Adaptive and Protective Systems Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and nonglandular: two examples of each), stomata (classification); Anatomical adaptations of xerophytes and hydrophytes.

  (ii) Secretory System: Hydathodes, cavities, lithocysts and laticifers.

PRACTICAL

1. Study of distribution and types of parenchyma, collenchyma and sclerenchyma, Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres, Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
2. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
3. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
4. Root: monocot, dicot, secondary growth.
5. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
6. Leaf: isobilateral, dorsiventral, C_4 leaves (Kranz anatomy).

Text Books:

1. Singh, Pandey and Jain (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.

Reference Books:

1. Eames and Mc Daniels ( ). An introduction to plant anatomy, Tata Mc Grow Hills, New Delhi
2. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.
3. M. S. Tayal (2012) Rajpal and Sons, New Delhi
4. B. K. Mishra (2017). Anatomy of Angiosperms, Kalynai Publishers, New Delhi.
5. B. P. Pandey (2017) Plant Anatomy, S. Chand Publication, New Delhi.

Core Paper VI

ECONOMIC BOTANY

Unit-I

(i) Origin of Cultivated Plants: Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of newcrops/varieties, importance of germplasm diversity.

(ii) Cereals: Brief account of Wheat, Rice and millets.

(iii)Legumes: General account, importance to man and ecosystem.

(iv)Sugars & Starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit-II

(i) Spices: Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper Beverages: Tea, Coffee (morphology, processing & uses)

(ii) Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.

(iii)Tobacco: Tobacco (Morphology, processing, uses and health hazards)

Unit-III

(i) Oils & Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and *Brassica* (Botanical name, family & uses)

(ii) Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Unit-IV

(i) Natural Rubber: Para-rubber: tapping, processing and uses.

(ii) Timber plants: General account with special reference to teak and pine. Fibers: Classification based on the origin of fibers, Cotton and Jute (morphology, extraction and uses).

PRACTICAL

(i) Cereals: Rice (habit sketch, study of paddy and grain, starch grains).
(ii) Legumes: Soya bean/moong bean/black gram, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
(iii) Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, starch grains, micro-chemical tests).
(iv) Spice and Beverages: clove, black pepper ,Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
(v) Oils & Fats: Groundnut, Mustard–plant specimen, seeds; tests for fats in crushedseeds.
(vi) Drug-yielding plants: Specimens of *Digitalis, Papaver* and *Cannabis.*
(vii)Woods: *Tectona*, *Pinus/*Sal: Specimen, Section of young stem.

(viii) Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Text Books:

1. B. P. Pandey (2017) Economic Botany. S. Chand Publication, New Delhi.

Reference Books:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Samba Murty and Subrahmanyam (2011). Text Book of Modern Economic Botany, CBS Publishers and Distributors, New Delhi.
3. Hill, Albert F. Economic Botany, Tata Mc Grow Hill Publishing Company, Ltd. New Delhi.
4. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
5. Singh, Pandey and Jain (2017). Economic Botany, Rastogi Publication, Meerut.
6. B. Baruah (2017). Economic Botany, Kalyani Publishers, New Delhi.

Core Paper VII

GENETICS

Unit-I

(i) Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominanttraits, Polygenic inheritance.

(ii) Extrachromosomal Inheritance:Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.

Unit-II

Linkage, crossing over and chromosome mapping: Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Unit-III

(i) Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

(ii) Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.

Unit-IV
  (i) Fine structure of gene: Classical vs. molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

  (ii) Population and Evolutionary Genetics: Gene pool, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

PRACTICAL

1. Meiosis through temporary squash preparation.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Blood Typing: ABO groups & Rh factor.
7. Chromosome anomaly : Translocation Ring, Laggards and Inversion Bridge, break etc.

Text Books:

  1. B. D. Singh (2017). Fundamental of Genetics, Kalyani Publishers, New Delhi.

  2. P. K. Gupta (2017). Genetics, Rastogi Publication, Meerut.

Reference Books:

  1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons,India. 8th edition.
  2. Sinnot, Dunn and Dobzhansky (1985) Principles of Genetics, Tata Mc Grow Hill, New Delhi
  3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. BenjaminCummings, U.S.A. 10th edition.
  4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to GeneticAnalysis. W.H. Freeman and Co., U.S.A. 10th edition.
  5. Strickberger, Monroe, W. Genetics, Pearson Publishers, 3rd Edition
  6. V. B. Rastogi (2017). Genetics, KedarNath & RamNath, Meerut

Core Paper VIII

MOLECULAR BIOLOGY

Unit-I
    Nucleic acids : Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty), Types of genetic material, denaturation and renaturation, cot curves. Organization of DNA and structure of RNA- Prokaryotes, Viruses, Eukaryotes, Fraenkel-Conrat's experiment. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome -Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Unit-II

(i) The replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5′ end of linear chromosome; Enzymes involved in DNA replication.

(ii) Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

(iii) Processing and modification of RNA: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eukaryotic mRNA processing (5′ cap, 3′ polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.

Unit-III

Mechanism of Transcription: Transcription in prokaryotes and eukaryotes;
Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Operon concept- Regulation of lactose metabolism and tryptophan synthesis in *E.coli.* Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing

Unit-IV

Translation (Prokaryotes and eukaryotes): Ribosome structure and assembly; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

<div align="center">

PRACTICAL
</div>

1. Preparation of LB medium and raising E. coli.
2. Isolation of genomic DNA from E. coli./onion roots
3. RNA estimation by orcinol method.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
6. Study of Barr body from buccal smear preparation.

Text Books:

1. P. K. Gupta (2017). Molecular Biology, Rastogi Publication, Meerut.

Reference Books:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). MolecularBiology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc.,U.S.A. 5th edition.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. BenjaminCummings.U.S.A. 9th edition.

4. Sheelar and Bianchi (2009) Molecular Biology of the Cell, Willey Publisher, New Delhi

5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to GeneticAnalysis. W.H. Freeman and Co., U.S.A. 10th edition.

6. Bruce Alberts et al. 2014. Molecular Biology of the cell Garland Science. 6 th Edition

7. C. B. Power (2017) Cell Biology, Himalaya Publishing House, New Delhi

8. AC. Sahu (2017). Essentials of Molecular Biology, Kalynai Publishers, New Delhi.

<div align="center">**Core Paper IX**</div>

<div align="center">**PLANT ECOLOGY & PHYTOGEOGRAPHY**</div>

Unit-I
  (i) Introduction Concept of ecology, Autoecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environment, concept of hydrosphere and lithosphere and dynamism, homeostasis.
  (ii) Light, temperature, wind and fire: Variations; adaptations of plants to their variation.

Unit-II
  (i) Soil: Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.
  (ii) Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit-III
Biotic interactions and Population ecology: Characteristics and Dynamics.

Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit-IV
  (i) Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.
  (ii) Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.
  (iii)Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Phytogeographical division of India; Local Vegetation.

PRACTICAL

1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)

2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.

3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.

4. Study of morphological adaptations of hydrophytes, xerophytes, halophyles (two each).

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).

6. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.

7. Field visit to familiarize students with ecology of different sites.

Text Books:

1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.

Reference Books:

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5thedition.

2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.

3. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach.Oxford University Press. U.S.A.

4. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

5. Santra, S. C. (2015) Environmental Science. New Central Book Agency (P) Ltd. Kolkata.

6. M. C. Das and S. P. Das (2009). Fundamental of Ecology.Tata MGrow Hill, New Delhi.

7. Shukla and Chandel (2016). A text book of Plant Ecology. S Chand Publication, New Delhi

Core Paper X

PLANT SYSTEMATICS

Unit-I

Plant identification, Classification, Nomenclature; Biosystematics. Identification: Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access

Unit-II

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit-III
   (i) Systematics- an interdisciplinary science: Evidence from palynology, cytology, phytochemistry and molecular data.

   (ii) Systems of classification: Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (up to series) and Hutchinson (up to series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit-IV
Phylogeny of Angiosperms: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin& evolution of angiosperms; co- evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Families of Angiosperms : Descriptive studies of Magnoliaceae, Rosaceae, Rubiacae, Liliaceae, Poaceae, and Orchidaceae

PRACTICAL

   (i) Study of vegetative and floral characters of available materials of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Magnoliaceae, Rosaceae, Rubiacae, Liliaceae, Poaceae, and Orchidaceae as per theory syllabus.

   (ii) Field visit, plant collection and herbarium preparation and submission. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

Text Books:
   1. O. P. Sharma (2009) Plant Taxonomy, Tata Mc Grow Hill, New Delhi

Reference Books:
   1. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd.,

      New Delhi.3rdedition.

   2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy*. Cambridge University Press, Cambridge.

   3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-

      APhylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

   4. Saxena, H. O. and Brahman, M..The Flora of Orissa, CSIR Publication.

   5. T. K. Bose (2009). Trees of the World, Regional Plant Resource Centre, Bhubaneswar, Odisha, India

   6. Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.

   7. Hanes, H. H. (2009). Botany of Bihar and Orissa,

8. C. R. Mohanty (2017). Text Book of Plant Systematics, Kalynai Publisher, New Delhi.

9. M. S. Subrahmainayam (2011) Modern Plant Taxonomy, Vikash Publishing House, New Delhi

10. B. P. Pandey (2017). Taxonomy of Angiosperm. S. Chand Publication.

Core Paper XI

REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Unit-I
(i) Introduction: History and scope.

(ii) Anther: Anther wall: Structure and functions, micro-sporogenesis, callose deposition and its significance.

(iii)Pollen biology: Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit-II
Ovule: Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– mega-sporogenesis and mega-gametogenesis; Types and ultra structure of mature embryo sac (Details of Polygonum type).

Unit-III
(i) Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.
(ii) Self incompatibility: Basic concepts; Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and *in vitro* pollination; Modification of stigma surface.

Unit-IV
(i) Endosperm: development, structure and functions
(ii) Embryo: Types of embryogeny; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo- endosperm relationship; Nutrition of embryo; Embryo development in *Paeonia*.
(iii)Seed: Structure, importance and dispersal mechanisms
(iv)Polyembryony and apomixes: Introduction; Classification; Causes and applications.

PRACTICAL
(i) Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
(ii) Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazolium test, Germination: Calculation of percentage germination in different media using hanging drop method.

(iii) Ovule:Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.

(iv) Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

Text Books:
1. Singh, Pandy and Jain (2017). Reproductive Biology of Angiosperms, Rastogi Publications, Meerut

Reference Books:
1. P Maheswari (2009). Embryology of Angiosperms.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
5. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
6. B. K. Mishra (2017). Reproductive Biology of Angiosperms Kalynai Publishers, New Delhi.

<div align="center">

Core Paper XII

PLANT PHYSIOLOGY

</div>

Unit-I
(i) Plant water relationship: Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, trans-membrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.

(ii) Translocation in the phloem: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.

Unit-II
(i) Mineral nutrition: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

(ii) Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems,proton ATPase pump and ion flux, uniport, co-transport, symport, and antiport.

Unit-III

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene. Brassinosteroids and Jasmonic acid.

Unit-IV

(i) Physiology of flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

(ii) Phytochrome: Discovery, chemical nature, role of phytochrome in photo-morphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. 2. Determination of water potential of given tissue (potato tuber) by weight method.

3. 3.Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.

4. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.

5. 5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).

6. To study the phenomenon of seed germination (effect of light).

7. To study the induction of amylase activity in germinating barley grains

8. To demonstrate suction due to transpiration.

Text Books:
1. R. K. Sinha, (2015). Modern Plant Physiology, Narosa Publishing House, New Delhi.

Reference Books:
1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.U.S.A. 4th edition.

2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development.Sinauer Associates Inc. USA. 6th edition.

3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. NarosaPublishing House, New Delhi.

4. Salisbury, F. B. and Ross, C. W. Plant Physiology Wadsworth Publishing Company, California

5. A. C. Sahoo (2018). Outlines of Plant Physiology Kalynai Publishers, New Delhi.

6. N. K.. Srivatava (2017). Plant Physiology, Rastogi Publications, Meerut.

7. Pandey and Sinha (2011). Plant Physiology, Vikash Publishing House, New Delhi

Core Paper XIII

PLANT METABOLISM

Unit-I

(i) Concept of metabolism: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).

(ii) Mechanisms of signal transduction: Calcium, phospholipids, cGMP, NO.

Unit-II

Carbon assimilation: Historical background, photosynthetic pigments, role of photosynthetic pigments, antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, C_3, C_4 pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction. Photorespiration

Unit-III

(i) Carbon Oxidation: Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

(ii) ATP-Synthesis: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photo- phosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

Unit-IV

(i) Lipid metabolism: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluco-neogenesis and its role in mobilisation of lipids during seed germination, α oxidation.

(ii) Nitrogen metabolism: Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and trans-amination.

PRACTICAL

1. Isolation and quantitization of photosynthetic pigments.

2. Experimental demonstration of Hill's reaction.

3. To study the effect of light intensity on the rate of photosynthesis.

4. Effect of carbon dioxide on the rate of photosynthesis.

5. To compare the rate of respiration in different parts of a plant.

6. Demonstration of absorption spectrum of photosynthetic pigments.

Text Books:
1. S, K. Gupta (2017). Plant Metabolism, Rastogi Publication, Meerut.

Reference Books:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.U.S.A. 4th edition.

2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development.Sinauer Associates Inc. USA. 6th edition.

3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. A. C. Sahoo (2018). Outlines of Plant Metabolism, Kalynai Publishers, New Delhi.

Core Paper XIV

PLANT BIOTECHNOLOGY

Unit-I

Plant Tissue Culture: Historical perspective; Aseptic tissue culture techniques, Composition of media; Nutrient and hormone requirements (role of vitamins and hormones). Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit-II

Recombinant DNA technology-I: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC).Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning).

Unit-III

Recombinant DNA technology-II: Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, Methods of gene transfer- *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit-IV

Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

PRACTICAL

1. a) Preparation of tissue culture (MS) medium.
    (b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
2. Study of anther culture.
3. Preparation of artificial seeds.
4. Testing and study of Bt cotton.
5. Isolation of plasmid DNA.
6. Gel electrophoresis (demonstration).

Text Books:

1. H. S. Chawla (2010). Introduction to Plant Biotechnology.Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.

Reference Books:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
4. Y. P. S. Bajaj Series, Springer Verlag
5. B. D. Singh (2018). Plant Biotechnology Kalynai Publishers, New Delhi.
6. P. K. Gupta (2017). Plant Biotechnology, Rastogi Publication, Meerut.
7. R. C. Dubey (2017). Advanced Biotechnology, S, Chand Publication, New Delhi

Discipline Specific Elective Paper-1

ANALYTICAL TECNIQUES IN PLANT SCIENCES

Unit-I

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Flow cytometry (FACS); Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit-II

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrosedensity gradient, $CsCl_2$ gradient, analytical centrifugation, ultracentrifugation. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment. Spectrophotometry: Principle and its application in biological research.

Unit-III

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit-IV

Biostatistics: Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit. T-Test and correlation.

PRACTICAL

1. Study of different microscopic techniques for chromosome study
2. Study of PCR Demonstration.
3. To separate chlorophyll by paper chromatography.
4. To separate phytochemicals by thin layer chromatography.
5. To estimate protein concentration through Lowry's methods.
6. To separate proteins using PAGE.
7. To separate DNA (marker) using AGE.
8. Estimation of plant pigments.

Text Books:
1. C. S. Patil (2017). Advanced Analytical Techniques, ABE Books, New Delhi.

Reference Books:
1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-

   HillPublishing Co. Ltd. New Delhi. 3rd edition.

2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford UniversityPress, New York. U.S.A.

3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A.,

   Struhl,K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd

   edition.

4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.
5. K. R. Aneja (2014). Laboratory manual of microbiology and biotechnology, Medtech, New Delhi

Discipline Specific Elective Paper-1I

NATURAL RESOURCE MANAGEMENT

Unit-I
(i) Natural resources: Definition and types.
(ii) Sustainable utilization :Concept, approaches (economic, ecological and socio-cultural).
(iii) Land: Utilization (agricultural, horticultural, silvicultural); Soil degradation and management.
(iv) Water: Fresh water (rivers, lakes, groundwater, water harvesting technology, rain water storage and utilization.

Unit-II

Biological Resources: Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan).

Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.

Unit-III

    (i) Energy: Renewable and non-renewable sources of energy-solar, wind, tidal, geothermal and bioenergy resources.

    (ii) Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint.

Unit-IV

Resource Accounting; Waste management. National and international efforts in resource management and conservation

PRACTICAL

    (i) Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.

    (ii) Collections of data on forest cover of specific area.

    (iii) Measurement of dominance of woody species by DBH (diameter at breast height) method.

    (iv) Calculation and analysis of ecological footprint.

    (v) Ecological modeling.

Text Books:

  1. B. W. Pandey. 2005. Natural Resource Management. Mittal Publication, New Delhi

Reference Books:

  1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House,New Delhi.

  2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and ResourceConservation. Anamaya Publications, New Delhi.

  3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

HORTICULTURAL PRACTICES AND POST-HARVEST TECHNOLOGY

Unit-I

(i) Introduction: Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.

(ii) Ornamental plants: Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (*Opuntia*, *Agave* and spurges)]

Unit-II

(i) Fruit and vegetable crops: Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops.

(ii) Horticultural techniques: Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.

(iii) Landscaping and garden design :Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Unit-III

(i) Post-harvest technology: Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation;

(ii) Disease control and management: Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices;

Unit-IV
Horticultural crops - conservation and management: Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

PRACTICAL

Practical related to theory

Text Books:
   1. K. V. Peter. (2009). Basics of Horticulture, Kalyani Publishers, New Delhi.

Reference Books:
   1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.

   2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.

   3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.

   4. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.

   5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

   6. P. H. Pandey (2007). Principles and Practices of Post Harvest Technology, Kalyani Publishers, New Delhi.

Discipline Specific Elective Paper-1V

INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOG

Unit-I
   (i) Scope of microbes in industry and environment: Bioreactors/Fermenters and fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors- laboratory.

   (ii) Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying.

Unit-II

Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).

Unit-III

Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water.

Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality.

Unit-IV

Microbes in agriculture and remediation of contaminated soils: Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.

PRACTICAL
1. Principles and functioning of instruments in microbiology laboratory
2. Hands on sterilization techniques and preparation of culture media
3. Screening microorganisms for industrial use.
4. Mycorrhiza, arbuscular mycorrhizal colonization in plant roots
5. Determination of BOD, COD, TDS and TOC of water samples;
6. Microorganisms as indicators of water quality

Text Books:
1. P. D. Sharma. (2017) Environmental Microbiology. Rastogi Publications, Meerut.

Suggested Readings
1. Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.
3. Pradipta K. Mohapatra (2008). Text Book of Environmental Microbiology, I. K. International Publishing House, New Delhi
4. A. K. Rath (2018). Industrial and Environmental Microbiology, Kalyani Publishers, New Delhi.

OR
DISSERTATION / PROJECT WORK**

Identification of problem	Review of Literature	Methodology	Findings	Analysis	Viva-Voce	Total
10	10	10	25	25	20	100

** = Students who score more than ≥60% in aggregate are eligible for project work

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

Unit-I
Microbes :Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit-II
(i) Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Morphology and life- cycles of the following: *Chlamydomonas, Oedogonium*, *Nostoc and Fucus, Vaucheria, Polysiphonia,* Economic importance of algae.

(ii) Fungi : Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Agaricus* Basidiomycota); Symbiotic Associations-Lichens:

Unit-III
(i) **Bryophytes :**General characteristics, adaptations to land habit, Classification, Range of thallus organization, Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria* (Developmental details not to be included).Ecology and economic importance of bryophytes.
(ii) **Pteridophytes :** General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included).Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

Unit-IV
Gymnosperms: General characteristics, classification.Classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus and Gnetum. (Developmental details not to be included).Ecological and economical importance.

PRACTICAL
1. Gram staining

2. Study of vegetative and reproductive structures of *Nostoc,   Chlamydomonas* (electron micrographs)*, Oedogonium, Vaucheria, and Polysiphonia* through temporary preparations and permanent slides.

3. *Rhizopus and Penicillium*: Asexual stage from temporary ounts and sexual structuresthrough permanent slides.

4. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.

5. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all 30temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).

6. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).

7. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).

8. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet,v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).

9. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Text Books:
1. Mitra, Mitra and Choudhury. Studies in Botany Volume 1. Moulik Publisher, Kolkata. Ninth Revised Edition

Reference Books:
1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi.2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, Mac Millan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, JohnWiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) LtdPublishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
9. B. P. Pandey (2017), Botany for degree studies (as per CBCS). S.Chand
10. B. S. Acharya and B. K. Mishra (2018). Plant Biodiversity, Kalyani Publishers, New Delhi.

Generic Elective Paper II

PLANT ECOLOGY AND TAXONOMY

Unit-I
   (i) Ecological factors: Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes

   (ii) Plant communities : Characters; Ecotone and edge effect; Succession; Processes and types

Unit-II
   (i) Ecosystem : Structure; Biotic and abiotic components, energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

   (ii) Phytogeography: Principle biogeographical zones; Endemism

Unit-III
   (i) Introduction to plant taxonomy: Identification, Classification, Nomenclature.

   (ii) Identification : Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit-IV

   (i) Taxonomic hierarchy: Ranks, categories and taxonomic groups

   (ii) Botanical nomenclature: Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

   (iii) Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Hutchinson (upto series).

   (iv) Taxonomic description of the families : Malvaceae, Fabaceae, Asteraceae and Poaceae.

PRACTICAL

   1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
   2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
   3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
   4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).
      (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite
   5. (*Orobanche*), Epiphytes, Predation (Insectivorous plants)
   6. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)

7. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law .
8. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Malvaceae, Caesalpiniaceae, Fabaceae, Apocynaceae, Asteraceae and Poaceae as in theory syllabus.
9. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Text Books:
1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.

Reference Books:
1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
5. A. C. Sahu (2017). Plant Ecology and Phytogeography, Kalyani Publishers, New Delhi.
6. M. C. Das and S. P. Das (2009). Fundamental of Ecology.Tata MGrow Hill, New Delhi.
7. Shukla and Chandel (2016). A text book of Plant Ecology. S Chand Publication, New Delhi
8. C. R. Mohanty (2017). Text Book of Plant Systematics, Kalynai Publisher, New Delhi.

<div align="center">

Generic Elective Paper III

PLANT PHYSIOLOGY AND METABOLISM

</div>

Unit-I
(i) Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
(ii) Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.
(iii)Translocation in phloem.: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Unit-II
    (i) Photosynthesis: Photosynthetic Pigments (*Chl* a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C_3, C_4 and CAM pathways of carbon fixation.
    (ii) Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative Phosphorylation.

Unit-III
    (i) Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.
    (ii) Nitrogen metabolism :Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit-IV
    (i) Plant growth regulators :Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.
    (ii) Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on hotomorphogenesis;Vernalization.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.

Text Books:
    1. A. C. Sahu (2018). Plant Physiology and Metabolism. Kalyani Publishers, New Delhi.

Reference Books:
    1. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
    2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
    3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
    4. H. S. Srivatava. Plant Physiology, Rastogi Publications, New Delhi

PLANT ANATOMY AND EMBRYOLOGY

Unit-I
  (i) Meristematic and permanent tissues : Root and shoot apical meristems; Simple and complex tissues
  (ii) Organs :Anatomy of dicot and monocot root stem and leaf.

Unit-II
  (i) Secondary Growth :Vascular cambium – structure and function, seasonal activity. Secondary growth in and stem, Wood (heartwood and sapwood)
  (ii) Adaptive and protective systems: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit-III
  (i) Structural organization of flower :Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs,organization and ultrastructure of mature embryo sac.
  (ii) Pollination and fertilization : Pollination mechanisms and adaptations; Double fertilization;

Unit-IV
  (i) Endosperm :Endosperm types, structure and functions.
  (ii) Embryo :Dicot and monocot embryo; Structure and development, Embryo endosperm relationship.
  (iii)Seed-structure and development, appendages anddispersal mechanisms.

PRACTICAL
 1. Study of meristems through permanent slides and photographs.
 2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
 3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
 4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
 5. Leaf: Dicot and Monocot leaf (only Permanent slides).
 6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
 7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
 8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous**.**

Text Books:
   1. Singh, Pandey and Jain (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.
Reference Books:
   1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
   2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
   3. C. R. Mohanty (2018). Plant Anatomy and Embryology. Kalyani Publishers, New Delhi.

BOTANY Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers

Marks per paper - Midterm: 15 marks, End term: 60 marks, Practical: 25 marks,
Total – 100 marks

Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 20 hours (practical)

Semester	Course Opted	Course Name	Credit	Marks
Semester-I	DSC-1(Theory),	Paper-I, Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4	75
	DSC-1 (Practical)	Paper –I, Biodiversity (Microbes, Algae, Fungi and Archegoniate)	2	25
Semester -II	DSC-2(Theory),	Paper-II, Plant Ecology and Taxonomy	4	75
	DSC-2 (Practical),	Paper-II,Plant Ecology and Taxonomy	2	25
Semester-III	DSC-3(Theory),	Paper-III, Plant Anatomy and Embryology	4	75
	DSC-3 (Practical),	Paper-III, Plant Anatomy and Embryology	2	25
Semester-IV	DSC-4(Theory),	Paper-IV, Plant Physiology and Metabolism	4	75
	DSC-4 (Practical)	Paper-IV, Plant Physiology and Metabolism	2	25
Semester-V	DSE-1(Theory),	Botany Paper-I – Economic Botany and Biotechnology	4	75
	DSE-1 (Practical),	Botany paper-I – Economic Botany and Biotechnology	2	25
Semester-VI	DSE-2(Theory),	Botany paper-II – Cell and Molecular Biology	4	75
	DSE-2 (Practical),	Botany paper-II – Cell and Molecular Biology	2	25
		Total:	36	600

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

THEORY

Unit 1: Microbes:
Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination, Economic importance. **Algae :**General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium*, *Fucus*. Economic importance of algae.

Unit 2: Fungi
General characteristics of fungi, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations- Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 3: Archegoniate and Bryophyte
Unifying features of archegoniates, Transition to land habit, Alternation of generations.
General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 5: Pteridophytes & Gymnosperms
General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.
General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

PRACTICAL

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium, Gram staining
3. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs)*, Oedogonium, Fucus** (* *Fucus* - Specimen and permanent slides)
4. ***Penicillium***: Asexual stage from temporary mounts and sexual structures through permanent slides.

5. ***Puccinia***: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.

6. ***Agaricus***: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.

7. **Mycorrhiza**: ecto mycorrhiza and endo mycorrhiza (Photographs)

8. ***Marchantia* & *Funaria*** - morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. of reproductive organ l.s. sporophyte .

9. ***Selaginella &Equisetum***- morphology, w.m. leaf with ligule, t.s. stem, ts/l.s of reproductive organ

10. ***Cycas & Pinus*** - morphology (roots, bulbil, leaf), t.s. root, v.s. leaflet, whole mount or v.s. of reproductive organs

Text Books

1. Singh, Pandey and Jain (2017). Microbiology and Phycology, Rastogi Publication, Meerut.

2. B. K. Mishra (2017), Mycology and Phytopathology, Kalynai Publishers, New Delhi.

3. Singh, Pandey and Jain (2017). Archegoniate, Rastogi Publication, Meerut.

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.

2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.

3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.

4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.

5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.

6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.

7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

\

Plant Ecology and Taxonomy

THEORY

Unit 1: Ecological factors
Introduction to plant ecology and taxonomy. Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 2: Plant communities and Ecosystems
Characters; Ecotone and edge effect; Succession; Processes and types. Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 3: Phytogeography and Plant Taxonomy
Principle biogeographical zones; Endemism. Identification, Classification, Nomenclature. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access, Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. Taxonomic hierarchy: Ranks, categories and taxonomic groups

Unit 4: Classification & Botanical nomenclature
Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Biometrics, numerical taxonomy and cladistics: cluster analysis; phenograms, cladograms (definitions and differences).

PRACTICAL
1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
6. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae, Asteraceae, Solanaceae, Lamiaceae, Liliaceae
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Text Books
1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.
2. O. P. Sharma (2009) Plant Taxonomy, Tata MGrow Hill, New Delhi

Suggested Readings
1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Discipline Specific Core Paper III

Plant Anatomy and Embryology

THEORY

Unit 1: Tissues, Organs and special tissues
Root and shoot apical meristems; Simple and complex tissues. Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 2: Structural organization of flower
Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 3: Pollination and fertilization
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. Apomixis and polyembryony**:** Definition, types and practical applications.

Unit 4: Embryo and endosperm
Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm relationship.

PRACTICAL
1. Study on different types of tissues : parenchyma, collenchymas, sclerenchyma,Xylary elements, Phloem
3. Stem, root and leaf anatomy: Monocot, Dicot, Secondary growth.
4. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
5. Structure of anther (young and mature), tapetum (amoeboid and secretory).
6. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
7. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development.
8. Calculation of percentage of germinated pollen in a given medium.

Text Books
1. Singh, Pandey and Jain (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.
2. Singh, Pandy and Jain (2017). Reproductive Biology of Angiosperms, Rastogi Publications,Meerut

Suggested Readings
1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Discipline Specific Core Paper IV

Plant Physiology and Metabolism

THEORY

Unit 1: Plant-water relations and nitrogen metabolism
Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Biological nitrogen fixation; Nitrate and ammonia assimilation.

U nit 2: Mineral nutrition and Phloem translocation
Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3: Photosynthesis and respiration
Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3 and C4. Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation.

Unit 4: Enzyme, Plant growth regulators and Plant response
Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition. Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

PRACTICAL
1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Suction due to transpiration.

Text Books
1. R. K. Sinha, (2015). Modern Plant Physiology, Narosa Publishing House, New Delhi.
2. S, K. Gupta (2017). Plant Metabolism, Rastogi Publication, Meerut.

Suggested Readings
1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Discipline Specific Elective Paper I

Economic Botany and Biotechnology

THEORY

Unit 1: Origin of Cultivated Plants, Cereals and Legumes
Concept of centres of origin, their importance with reference to Vavilov's work. Rice cultivation process, Economic importance. Cereals:- Wheat -Origin, morphology, uses. Legumes: General account with special reference to Gram and soybean

U nit 2: Spices and Beverages
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses). Tea (morphology, processing, uses)

U nit 3: Oils and Fats and Fibre Yielding Plants
General description with special reference to groundnut. General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

U nit 4: Plant tissue culture and molecular techniques
Introduction to biotechnology. Micropropagation; Anther culture, haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications. Protoplast culture, Hybrid and Cybrids. DNA Fingerprinting; Molecular DNA markers i.e. PCR, RAPD, RFLP.

PRACTICAL

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Text Books:
1. B. P. Pandey (2017) Economic Botany. S. Chand Publication, New Delhi.
2. H. S. Chawla (2010). Introduction to Plant Biotechnology.Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.

Suggested Readings
1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Discipline Specific Elective Paper II

Cell and Molecular Biology

THEORY

Unit 1: Techniques in Biology
Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy.

Unit 2: Cell and Cell Organelles
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast - Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization.

Unit 3: Cell Membrane, Cell Wall and Cell Cycle
The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

Unit 4: Genetic material, transcription, gene expression and Cell Cycle
DNA: Miescher to Watson and Crick- historic perspective, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes), Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression: Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes. Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

PRACTICAL

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. Study of mitosis and meiosis (temporary mounts and permanent slides).
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
10. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
11. Study DNA packaging by micrographs.
12. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Text Books
  1. B. D. Singh (2017). Fundamental of Genetics, Kalynai Publishers, New Delhi.
  2. H. S. Chawla (2010). Introduction to Plant Biotechnology. Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.

Suggested Readings
1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

OPTIONAL FOR SECC II PAPER

SKILL ENHANCEMENT COURSE (SECC II Option I)

BIO-FERTILIZERS

Unit-I
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. Azospirillum: isolation and mass multiplication, Azotobacter: classification, characteristics – crop response to Azotobacter inoculums, maintenance and mass multiplication.

Unit-II
Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit-III
Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit-IV
Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Text Books:
1. Mahendra Rai, (2006). Hand book of Microbial Biofertilizers. CRC Press.

Reference Books:
1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.

2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.

3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay _Publication, New Delhi.

4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.

5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New -Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic. Farming Akta

   Prakashan, Nadiad

7. Pravin Chandra Dwivedi.(2008). Biofertilizers. Pointer Publishers.

SKILL ENHANCEMENT COURSE (SECC II Option II)

NURSERY AND GARDENING

Unit-I
Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.
Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion – Seed production technology - seed testing and certification.

Unit-II

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.

Unit-III

Gardening: definition, objectives and scope - different types of gardening – landscape and home gardening - parks and its components - plant materials and design – computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit-IV

Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Text Books:
1. Saidaiah Pidigam, Sindhuja S., Geetha Amarapalli. (2018)Text Book of Nursery, Gardening and Floriculture, Kalyani Publishers, New Delhi.

Reference Books:
1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co.,New Delhi.

2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.

3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co.,New Delhi.

5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and

   Cooperation, National - Seed Corporation Ltd., New Delhi.

6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

SKILL ENHANCEMENT COURSE (SECC II Option III)

ETHNOBOTANY

Unit-I
(i) Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

(ii) Methodology of Ethnobotanical studies a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit-II
Role of ethnobotany in modern Medicine Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanicalpractices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctumc) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria. Role of ethnobotany in modern medicine with special example Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania.

Unit-III
Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit-IV
Ethnobotany and legal aspects Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Text Books:
1. Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd

Reference Books:
1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3. Lone et al,. Palaeoethnobotany

4. S.K. Jain (ed.) 1989. Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow, India.
5. S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.

6. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester

7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in AndhraPradesh, India.Botanical Survey of India. Howrah.
8. Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996
9. Rath, A. K. and Mishra, S. R. (2017). Ethnobotany, Kalyani Publishers, New Delhi..

<div align="center">

SKILL ENHANCEMENT COURSE (SECC II Option IV)
MUSHROM CULTIVATION

</div>

Unit-I
Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus*. Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.

Unit-II

Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

Unit-III

Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fiber content - Vitamins.

Unit-IV

Food Preparation: Types of foods prepared from mushroom. Research Centers - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Text Books:
   1.   B. C. Suman and V. P. Sharma. (2007). Mushroom Cultivation in India. Daya Publishing House, New Delhi.

Reference Books:
   1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991)

       Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu

       AgriculturalUniversity, Coimbatore.

   2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and

       Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

   3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications,Delhi.

   4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
   5.   5.Anon. (2010).The Cultivation of Mushrooms - An Outline of Mushroom Culture, Read Book Design, New Delhi

CAPACITY BUILDING OF FACULTY

Following modules have been proposed for training of faculties:

- Isolation and quantification of nucleic acids following spectrophotometric and gel electrophoresis techniques

- Techniques of Chromatography

- Micrometry and Haemocytometry

- Tissue Culture Techniques

- PCR techniques

- Chromosome techniques

The above module may be of 3-4 weeks duration with 30 participants.

LIST OF EQUIPMENTS

Sl. No.	List of Equipments	Quantity
01	Dissecting Microscope (Indian Make)	2 no.
02	Compound Microscope (Indian Make) with photographic attachment	2 no.
03	Occular and Stage Micrometer (Indian Make)	1 no.
04	Uv Spectrophotometer (Indian Make)	1 no.
05	Cold Centrifuge (Indian Make)	1 no.
06	Refrigerator (Indian Make)	1 no.
07	Soil Thermometer (Indian Make)	1 no.
08	Anemometer (Indian Make)	1 no.
09	Psychrometer (Indian Make)	1 no.
10	Rain gauge (Indian Make)	1 no.
11	pH meter (Indian Make)	1 no.
12	Herbarium Press (Indian Make)	1 set
13	Hot air Oven (Indian Make)	1 no.
14	Electronic Balance (Indian Make)	1no.
15	Gel Electrophoresis (Indian Make) Vertical and submarine	1 no.
16.	Power Pack for electrophoresis	1 no.
17	Blood Testing Kit (Indian Make)	1 no.
18	Laminar Flow (Indian Make)	1 no.
19	BOD Incubator (Indian Make)	1 no.
20	Autoclave (Indian Make)	1 no.

STATE MODEL SYLLABUS FOR UNDER GRADUATE

COURSE IN CHEMISTRY

(Bachelor of Science Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course structure of UG Chemistry Honours

Semester	Course	Course Name	Credits	Total marks
I	AECC-I	AECC-I	04	100
	C-I	Inorganic Chemistry-I	04	75
	C-I Practical	Inorganic Chemistry-I Lab	02	25
	C-II	Physical Chemistry-I	04	75
	C-II Practical	Physical Chemistry-I Lab	02	25
	GE-I	GE-I	04	75
	GE-I Practical	GE-I Lab	02	25
			22	**400**
II	AECC-II	AECC-II	04	100
	C-III	Organic Chemistry-I	04	75
	C-III Practical	Organic Chemistry-I Lab	02	25
	C-IV	Physical Chemistry-II	04	75
	C-IV Practical	Physical Chemistry-II	02	25
	GE-II	GE-II	04	75
	GE-II Practical	GE-II Lab	02	25
			22	**400**
III	C-V	Inorganic Chemistry-II	04	75
	C-V Practical	Inorganic Chemistry-II Lab	02	25
	C-VI	Organic Chemistry-II	04	75
	C-VI Practical	Organic Chemistry-II Lab	02	25
	C-VII	Physical Chemistry-III	04	75
	C-VII Practical	Physical Chemistry-III Lab	02	25

Semester	Course	Course Name	Credits	Total marks
	GE-III	GE-III	04	75
	GE-III Practical	GE-III Lab	02	25
	SEC-I	SEC-I	04	100
			28	**500**
IV	C-VIII	Inorganic Chemistry-III	04	75
	C-VIII Practical	Inorganic Chemistry-III Lab	02	25
	C-IX	Organic Chemistry-III	04	75
	C-IX Practical	Organic Chemistry-III Lab	02	25
	C-X	Physical Chemistry-IV	04	75
	C-X Practical	Physical Chemistry-IV Lab	02	25
	GE-IV	GE-IV (Theory)	04	75
	GE-IV Practical	GE-IV (Practical)	02	25
	SEC-II	SEC-II	04	100
			28	**500**
Semester	Course	Course Name	Credits	Total marks
V	C-XI	Organic Chemistry-IV	04	75
	C-XI Practical	Organic Chemistry-IV	02	25
	C-XII	Physical Chemistry-V	04	75
	C-XII Practical	Physical Chemistry-V	02	25
	DSE-I	DSE-I	04	75
	DSE-I Practical	DSE-I Lab	02	25
	DSE-II	DSE-II	04	75
	DSE-II Practical	DSE-II Lab	02	25
			24	**400**
VI	C-XIII	Inorganic Chemistry- IV	04	75
	C-XIII Practical	Inorganic Chemistry-IV	02	25

	C-XIV	Organic Chemistry-V	04	75
	C-XIV Practical	Organic Chemistry-V	02	25
	DSE-III	DSE-III	04	75
	DSE-III Practical	DSE-III Lab	02	25
	DSE-IV	DSE-IV	04	75
	DSE-IV Practical	DSE-IV Lab	02	25
	OR			
	DSE-IV	Dissertation	06	100*
			24	**400**
		TOTAL	**148**	**2600**

Discipline Specific Elective Papers: (Credit: 06 each)

(4 papers to be selected by students of Chemistry Honours): DSE (1-IV)

1. Polymer Chemistry

2. Green Chemistry

3. Industrial Chemicals & Environment

4. Inorganic Materials of Industrial Importance

5. *Dissertation (can be opted as alternative of DSE-IV only and of 6 credits. **Dissertation content: 60, Seminar cumViva: 20)**

6. Analytical Methods in Chemistry (Alternative)

CHEMISTRY

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 6 papers suggested)

Generic Elective for non Chemistry students – 4 papers. Incase the University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

 Total – 100 marksCredit per paper – 6

Teaching hours per paper – 40 hours Theory classes + 20 hours Practical classes

CORE PAPER1

INORGANIC CHEMISTRY-I

Unit-I

Atomic structure

 Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Sommerfeld's modification. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle (time independent) and its significance, Derivation of Schrödinger's wave equation (for hydrogen atom) in Cartesian coordinate, significance of ψ and ψ^2. Normalized and orthogonal wave functions. Sign of wave functions; Setting of Schrödinger's equation in polar coordinates (derivation not required), radial and angular wave functions for hydrogen atom. Radial and angular distribution curves; Shapes of s, p, d and f orbitals; Quantum numbers and their significance. Pauli's Exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations**.**

Unit-II

Periodicity of elements

 Periodicity of Elements: s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-blocks. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent

radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization. Sanderson's electron density ratio.

Unit-III

Chemical bonding-I

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation. Madelung constant, Born-Haber cycle and its application, Solvation energy. (ii) Covalent bond: Valence Bond theory (Heitler-London approach). Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy.

Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions (CO^+, NO^+, NO^-).

Unit-IV

Chemical bonding-II

VSEPR theory, shapes of simple molecules and ions containing lone and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators. (ii) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process**.**

Oxidation-reduction: Redox equations, standard electrode potential and its applications to inorganic reactions. Principles involved in some volumetric analyses (iron and copper).

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017
4. Selected Topic in Inorganic Chemistry, S. Chand, New Delhi, 17th Ed., 2010.

Reference books

5. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.
6. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER I LAB

Students are required to learn the followings:

   i. Calibration and use of apparatus
   ii. Preparation of solutions of different Molarity/Normality of titrants.

List of experiments

(A) Acid-Base Titrations

   i. Estimation of carbonate and hydroxide present together in mixture.
   ii. Estimation of carbonate and bicarbonate present together in a mixture.
   iii. Estimation of free alkali present in different soaps/detergents

(B) Oxidation-Reduction Titrimetry

   i. Standardization of $KMnO_4$ with standard sodium oxalate and estimation of Fe(II) using standardized $KMnO_4$ solution.
   ii. Estimation of percentage of oxalic acid and sodium oxalate in a given mixture.
   iii. Estimation of Fe(II) and Fe(III) in a mixture by standard $K_2Cr_2O_7$ solution.

Reference text:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER II
PHYSICAL CHEMISTRY- I

Unit-I

Gaseous state-I

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waal's equation of state, its derivation and application in explaining real gas behaviour. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Unit-II

Liquid state

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Ionic equilibria- I

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono- and diprotic acids.

Unit- III: Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analyses of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals (stoichiometric and non- stoichiometric). Glasses and liquid crystals.

Unit-IV

Ionic equilibria - II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma &Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017
4. Castellan G. W. Physical Chemistry 4[th]Edn. Narosa (2004).

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications
2. Mortimer R. G., Physical Chemistry, Elsevier (Academic Press), 3rd Ed (2008).
3. Ball D. W. Physical Chemistry Thomson Press, India (2007).
4. Engel T. & Reid P., Physical Chemistry, 3rd Ed. Pearson   (2013)

CORE PAPER II LAB

Surface tension measurements.

a.   Determine the surface tension by (i) drop number (ii) drop weight method.

b.   Study the variation of surface tension of detergent solutions with concentration.

Viscosity measurement using Ostwald's viscometer.

a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.

b. Study the variation of viscosity of sucrose solution with the concentration of solute.

pH-metry

a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

b. Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide

c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

d. Determination of dissociation constant of a weak acid.

Ionic equilibria

a. Determination of solubility product of PbI_2 by titrimetric method.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry, 8th Ed.; McGraw-Hill, New York (2003).
3. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry, Viva Books (2009).

4. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co., New York (2003).

CORE PAPER – III

ORGANIC CHEMISTRY I

Unit –I:

Basics of organic chemistry

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and heterolytic fission with suitable examples. Curly arrow rules; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stability of carbocations, carbanions, free radicals and carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Carbon-carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Unit – II:

Stereochemistry

Fischer Projection, Newmann and Sawhorse Projection formulae; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres, Distereoisomers, meso-structures, Racemic mixture and resolution, inversion. Relative and absolute configuration: D/L and R/S designations.

Unit – III:

Chemistry of aliphatic hydrocarbons

Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2- and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformational analysis of alkanes (ethane and n-butane): Relative stability with energy diagrams. Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

Unit – IV:

Aromatic hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups

Recommended Text Books:

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. Kalsi, P. S., Stereochemistry Conformation and Mechanism; 8thEdn, New Age International, 2015.

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER III LAB

Students are required to learn the followings:

- Checking the calibration of the thermometer
- Determination of melting point, effect of impurities on the melting point – mixed melting point of two unknown organic compounds
- Determination of boiling point of liquid compounds [boiling point lower than and more than 100°C (up to 160°C) by distillation and capillary method, respectively](**e**.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide etc.).

List of experiments

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid groups and identification of unknown organic compounds of CHO system (without element detection).

2. Separation and purification of any one component of following binary solid mixture based on the solubility in common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc. and determination of melting point.

   Benzoic acid/p-Toluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/p-Anisidine etc.

3. Chromatography

   - Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
   - Separation of a mixture of two sugars by ascending paper chromatography

     OR

   - Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

CORE PAPER IV
PHYSICAL CHEMISTRY II

Unit-I:

Chemical thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

Unit-II

Carnot cycle, efficiency of heat engine, Carnot theorem

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters, inversion temperature, Gibbs-Helmholtz equation, Maxwell relations, thermodynamic equation of state.

Unit-III

Systems of variable composition

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical equilibrium

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient (vant Hoff's reaction). Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment) and its applications.

Unit-IV

Solutions and Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).

2. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co, 47th Edn., 2017.

3. Text Book of Physical Chemistry, K. L. Kapoor, Mac Grow Hill, 3rdEdn. 2017

4. Castellan G. W. Physical Chemistry 4th Ed. Narosa (2004).

Reference Books:

1. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013).

2. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).

3. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.

CORE PAPER IV LAB
THERMOCHEMISTRY

a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

c) Calculation of the enthalpy of ionization of ethanoic acid.

d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

f) Determination of enthalpy of hydration of copper sulphate.

g) Determination of heat of solution (ΔH) of oxalic acid/benzoic acid from solubility measurement.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry, New Age International: New Delhi (2001).

3. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry, Viva Books (2009)

CORE PAPER V
INORGANIC CHEMISTRY-II

UNIT-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

Acids and Bases

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

UNIT-II

Chemistry of *s* and *p* Block Elements - I

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

UNIT-III

Chemistry of *s* and *p* Block Elements - II

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes. Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

UNIT-IV

Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
4. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5th Edn.(2010).

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER V LAB

Iodometric / Iodimetric titrations

    (i)   Standardization of sodium thiosulphate solution by standard of $K_2Cr_2O_7$ solution.

    (ii)   Estimation of Cu(II) using standard sodium thiosulphate solution (Iodimetrically).

    (iii)   Estimation of available chlorine in bleaching powder iodometrically.

Inorganic preparations

    (i)   Cuprous oxide (Cu_2O)

    (ii)   Cuprous chloride, Cu_2Cl_2

    (iii)   Manganese(III) phosphate, $MnPO_4.H_2O$

(iv)   Aluminium potassium sulphate $K_2SO_4.Al_2(SO_4)_2.24H_2O$ (Potash alum).

(v)   Lead chromate $(PbCrO_4)$

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson, 2009.

2. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

3. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt. Ltd., (2017).

CORE PAPER VI
ORGANIC CHEMISTRY-II

UNIT-I

Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts, nucleophilic aromaticsubstitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

UNIT-II

Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of $1°$, 2°, 3° alcohols, Bouvaelt-BlancReduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitutionreactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with

mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides withalcohols, ammonia derivatives and $LiAlH_4$

UNIT-III

Carbonyl Compounds

Structure, reactivity and preparation:

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction, Beckmann rearrangements,α haloform reaction and Baeyer Villiger oxidation, - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV.; Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

UNIT-IV

Carboxylic Acids and their Derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic, lactic, malic, tartaric, citric, maleic and fumaric acids;

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur containing compounds: Preparation and reactions of thiols and thioethers**.**

Recommended Text Books:
1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009..

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)

2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.

3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER VI LAB

Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:

    a. Using conventional method.

    b. Using green approach

ii. Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.

iii. Bromination of any one of the following:

    a. Acetanilide by conventional methods

    b. Acetanilide using green approach (Bromate-bromide method)

iv. Nitration of any one of the following:

    a. Acetanilide/nitrobenzene by conventional method

    b. Salicylic acid by green approach (using ceric ammonium nitrate).

The above derivatives should be prepared using 0.5-1g of the organic compound.

Calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

Purification of the crude product by recrystallisation from water/alcohol, or sublimation, whichever is applicable and determination of melting point.

Reference Books

1. Vogel, A. I. Elementary Practical Organic Chemistry, Part 1: Small scale Preparations, Pearson (2011)

2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)

3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)

4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).

5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: QualitativeAnalysis,* University Press (2000).

CORE PAPER VII
PHYSICAL CHEMISTRY-III

UNIT-I

Phase Equilibria-I

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications (H_2O and sulphur system).

Phase diagrams for systems of solid-liquid equilibria involving eutectic (Pb-Ag system, desilverisation of lead), congruent (ferric chloride-water) and incongruent (sodium sulphate-water) melting points, completely miscible solid solutions (intermediate, medium, maximum freezing points).

UNIT-II

Phase Equilibria-II

Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications tofractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

UNIT-III

Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of orders.

Kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing

reactions (ii) parallel reactions (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, qualitative treatment of the theory of absolute reaction rates.

UNIT-IV

Catalysis

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms (Langmuir, Freundlich and Gibb's isotherms), nature of adsorbed state.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma &Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017
4. Castellan G. W. Physical Chemistry 4thEdn. Narosa (2004).

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications
2. Levine, I. N. *Physical Chemistry 6thEd.,* Tata McGraw-Hill (2011).
3. Ball D. W. Physical Chemistry Thomson Press, India (2007).
4. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013)

CORE PAPER VII LAB

1. Determination of distribution coefficients of:

   (a) Iodine between water and carbon tetrachloride.

   (b) Acetic/ benzoic acid between water and cyclohexane.

2. Study the equilibrium of at least one of the following reactions by the distribution

method:

- $I_2 \text{ (aq)} + I^- \rightarrow I_3^-\text{(aq)}$
- $Cu^{2+}\text{(aq)} + nNH_3 \rightarrow Cu(NH_3)_n$

3. Study the kinetics of the following reactions.
    (i)   Integrated rate method:
        a) Acid hydrolysis of methyl acetate with hydrochloric acid.
        b) Saponification of ethyl acetate.
    (ii) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.
4. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed.*; McGraw-Hill: New York (2003).

3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

<div align="center">

CORE PAPER VIII

INORGANIC CHEMISTRY-III

</div>

UNIT-I

Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, Labile and inert complexes.

Crystal field theory, measurement of CFSE weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq in octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry. Qualitative aspect of ligand field and MO Theory.

UNIT-II

Transition Elements-I

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer &Bsworth diagrams). Difference between the first, second and third transition series.

UNIT-III

Transition Elements-II

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).

Lanthanoids and Actinoids

Electronic configuration, oxidation states, colour, spectral and magnetic properties,lanthanide contraction, separation of lanthanides (ion-exchange method only).

General features of actinoids, separation of Np, Pm, Am from U.

UNIT-IV

Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin and myoglobin.

Recommended Text Books:
1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.

4. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5thEdn..

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.

2. Bioinorganic Chemistry, Asim Kumar Das, Books & Allied (P) Ltd. 1st ed. 2015.

3. Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publisher. 17th Ed. 2010.

4. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER VIII LAB

Inorganic preparations

Preparation of complexes:

      i.   Hexamine nickel(II), $[Ni(NH_3)_6]Cl_2$

    i.   Potassium trioxalatoferrate(III) trihydrate

   ii.   Tetraamminecopper(II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$

  iii.   Tetraamminecarbonatocobalt(III) nitrate

Complexometric titration

   i.   Estimation of Ca by EDTA

  ii.   Estimation of Mg by EDTA

Gravimetric Analysis:

   i.   Estimation of nickel(II) using dimethylglyoxime (DMG).

  ii.   Estimation of copper as CuSCN

  iii.   Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.

  iv.   Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)$_3$ (aluminiumoxinate).

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

   i.   Ni(II) and Co(II)

ii.   Fe(III) and Al(III)

Reference Books:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS (1978).

2. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

3. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER IX
ORGANIC CHEMISTRY-III

UNIT-I

Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles.

Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

UNIT-II

Diazonium Salts

Preparation and their synthetic applications.

Polynuclear Hydrocarbons

Reactions of naphthalene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene. Polynuclear hydrocarbons.

UNIT-III

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine. Fischer indole synthesis and Madelung synthesis,

Derivatives of furan: Furfural and furoic acid (preparation only).

UNIT-IV

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action
Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of
Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine,
and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral
and α-terpineol.

Recommended Text Books:

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.
   (Pearson Education).
2. Advanced Organic Chemistry, 2nd Edition, Arun Bahl & B S Bahl, S. Chand Publisher,
   2012.

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley
   Student Ed, 11th Edition (2013)
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford
   Publisher, 2014.
3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER IX LAB

Qualitative organic analysis of organic compounds

1. Detection of extra elements (N, X, S) in organic compounds by Lassaigne's test.

2. Qualitative analysis of unknown organic compounds containing simple functional groups
   under CHN system (amine, nitro, amide and imide), determination of melting/boiling
   point, and preparation of their derivative.

Reference Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical OrganicChemistry, 5th Ed., Pearson (2012)

3. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry:Qualitative Analysis, University Press (2000).

4. Ghoshal, A., Mahapatra, B., Nad, A. K. An Advanced Course in Practical Chemistry, New Central Book Agency (2007).

CORE PAPER X
PHYSICAL CHEMISTRY-IV

UNIT-I

Conductance-I

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

UNIT-II

Conductance-II

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

UNIT-III

Electrochemistry-I

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes.

UNIT-IV

Electrochemistry-II

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Electrical properties of atoms and molecules

Basic ideas of electrostatics, Electrostatics of dielectric media. Clausius-Mosotti equation and Lorenz-Laurentz equation (no derivation), Dipole moment and molecular polarizabilities and their measurements.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma &Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor, K. L., Text Book of Physical Chemistry, Mac Grow Hill, 3rdEdn., 2017
4. Castellan G. W. Physical Chemistry 4th Ed. Narosa (2004).

Reference Books:

1. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013).
2. Levine, I. N. Physical Chemistry 6thEd., Tata McGraw-Hill (2011).
3. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
4. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications

CORE PAPER X LAB

Conductometry

I.   Determination of cell constant.

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

   i.   Strong acid vs. strong base

   ii. Weak acid vs. strong base

   iii. Strong acid vs. weak base

Potentiometry

I   Perform the following potentiometric titrations:

   i.   Strong acid vs. strong base

   ii. Weak acid vs. strong base

   iii. Dibasic acid vs. strong base

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand &Co.,New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P., Experiments in Physical Chemistry8[th] Ed.; McGraw-Hill: New York (2003).

3. Halpern, A. M. &McBane, G. C., Experimental Physical Chemistry 3[rd]Ed.; W.H. Freeman & Co., New York (2003).

4. Viswanathan, B., Raghavan, P.S., Practical Physical Chemistry, Viva Books (2009).

CORE PAPER XI
ORGANIC CHEMISTRY-IV

UNIT-I

Organic Spectroscopy-I

UV Spectroscopy: Types of electronic transitions, λ_{max}, Lambert-Beer's law and its limitations, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward rules for calculation of λ_{max} for the following systems: α,β the unsaturated aldehydes: ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

UNIT-II

Organic Spectroscopy-II

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorptionpositions of O and N containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in simple functional group analysis.

UNIT-III

Organic Spectroscopy-III

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift andfactors influencing it; Spin-spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics; Interpretation of NMR spectra of simple compounds.

Mass Spectroscopy- Basic principle, Fragmentation pattern, instrumentation, determination of m/e ratio. Application of mass spectroscopy on CH_4, C_2H_6, *n*-butane and *neo*-pentane.

Applications of IR, UV & NMR for identification of simple organic molecules.

UNIT-IV

Carbohydrates

Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections

and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

Disaccharides – Structure elucidation of maltose; Polysaccharides – Elementary treatment of starch, cellulose.

Recommended Text Books:

1. Kemp William, Organic Spectroscopy, 3rd Edition, Palgrave Publisher, 1991.
2. Davis, B. G., Fairbanks, A. J., Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford   University Press.
3. J Kalsi P. S., Spectroscopy of Organic Compounds, 5th Edition, , New Age International Publishers, 2016.
4. Advanced Organic Chemistry, 2nd Edition, Arun Bahl & B S Bahl, S. Chand Publisher, 2012.

Reference Books:

1. Y R Sharma, Elementary Organic Spectroscopy, 5th Edition, S. Chand & Company, 2013.
2. Jag Mohan, Organic Spectroscopy and Applications, NarosaPublishrs, 2012.
3. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013).
4. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
5. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER XI LAB

1. Qualitative analysis of carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.

2. Qualitative analysis of unknown organic compounds containing simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.

3. Quantitative estimation of sugars:

    (c) Estimation glucose by titration with Fehling's solution.

    (d) Estimation of sucrose by titration with Fehling's solution.

(e) Estimation glucose and sucrose in a given mixture.

4. Identification of labelled peaks in the ^{1}H NMR spectra of the known organic compounds explaining the relative δ-values and splitting pattern.

5. Identification of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (CORE PAPERH, O-H, N-H, CORE PAPERO, CORE PAPERN, CORE PAPERX, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; characteristic bending vibrations are included).

Reference Books:

1. Vogel, A.I. *Quantitative Organic Analysis,* Part 3, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis,* University Press (2000).

CORE PAPER XII
PHYSICAL CHEMISTRY V

UNIT-I

Quantum Chemistry-I

Quantum mechanical operators, Postulates of quantum mechanics, Schrödinger equation and its application to particle in one-dimensional box (complete solution) - quantization of energy levels, zero-point energy, normalization of wave functions, probability distribution functions, nodal properties. Extension to three-dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

Rigid rotator model of rotation of diatomic molecule: Schrödinger equation, transformation to spherical polar coordinates. Separation of variables (Preliminary treatment).

UNIT-II

Chemical Bonding

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations. Localized and non-localized molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

UNIT-III

Molecular Spectroscopy-I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

UNIT-IV

Molecular Spectroscopy-II

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation.

Photochemistry

Characteristics of electromagnetic radiation, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching, chemiluminescence.

Recommended Text Books:

1. McQuarie D., Quantum Chemistry, University Science Publishers, 2007
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2010).
4. Prasad R K., Quantum Chemistry, New Age International Publishers, 4[th]Edn, 2010.
5. Rohatagi Mukherjee K K., Fundamentals of Photochemistry, Wiley Eastern Ltd., 1992.

Reference Books:

1. Puri, Sharma &Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
2. Kapoor, K. L., Text Book of Physical Chemistry, McGraw Hill, Vol. II, IV
3. Levine, I. N. Quantum Chemistry, PHI

CORE PAPER XII LAB

Spectroscopy/Colorimetry

1. Study of absorption spectra (visible range) of $KMnO_4$ and determine the λ_{max} value. Calculate the energies of the transitions in kJ mol^{-1}, cm^{-1}, and eV.
2. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration.
3. Determine the dissociation constant of an indicator (phenolphthalein).

Spectrophotometric titration

1. Determine the concentration of HCl against 0.1 N NaOH spectrophotometrically.

2. To find the strength of given ferric ammonium sulfate solution of (0.05 M) by using EDTA spectrophotometrically.

3. To find out the strength of $CuSO_4$ solution by titrating with EDTA spectrophotometrically.

4. To determine the concentration of Cu(II) and Fe(III) solution photometrically by titrating with EDTA.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in PhysicalChemistry 8th Ed.;* McGraw-Hill: New York (2003).

3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

4. J. N. Gurtu, R. Kapoor, Experimental Physical Chemistry.

CORE PAPER XIII
INORGANIC CHEMISTRY-IV

UNIT-I

Organometallic Compounds-I

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

UNIT-II

Organometallic Compounds-II

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation), structure and aromaticity, comparison of aromaticity and reactivity with that of benzene.

UNIT-III

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1.   Alkene hydrogenation (Wilkinson's Catalyst)

2.   Hydroformylation (Co salts)

3.   Wacker Process

4.   Synthetic gasoline (Fischer Tropsch reaction)

Theoretical Principles in Qualitative Analysis (H$_2$S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride and phosphate) and need to remove them after Group II.

UNIT-IV

Thermodynamic & kinetic aspects and reaction mechanism of metal complexes

Thermodynamic and kinetic stability, Stepwise and overall formation constants and their relationship, factors affecting stability. Introduction to inorganic reaction mechanisms-types of

reaction and classification od substitution reaction. Substitution reaction of square planar complexes, Trans effect and its applications, theories of trans-effect (electrostatic polarization and Static π-Bonding Theory). Kinetics of octahedral substitution (classification of metal ions based on water exchange rate), General mechanism of ligand substitution reactions in octahedral complexes (D, I, I_d, I_a).

Recommended Text Books:

1. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E., Atkins P. W., InorganicChemistry, Oxford UniversityPress,5thEdn..
4. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-0307.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publisher. 17th Ed. 2010.
3. Mehrotra R.C. and Singh, A. *Organometallic Chemistry,* New Age International Publishers, 2ndEdn, 2000.
4. Gupta B. D. and Elias A. J., Basic organometallic Chemistry, 2ndEdn., University Press (2013).

CORE PAPER XIII LAB

- Qualitative analysis of mixtures containing 4 radicals (2 anions and 2 cations). Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

  CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, F^-, Cl^-, Br^-, I^-, NO_3^-, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

- Mixtures may contain one insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3)

orcombination of interfering anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-.

- Spot tests should be done whenever possible.

Reference Books

1. Vogel's Qualitative Inorganic Analysis, 7th Ed, Revised by G. Svehela, 4th Ed., Person (2007).
2. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER XIV
ORGANIC CHEMISTRY-V

UNIT-I

Amino Acids, Peptides and Proteins

Amino acids: Classification; α-Amino acids - Synthesis, ionic properties and reactions.

Zwitterions, pK_a values, isoelectric point and electrophoresis.

Peptides: Classification, determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, CORE PAPERprotecting and CORE PAPERactivating groups -Solid-phase synthesis.

Proteins: Structure of proteins, protein denaturation and renaturation

UNIT-II

Enzymes

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereo specificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

Nucleic Acids

Components of nucleic acids, Nucleosides and nucleotides;

Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

UNIT-III

Lipids

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Concept of Energy in Biosystems

Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism and anabolism).

Overview of catabolic pathways of fat and protein.

Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.

UNIT-IV

Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

Dyes

Classification, colour and constitution; Mordant and Vat dyes; Chemistry of dyeing. Synthesis and applications of: *Azo dyes* – Methyl orange and Congo red (mechanism of Diazo Coupling); *Triphenylmethane dyes* - Malachite Green, and crystal violet; *Phthalein dyes* – Phenolphthalein and Fluorescein.

Recommended Text books

1. Nelson, D.L., Cox, M.M. and Lehninger, A.L. Principles of Biochemistry. 6[th]Edn. W.H. Freeman and Co. (2013).
2. Kar Ashutosh, Medicinal chemistry, New Age International (P) Ltd., (2007)

3. Debojyoti Das, Biochemistry, (part-I) Academic Publishers (1979)

Reference Books:

1. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.

2. Berg, J.M., Tymoczko, J.L. &Stryer, L. Biochemistry, W.H. Freeman, 2002.

4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.

5. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry, 6th Edition. W.H. Freeman and Co. (2002).

6. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).

7. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.

CORE PAPER XIV LAB

1. Preparations of the following compounds

    i. Aspirin

    ii. Methyl orange

2. Estimation of phenol and aniline by bromination method.

3. Saponification value of an oil/fat/ester.

4. Estimation of glycine by Sorenson's formalin method.

5. Estimation formaldehyde (formalin).

6. Estimation of ascorbic acid in fruit juices/Vitamin C tablet (Iodometric method)

7. Determination of Iodine number of an oil/ fat.

Reference Books:

1. Arthur, I. Vogel, Elementary Practical Organic Chemistry, Part-1 Small scale preparations, Indian Edition, Pearson (2011).

2. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

3. Arthur, I. Vogel, *Quantitative Organic Analysis,* Pearson.

4. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).

Discipline Specific Elective Paper-1

POLYMER CHEMISTRY

UNIT-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

UNIT-II

Mechanism & Kinetics of Polymerization:

Polymerization reactions – addition and condensation, mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

UNIT-III

Molecular weight of polymers and their determination (M_n, M_w, M_v, M_z) by end group analysis, viscometry and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (T_g) and it determination: WLFequation, Outlines of factors affecting glass transition temperature (T_g).

UNIT-IVProperties of polymers (physical, thermal and mechanical properties).

Preparation, structure, properties and applications of the following polymers: polyolefins (polyethylene, polypropylene), polystyrene, polyvinyl chloride, polyvinyl acetate, polyacrylamide, fluoro polymers (Teflon), polyamides (nylon-6 and nylon 6,6). Thermosetting polymers - phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, conducting polymers (polyacetylene, polyaniline). Brief outline of biodegradable polymers.

Recommended Text Books:

1. V. R. Gowarikar, Jayadev Sreedhar, N. V. Viswanathan, Polymer Science 1st Edition, New Age International Publishers, 1986.

2. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rdEdition, McGraw Hill Education, 2010.

3. P. Bahadur &N.V.Sastry, Principles of polymer science, Narosa Publishing house, New Delhi 2002.

4. Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)

Reference books

1. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)

2. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)

3. Seymour/Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

4. Nayak P.L., Polymer Chemistry, Kalyani Publisher (2017).

Discipline Specific Elective Paper I LAB

Polymer synthesis (At least three experiment)

1. Preparation of nylon-6,6 / Polyaniline

2. Preparations of phenol-formaldehyde resin-novalac / phenol-formaldehyde resin resold.

3. Preparation of urea-formaldehyde resin

4. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
   a. Purification of monomer
   b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)

5. Redox polymerization of acrylamide

6. Precipitation polymerization of acrylonitrile

Polymer characterization/analysis (At least two different experiemtn)

1. Determination of molecular weight by viscometry:

   a. Polyacrylamide / Polystyrene

   b. (Polyvinyl pyrolidine (PVP)

2. Determination of acid value/saponification value of a resin.

3. Determination of hydroxyl number of a polymer using colorimetric method.

4. Estimation of the amount of HCHO in the given solution by sodium sulphite method

5. Analysis of some IR spectra of polymers – Identification of labelled peaks in IR spectra of known polymer.

Reference Books:

1. Hundiwale G.D., Athawale V.D., Kapadi U.R. and Gite V. V., Experiments in Polymer Science, New Age Publications (2009)

2. Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.

3. Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)

4. Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)

5. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)

<div align="center">

Discipline Specific Elective Paper-1I

GREEN CHEMISTRY

</div>

UNIT-I

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis-I

Twelve principles of Green Chemistry. Explanations of principle with special emphasis on - Designing green synthesis processes: Prevention of Waste/ by-products; maximize the incorporation of the materials used in the process into the final products (Atom Economy) with reference to rearrangement, addition, substitution and elimination reactions; Prevention/ minimization of hazardous/ toxic products; Designing safer chemicals; Use of safer solvents and

auxiliaries (e.g. separating agent) - green solvents (supercritical CO_2, water, ionic liquids), solventless processes, immobilized solvents.

UNIT-II

Principles of Green Chemistry and Designing a Chemical synthesis-II

Explanation of green chemistry principles with special emphasis on:

Energy efficient processes for synthesis - use of microwaves and ultrasonic energy. Selection of starting materials (use of renewable feedstock); avoidance of unnecessary derivatization (e.g. blocking group, protection groups, deprotection); Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products use of chemically safer substances for prevention of chemical accidents, inherent safer design greener - alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol); real-time, in-process monitoring and control to prevent the formation of hazardous substances; development of green analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes;

UNIT-III

Examples of Green Synthesis/ Reactions and some real world cases-I

Green Synthesis of the following compounds: adipic acid, catechol, methyl methacrylate, urethane, disodium iminodiacetate (alternative to Strecker synthesis), paracetamol, furfural.

Microwave assisted reactions: Applications to reactions (i) in water: Hofmann Elimination, hydrolysis (of benzyl chloride, methyl benzoate to benzoic acid), Oxidation (of toluene, alcohols); (ii) reactions in organic solvents: Diels-Alder reaction and Decarboxylation reaction.

Ultrasound assisted reactions: Applications to esterification, saponification, Simmons-Smith Reaction (Ultrasonic alternative to Iodine).

UNIT-IV

Examples of Green Synthesis/ Reactions and some real world cases-II

Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments; Designing of Environmentally safe marine antifoulant; Rightfit pigment: synthetic azopigments to replace toxic organic and

inorganic pigments; Synthesis of a compostable and widely applicable plastic (poly lactic acid) from corn; Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Future Trends in Green Chemistry

Oxidizing and reducing reagents and catalysts; multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Green chemistry in sustainable development. (Bio-diesel, bio-ethanol and biogas)

Recommended Text Books:

1. Anastas P.T. & Warner J.K.: Green Chemistry- Theory and Practical, Oxford University Press (2000).
2. Ahluwalia V.K. & Kidwai M.: New Trends in Green Chemistry, Anamalaya Publishers, New Delhi (2004).
3. Kumar V., An Introduction to Green Chemistry, Vishal Publishing Co., (2015).
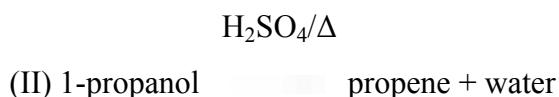
Reference Books:

1. Matlack A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
2. Das Asim K. amd Das Mahua , Environment Chemistry with Green Chemistry, Books and Allied (P) Ltd. (2010)

Discipline Specific Elective Paper II LAB

At least five experiments should be done:

1. Acetylation of primary amine (Aniline to N-phenylacetamide) using Zn dust.
2. Nitration of salicylic acid by green method (Using calcium nitrate and acetic acid).
3. Bromination of acetanilide using ceric ammonium nitrate/KBr.
4. Microwave assisted nitration of Phenols using $Cu(NO_3)_2$.
5. Detection of elements in organic compounds by green method (Sodium carbonate fusion)
6. Base catalyzed Aldol condensation (Synthesis of dibenzalpropanone)
7. Vitamin C clock reaction using vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch. Effect of concentration on clock reaction.
8. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

9. Diels Alder reaction in water: Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.

10. Preparation and characterization of nanoparticles (Cu, Ag) using plant extract.

11. Preparation of propene by following two methods or any other reactions like addition, elimination, substitution showing atomic economy can be studied

   (I) Triethylamine ion $+$ OH$^-$ $\rightarrow$ propene $+$ trimethylpropene $+$ water

                         H$_2$SO$_4$/Δ

   (II) 1-propanol   propene + water

Reference Books:

1. Monograph on Green Chemistry Laboratory Experiments, edited and published by Green Chemistry Task Force Committee, DST Govt. of India, p. 1-79.

2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistryexperiment*. American Chemical Society, Washington DC (2002).

3. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment:A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN978-93-81141-55-7 (2013).

<div align="center">

Discipline Specific Elective Paper-1II

INDUSTRIAL CHEMICALS AND ENVIRONMENT

</div>

UNIT-I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of thefollowing gases: oxygen, nitrogen, argon, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide.

Inorganic Chemicals: Manufacture, application and hazards in handling thefollowing chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

UNIT-II

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone. Major sources of air pollution.

Pollution by SO_2, CO_2, CO, NO_x, and H_2S and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal.

UNIT-III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources andnature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, fertilizer. Sludge disposal.

Industrial waste management: incineration of waste. Water treatment and purification (reverse osmosis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

UNIT-IV

Energy and Environment

Sources of energy: Coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen, geothermal, tidal and hydel.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis

Introduction to biocatalysis: Importance in green chemistry and chemical industry.

Recommended Text Books:

1. De, A. K. *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi, 2010.

2. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books:

4. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

5. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.

6. Miller G.T., Environmental Science, 11th edition. Brooks/ Cole (2006).

7. Mishra, Environmental Studies, Selective and Scientific Books, New Delhi (2005).

Discipline Specific Elective Paper III LAB

1. Determination of Dissolved Oxygen (DO) in water.

2. Determination of Chemical Oxygen Demand (COD)

3. Determination of Biological Oxygen Demand (BOD)

4. Percentage of available chlorine in bleaching powder.

5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).

6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.

7. Measurement of dissolved CO_2.

8. Study of some of the common bio-indicators of pollution.

9. Estimation of SPM in air samples.

10. Preparation of borax/ boric acid.

Reference Books:

1. Dara S. S., A Textbook on Experiments and Calculations in Engineering

ChemistrySChand & Company; 9th Revised edition (2015).

2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

3. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

4. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

5. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

Discipline Specific Elective Paper-1V
INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Unit 1
Silicate Industries

Glass: Glassy state and its properties, classification (silicate and nonsilicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Unit II
Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Unit III
Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint,

Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing.

Unit IV

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment nitriding, carburizing). Composition and properties of different types of steels.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Recommended Text Books:
1. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
3. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

Reference Books:
1. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
2. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
3. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

<div align="center">

Discipline Specific Elective Paper-IV LAB

</div>

List of Practicals

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Determination of composition of dolomite (by complexometric titration).

5. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.

6. Analysis of Cement.

7. Estimation of Iron from Cement Volumetrically

8. Preparation of pigment (zinc oxide).

Reference Books

1. Dara S. S., A Textbook on Experiments and Calculations in Engineering ChemistryS Chand & Company; 9th Revised edition (2015).

2. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

3. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

4. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers,   New Delhi.

5. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

6. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

7. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

<u>**Alternative to DSC CORE PAPERIV**</u>
Discipline Specific Elective Paper-V
DISSERTATION

A project work is to be carried out by the student in consultation with the teachers of the department. The report of work (dissertation) in a standard format is to be submitted and presented for evaluation.

Distribution of marks

(a) Project Report/Dissertation (Proper documentation of literature, data, discussion etc. and logical flow of work undertaken): 50 Marks

(b) Seminar/Presentation: 30 marks

(c) Viva voce: 20 marks

A brief Guidelines to Project Work:

1. Students shall undertake the project work (experimental/theoretical) related to any branch of

chemistry/Chemical science under the guidance of teacher(s) from the department or jointly with teachers/research personnel of other institutes.

2. The following activities have been outlined as guidelines (not exhaustive):

- Physiochemical studies (pH, conductivity, turbidity, etc.) of different wetlands (ponds, lakes, river etc.)

- Analysis of iron in pond / tube well / river water.

- Analysis of Hardness of water samples.

- Adulteration detection activities in food stuff and other edible items.

- Extraction and preliminary characterization of useful chemicals (as far as possible) from plants.

- Solubility, surface tension, and viscosity measurements of some solution of practical relevance, (cough syrup, soap solution, pesticides, fertilizers.. etc.)

- Pollution related activities (Industrial/Agricultural/Municipal etc.)

- Nutrition related activities, (essential metal detection in food, cereals, pulses, fruits etc.).

- Small synthetical work (inorganic/Organic/Polymeric compounds)

2. The UG level project work is a group activity, maximum number of students being limited to three. HOD to notify the name of teacher(s) for supervising the project work of each group. A teacher can guide more than one group, if necessary.

4. No two groups in the same institution are permitted to do project work on the same problem.

5. Each student shall prepare and submit the project report separately for evaluation. Two copies of project report are required to be submitted in bound form (spiral/paperback).

6. The project report shall be divided as:

Chapter I: Introduction (Introduction on the topic, review of literature, objective and scope of the work)

Chapter II: Materials and methods

Chapter II: Results and discussion

Chapter IV: Conclusions and Scope of future studies

Chapter V: References

Reference Books:

1. M. A. Malati, An Investigative, Integrated Approach to Practical Project Work; Mid-Kent

College of Higher/Further Education, UK (October 1999); Imprint: Woodhead Publishing; ISBN: 978-1-898563-47-1.

2. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed., Prentice-Hall, Harlow.

<u>**Alternative for Discipline Specific Elective (DSE) Papers**</u>
Discipline Specific Elective Paper-VI
ANALYTICAL METHODS IN CHEMISTRY

Unit I

UV-Visible and IR Spectrometry

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Unit II

Qualitative and quantitative aspects of analysis

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Flame Atomic Absorption Spectrometry

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Unit III

Thermal and electro-analytical methods of analysis

Theory of thermo-gravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Classification of electro-analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.

Unit IV

Separation techniques

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: TLC and HPLC.

Recommended text books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.

2. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017).

3. Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004.

Reference books

1. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W. H. Freeman, 2001.

2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

4. Pavia, Lamman, Kriz and Vyvyan, Introduction to Spectroscopy, Cengage Learning, 3rd Indian Reprint (2017).

5. Dash U N , Analytical Chemistry

Discipline Specific Elective Paper -V LAB

1. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.

3. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

4. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

5. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

6. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

7. Analysis of soil: determination of pH of soil, total soluble salt, estimation of calcium, magnesium, phosphate, nitrate

8. Separation of metal ions from their binary mixture.

9. Separation of amino acids from organic acids by ion exchange chromatography.

10. Determination of dissolved oxygen in water.

11. Determination of chemical oxygen demand (COD).

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G. H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.

2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

Generic Elective Paper I (Theory)

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

SECTION A: INORGANIC CHEMISTRY-1

Unit-I

Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Quantum numbers and their significance, shapes of s, p and d atomic orbitals, nodal planes.

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit-II

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics, energy considerations.Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules and its applications.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of

orbitals, MO treatment of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, NO). Comparison of VB and MO approaches

Section B: Organic Chemistry-1

Unit- III

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive effect, Electromeric effect, Resonance and hyperconjugation. Cleavage of bonds: Homolysis and heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/ S (for one chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Unit-IV

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons).*Preparation:*Catalytic hydrogenation, Wurtz reaction,Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons)*Preparation:*Elimination reactions: Dehydration of alkenesand dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and trans-alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis,

Alkynes: (Up to 5 Carbons)*Preparation:*Acetylene from $CaC_2$and conversion intohigher

alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5[th]Edn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5[th]Edn..
4. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
5. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. BhalArun & BhalB S , Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
7. Kalsi, P. S. Stereochemistry Conformation and Mechanism; 8[th]Edn, New Age International, 2015.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
3. Mallick, Madan and Tuli, S. Chand Selected Topic in Inorganic Chemistry, , 17[th]Edn. 2010.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Generic Elective Paper I LAB

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B:Organic Chemistry

1. Detection of extra elements (N, S, Cl) in organic compounds (containing up to two extra elements)

2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

   (f) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

   (g) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Generic Elective Paper II (Theory)

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY
Section A: Physical Chemistry-I

Unit-I

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics

Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases

Unit- II

Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-II

Unit- III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SNi) reactions.

Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer &Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Unit- IV

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes and ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction,

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): Formaldehyde, acetaldehyde, acetone and benzaldehyde

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co, 47th Edn., 2017.
3. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3[rd]Edn. 2017.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Generic Elective Paper II LAB

Section A: Physical Chemistry

Thermochemistry (any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:
   - Sodium acetate-acetic acid
   - Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water) and determination of melting.
2. Preparations, recrystallisation, determination of melting point and calculation of quantitative yields of the followings:
   (a) Bromination of Phenol/Aniline
   (b) Benzoylation of amines/phenols
   (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

4. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Generic Elective PaperIII (Theory)

CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OFMATTER & CHEMICAL KINETICS

UNIT-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Cu, Ni): electrolytic, oxidative refining, Parting process, van Arkel-de Boer process and Mond's process.

_s_- and _p_-Block Elements

Periodicity in _s_- and _p_-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling &Mulliken scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

UNIT-II

Compounds of _s_- and _p_-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements.

Concept of multicentre bonding (diborane).

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental

chemistry.

Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH); Oxoacids of P, S and Cl; Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$.

Section B: Physical Chemistry-3

UNIT-III

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

UNIT-IV

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for

zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Recommended Text Books:
1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn..
4. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co, 47th Edn., 2017.
5. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rd Edn. 2017.

Reference Books:
1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

Generic Elective Paper -III LAB
Section A: Inorganic Chemistry

Qualitative analysis of inorganic slat mixture using H_2S: not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_3^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, F^-

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

Chemical Kinetics

Study the kinetics of the following reactions.

1.   Initial rate method: Iodide-persulphate reaction
2.   Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. Svehla, G, Vogel's Qualitative Inorganic Analysis, 7th Ed, 4th Ed., Pearson Education (2007).

2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

3. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1[st]Edn., CBS Publishers & Distributors Pvt Ltd., (2017).

Generic Elective Paper- IV (Theory)

ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Section A: Inorganic Chemistry-4

UNIT-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. Synergic effects (VB approach).

UNIT-II

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, and structural role (bones).

Section B: Organic Chemistry-4

UNIT-III

Polynuclear and heteronuclear aromatic compounds

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules havingup to 6 carbon).

UNIT-IV

Application of Spectroscopy (UV-Visible, IR) to Simple Organic Molecules

Electromagnetic radiations, electronic transitions, λ_{max}&ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating $\lambda_{max}$of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Recommended Text Books:
1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
2. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5thEdn..
3. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.

4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.

2. Das Asim K., Bioinorganic Chemistry, Books & Allied (P) Ltd. 1st ed. 2015.

3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Generic Elective PaperIV LAB

Section A: Inorganic Chemistry

1. Preparation of following compounds (Any two)

   a.   Cuprous oxide (Cu_2O)

   b.   Cuprous chloride, Cu_2Cl_2

   c.   Manganese(III) phosphate, $MnPO_4.H_2O$

   d.   Lead chromate ($PbCrO_4$

2. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

   • Paper chromatographic separation of Fe^{3+}, Al^{3+} and Cr^{3+} or

   • Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

Section B: Organic Chemistry

Systematic qualitative organic analysis of organic compounds possessing mono-functional groups (-COOH, phenolic, aldehyde, ketone, amide, nitro, amines) and preparation of one derivative.

Reference Books

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6[th]Edn, Pearson, 2009.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

4. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1[st]Edn., CBS Publishers & Distributors Pvt. Ltd., (2017).

Course structure of UG Chemistry Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Atomic structure, bonding, general organic chemistry &aliphatic hydrocarbons	04	75
	DSC-I Practical		02	25
II	DSC-II	Chemical energetics, equilibria & functional organicchemistry	04	75
	DSC-II Practical		02	25
III	DSC-III	Chemistry of s- and p-block elements, states of matter &chemical kinetics	04	75
	DSC-III Practical		02	25
IV	DSC-IV	Organometallics, bioinorganic chemistry, polynuclear hydrocarbons and UV, IR spectroscopy	04	75
	DSC-IV Practical		02	25
V	DSE-I	Polymer chemistry	04	75
	DSE-I Practical		02	25
VI	DSE-II	Industrial chemicals and Environment	04	75
	DSE-II Practical		02	25
			36	**600**

CHEMISTRY PAPERS FOR PASS STUDENTS

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

 Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

Total – 100 marksCredit per paper – 6

Teaching hours per paper – 40 hours theory classes + 20 hours practical classes

Discipline Specific Core Paper I (Theory)

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS
SECTION A: INORGANIC CHEMISTRY-1

Unit-I

Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Quantum numbers and their significance, shapes of s, p and d atomic orbitals, nodal planes.

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit-II

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics, energy considerations. Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules and its applications.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, NO). Comparison of VB and MO approaches

<div align="center">

Section B: Organic Chemistry-1

</div>

Unit- III

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive effect, Electromeric effect, Resonance and hyperconjugation. Cleavage of bonds: Homolysis and heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/ S (for one chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Unit-IV

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons).*Preparation:*Catalytic hydrogenation, Wurtz reaction,Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons)*Preparation:*Elimination reactions: Dehydration of alkenesand dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and trans-alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis,

Alkynes: (Up to 5 Carbons)*Preparation:*Acetylene from $CaC_2$and conversion intohigher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.
Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5[th]Edn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5[th]Edn..
4. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
5. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. BhalArun & BhalB S , Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
7. Kalsi, P. S. Stereochemistry Conformation and Mechanism; 8[th]Edn, New Age International, 2015.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

3. Mallick, Madan and Tuli, S. Chand Selected Topic in Inorganic Chemistry, , 17[th]Edn. 2010.

4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper-I LAB

Section A: Inorganic Chemistry

Volumetric Analysis

1.   Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2.   Estimation of oxalic acid by titrating it with $KMnO_4$.

3.   Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4.   Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5.   Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B:Organic Chemistry

1. Detection of extra elements (N, S, Cl) in organic compounds (containing up to two extra elements)

2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

  (h) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

  (i) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press

Discipline Specific Core Paper II (Theory)

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Section A: Physical Chemistry-I

Unit-I

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics

Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

Unit- II

Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

Section B: Organic Chemistry-II

Unit- III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and

sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SNi) reactions.

Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer &Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Unit- IV

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes and ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction,

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): Formaldehyde, acetaldehyde, acetone and benzaldehyde

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).

2. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co, 47th Edn., 2017.

3. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3^{rd}Edn. 2017.

4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.

2. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper II LAB
Section A: Physical Chemistry

Thermochemistry (any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

1. pH measurements

   Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

2. Preparation of buffer solutions:

- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water) and determination of melting.

2. Preparations, recrystallisation, determination of melting point and calculation of quantitative yields of the followings:

    (a) Bromination of Phenol/Aniline

    (b) Benzoylation of amines/phenols

    (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
4. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Discipline Specific Core Paper III (Theory)

CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OFMATTER & CHEMICAL KINETICS

UNIT-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Cu, Ni): electrolytic, oxidative refining, Parting process, van Arkel-de Boer process and Mond's process.

s- and p-Block Elements

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling &Mulliken scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

UNIT-II

Compounds of s- and p-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements.

Concept of multicentre bonding (diborane).

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH); Oxoacids of P, S and Cl; Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$.

Section B: Physical Chemistry-3

UNIT-III

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

UNIT-IV

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Recommended Text Books:
1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5thEdn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.

3. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5[th]Edn..

4. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co, 47th Edn., 2017.

5. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3[rd]Edn. 2017.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.

2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

Discipline Specific Core Paper III LAB
Section A: Inorganic Chemistry

Qualitative analysis of inorganic slat mixture using H_2S: not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_3^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, F^-

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

1. Chemical Kinetics
2. Study the kinetics of the following reactions.
3. Initial rate method: Iodide-persulphate reaction
4. Integrated rate method:
   a. Acid hydrolysis of methyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. Svehla, G, Vogel's Qualitative Inorganic Analysis, 7th Ed, 4th Ed., Pearson Education (2007).

2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

3. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

Discipline Specific Core Paper - IV (Theory)

ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Section A: Inorganic Chemistry-4

UNIT-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. Synergic effects (VB approach).

UNIT-II

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, and structural role (bones).

Section B: Organic Chemistry-4

UNIT-III

Polynuclear and heteronuclear aromatic compounds

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules havingup to 6 carbon).

UNIT-IV

Application of Spectroscopy (UV-Visible, IR) to Simple Organic Molecules

Electromagnetic radiations, electronic transitions, λ_{max}&ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating $\lambda_{max}$of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Recommended Text Books:

1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
2. Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford UniversityPress,5thEdn..
3. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Das Asim K., Bioinorganic Chemistry, Books & Allied (P) Ltd. 1st ed. 2015.
3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper -IV LAB

Section A: Inorganic Chemistry

3.   Preparation of following compounds (Any two)

   a.   Cuprous oxide (Cu_2O)
   b.   Cuprous chloride, Cu_2Cl_2
   c.   Manganese(III) phosphate, $MnPO_4.H_2O$
   d.   Lead chromate ($PbCrO_4$)

2. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

- Paper chromatographic separation of Fe^{3+}, Al^{3+} and Cr^{3+} or
- Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

Section B: Organic Chemistry

Systematic qualitative organic analysis of organic compounds possessing mono-functional groups (-COOH, phenolic, aldehyde, ketone, amide, nitro, amines) and preparation of one derivative.

Reference Books

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6thEdn, Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).
4. Gulati Shikha , Sharma Gulati JL and ManochaShagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt. Ltd., (2017).

Discipline Specific Elective Paper –I

POLYMER CHEMISTRY

UNIT-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

UNIT-II

Mechanism & Kinetics of Polymerization:

Polymerization reactions – addition and condensation, mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

UNIT-III

Molecular weight of polymers and their determination (M_n, M_w, M_v, M_z) by end group analysis,viscometry and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (T_g) and it determination: WLFequation, Outlines of factors affecting glass transition temperature (T_g).

UNIT-IV

Properties of polymers (physical, thermal and mechanical properties).

Preparation, structure, properties and applications of the following polymers: polyolefins (polyethylene, polypropylene), polystyrene, polyvinyl chloride, polyvinyl acetate,

polyacrylamide, fluoro polymers (Teflon), polyamides (nylon-6 and nylon 6,6). Thermosetting polymers - phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, conducting polymers (polyacetylene, polyaniline). Brief outline of biodegradable polymers.

Recommended Text Books:

1. V. R. Gowarikar, Jayadev Sreedhar, N. V. Viswanathan, Polymer Science 1st Edition, New Age International Publishers, 1986.
2. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rdEdition, McGraw Hill Education, 2010.
3. P. Bahadur &N.V.Sastry, Principles of polymer science, Narosa Publishing house, New Delhi 2002.
4. Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)

Reference books

1. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
2. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
3. Seymour/Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).
4. Nayak P.L., Polymer Chemistry, Kalyani Publisher (2017).

Discipline Specific Elective Paper -I LAB

Polymer synthesis (Any three)

1. Preparation of nylon-6,6 / Polyaniline
2. Preparations of novalac resin/resold resin.
3. Preparation of urea-formaldehyde resin
4. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
5. Purification of monomer
6. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
7. Redox polymerization of acrylamide

8. Precipitation polymerization of acrylonitrile

Polymer characterization/analysis

1. Determination of molecular weight by viscometry:

    Polyacrylamide/Polystyrene

    (Poly vinyl pyrolidine (PVP) in water

2. Determination of acid value / saponification value of a resin

3. Determination of hydroxyl number of a polymer using colorimetric method.

4. Estimation of the amount of HCHO in the given solution by sodium sulphite method

5. Analysis of some IR spectra of polymers

Reference Books:

1. Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.

2. Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)

3. Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)

4. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)

5. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)

6. Seymour/Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

<div align="center">

Discipline Specific Elective Paper –II

INDUSTRIAL CHEMICALS AND ENVIRONMENT

</div>

UNIT-I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of thefollowing gases: oxygen, nitrogen, argon, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide.

Inorganic Chemicals: Manufacture, application and hazards in handling thefollowing chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder,

sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

UNIT-II

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone. Major sources of air pollution.

Pollution by SO_2, CO_2, CO, NO_x, and H_2S and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal.

UNIT-III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources andnature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, fertilizer. Sludge disposal.

Industrial waste management: incineration of waste. Water treatment and purification (reverse osmosis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

UNIT-IV

Energy and Environment

Sources of energy: Coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen,

geothermal, tidal and hydel.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis

Introduction to biocatalysis: Importance in green chemistry and chemical industry.

Recommended Text Books:

1. De, A. K. *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi, 2010.

2. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books:

1. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

2. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.

3. Miller G.T., Environmental Science, 11th edition. Brooks/ Cole (2006).

4. Mishra, Environmental Studies, Selective and Scientific Books, New Delhi (2005).

<div align="center">

Discipline Specific Elective Paper II LAB
INDUSTRIAL CHEMICALS & ENVIRONMENT
</div>

1. Determination of Dissolved Oxygen (DO) in water.

2. Determination of Chemical Oxygen Demand (COD)

3. Determination of Biological Oxygen Demand (BOD)

4. Percentage of available chlorine in bleaching powder.

5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).

6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.

7. Measurement of dissolved CO_2.

8. Study of some of the common bio-indicators of pollution.

9.   Estimation of SPM in air samples.

10. Preparation of borax/ boric acid.

Reference Books:

1.   Dara S. S., A Textbook on Experiments and Calculations in Engineering ChemistryS Chand & Company; 9th Revised edition (2015).

2.   E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.

3.   R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.

4.   A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

5.   S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi

SKILL ENHANCEMENT COMPULSORY COURSES (SECC)

Optional for SECC II paper

Skill Enhancement Compulsory Courses (SECC Option-I)

PESTICIDE CHEMISTRY

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship.

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor). Ecofriendly pesticides.

Safety measures: Environmental aspects and degradability

Reference Books:

1. R. J. W. Cremlyn: *Pesticides:* John Wiley and Sons Ltd (1978)
2. D.S. Reddy, M. Pushpa Latha, Pesticides, New Vishal Publications (2015).
3. Roy N. K., Chemistry of Pesticides. CBS Publisher & Distributors P Ltd; 1st Ed. (2010)

Skill Enhancement Courses   (SECC OptionII)
FUEL CHEMISTRY

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value

Coal:Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization ofcoal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry:Composition of crude petroleum, Refining anddifferent types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals:

Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting)Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
3. B.K. Sharma: *Industrial Chemistry*, Goel Publishing House, Meerut.

List of topics included in CBCS syllabus requiring training of College Teachers for 21 days

Theory (15 days)

1. Quantum Chemistry
2. Organometallics
3. Coordination Chemistry
4. Polymer Chemistry
5. Green Chemistry
6. Organic Chemistry

Practical (6days)

1. Green chemistry and other new practical's introduced in the new CBCS syllabus

List of minimum instrument required for undertaking practical classes of UG-CBCS in Chemistry (Core and DSC Practicals)

Sl.	Name of the instrument	Numbers
1.	Ostwald's viscometer	02
2.	Tensiometer (Surface tension measurements)	01
3.	Digital pH-meter with accessories	02
4.	Digital Conductivity meter with accessories	02
5.	Potentiometer with accessories	01
6.	Colorimeter	01
7.	Calorimeter with accessories (precision thermometer)	01
8.	Visible spectrophotometer (single beam)	01
9.	Magnetic stirrer (with/without hot plate)	02
10.	Heating mantle	01
11.	Melting point apparatus	02
12.	Vacuum pump for filtration	01
13.	Single distillation units (All glass) 2lit/hr capacity	02

14.	Single pan digital balance with precision 0.01 gm and 0.001 gm	02
15.	Water bath (Electrical)	01
16.	Fume hood	01
17.	Kipp'sapparature (PP)	02
18.	Fire extinguishers	02
19.	Aspirator for chromatographic developer	01
20.	Air oven (up to $300^{o}C$)	01
21.	Microwave oven (kitchen quality)	01
22.	Small lab accessories like glassware, plastic wares, laboratory wires and other small accessories as per requirement.	

SYLLABUS FOR UNDERGRADUATE

COURSE IN HISTORY

(Bachelor of Arts Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course Structure of U.G. History Honours

Semester	Course	Course Name	Credit	Total marks
Semester-I	AECC-I	AECC-I	4	100
	C 1	History of India-I	6	100
	C 2	Social Formations and Cultural Patterns of the Ancient World	6	100
	GE-I	History of India-I (Early Times to 1750)	6	100
Semester-II	AECC-II	AECC-II	4	100
	C 3	History of India-II	6	100
	C 4	Social Formations and Cultural Patterns of the Medieval World	6	100
	GE-II	History of India – II (1750-1950)	6	100
Semester-III	C 5	History of India-III (c.750-1206)	6	100
	C 6	Rise of Modern West-I	6	100
	C 7	History of India-IV (c.1206-1526)	6	100
	GE-III	Rise of the Modern West – I	6	100
	SEC-I	SEC-I	4	100
Semester-IV	C 8	Rise of Modern West-II	6	100
	C 9	History of India-V (c.1526-1750)	6	100
	C 10	Historical Theories and Methods	6	100
	SEC-II	SEC-II	4	100
	GE-IV	Rise of the Modern West – II	6	100
Semester-V	C 11	History of Modern Europe-I(c.1780-1880)	6	100
	C 12	History of India-VII (1750-1857)	6	100
	DSE-I	History and Culture of Odisha - I	6	100
	DSE-II	History and Culture of Odisha - II	6	100
Semester-VI	C 13	History of India-VIII (C.1857-1950)	6	100
	C 14	History of Modern Europe-II(1880-1939)	6	100
	DSE-III	History and Culture of Odisha- III	6	100

	DSE-IV	Project Report	6	100
		Total	**148**	**2600**

HISTORY

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers
Generic Elective for non History students – 4 papers. In case University offers 2 subjects as GE, then paper 1 and 2 will be the GE papers.

Marks per paper – Mid term: 20 Marks, End term: 80 Marks Total – 100 marks
Credit per paper – 6

Teaching hours per paper – 50 hours (Theory) + 10 hours (Tutorial)

Core Paper I

HISTORY OF INDIA- I

Unit-I: Reconstructing Ancient Indian History
    1. Early Indian notions of History
    2. Sources of Historical Writings
    3. Historical Geography (Major Harappan Sites and Sixteen Mahajanapadas).

Unit-II: Pre-historic Hunter-Gatherers and Food Production
    1. Paleolithic Culture: Upper, Middle and Lower; Tool making habit
    2. Mesolithic Culture: New developments in Technology and Economy
    3. Neolithic and Chalcolithic Settlements
    4. Food Production : Beginning of Agriculture

Unit-III: The Harappan Civilization
    1. Origins; Settlement Patterns and Town Planning
    2. Economic Life: Agriculture, Craft Productions and Trade
    3. Social and Political Organization; Religious Beliefs and Practices; Art

Unit-IV: Cultures in Transition
    1. Early Vedic Age: Society, Polity, Religion and Literature
    2. Later Vedic Age: Social Stratification (Varna and Gender), Polity, Religion, and Culture

Suggested Text Books:
    1. R. S. Sharma, Material Culture and Social Formations in Ancient India, 1983.
    2. Upinder Singh, A History of Ancient and Early Medieval India.

Reference Reading:
    1. Romila Thapar, Early India: From Beginning to 1300 CE, Penguin.
    2. A.L. Basham, The Wonder that was India, Vol.1
    3. B. Fagan, Digging from the Earth
    4. H.D. Sankhalia, Prehistory of India.
    5. B.R. Alchin, The Birth of Indian Civilization.

Core Paper II

SOCIAL FORMATIONS AND CULTURAL PATTERNS
OF THE ANCIENT WORLD

Unit-I:
1. Evolution of Man
2. Paleolithic Cultures
3. Mesolithic Cultures

Unit-II: Neolithic Culture:
1. Food Production
2. Development of Agriculture
3. Animal Husbandry

Unit-III: Bronze Age Civilizations
1. Egypt
2. Mesopotamia (Sumeria & Babylonia)
3. China (Shang)

Unit-IV: Ancient Greece:
1. Athens and Sparta
2. Politics, Economic
3. Culture

Suggested Text Books:
1. Burns and Ralph. World Civilizations, Vol. A.
2. V. Gordon Childe, What Happened in History?

Reference Reading:

1. G. Clark, World Prehistory: A New Perspective.

2. Bisman Basu, The Story of Man

3. H.Neil & M.C.Willam, A World of History, Oxford, New York, 1907.

4. H.R. Hall, Ancient History of the Near East, 1932.

5. H.S. Baghela, World of Civilization

Core Paper III

HISTORY OF INDIA-II (300BCE-750CE)

Unit-I: Economy and Society (circa 300 BCE to circa CE 300):
1. Expansion of Agrarian Economy: Production relations.
2. Urban growth: Trade & Commerce
3. Social stratification: Class, Varna, Jati, Gender

Unit-II: Changing Political Formations (circa 300 BCE to circa CE 300):
1. The Mauryan Empire: Chandragupta Maurya and Asoka-Conquest and Administration
2. Post-Mauryan Polities: Kushanas, and Satavahanas
3. The Cholas

Unit-III: Towards Early Medieval India [circa CE fourth century to CE 750]:
1. Gupta Age: Agrarian Expansion, Land Grants, Graded Land Rights and Peasantry.
2. Varna, Proliferation of Jatis: changing norms of marriage and property.
3. The Nature of Polities: The Gupta Empire
4. Post- Gupta Polities - Pallavas, Chalukyas, and Vardhanas

Unit-IV: Religion, Culture, Philosophy and Society
1. Consolidation of the Brahmanical Tradition: Dharma, Varnashram, Purusharthas,
2. Buddhism: Hinayan and Mahayana
3. Jainism: It's major Priniples
4. Development of Art and Architecture: Mauryan, and Gupta

Suggested Text Books:
1. D. D. Kosambi, An Introduction to the Study of Indian History, 1975.
2. A. L. Basham, Wonder That Was India, Rupa.

Reference Reading:
1. Romila Thapar, Early India: From the Origins to 1300, 2002.
2. Dharma Kumar and Irfan Habib, Cambridge Economic History of India, vol-I.
3. Romila Thapar, Ancient India.
4. K.M. Ashraf, Life and Condition of the People of Hindustan.
5. D.N. Jha (ed.), Feudal Social Formation in Early India.

<div align="center">

Core Paper IV

**SOCIAL FORMATIONS AND CULTURAL PATTERNS
OF THE MEDIEVAL WORLD**

</div>

Unit-I: Polity and Economy in Ancient Rome
1. Polity and Empire in Ancient Rome
2. Crises of the Roman Empire-Rise and fall of Julius Caesar
3. Agrarian Economy
4. Urbanization and Trade

Unit-II: Economic Developments in Europe from 7th to 14th Centuries:
1. Agricultural Production
2. Towns and Trade,
3. Feudalism- Origin, Growth and Decline

Unit-III: Religion and Culture in Medieval Europe:
1. Medieval Church,
2. Monastic Communities
3. Papacy

Unit-IV: Societies in Central Islamic Lands:
1. The Tribal background, Rise of Islam; Rise of Sultanates
2. Religious Developments: the Origins of Shariah,

Suggested Text Books:
1. Perry Anderson, Passages from Antiquity to Feudalism.
2. Marc Bloch, Feudal Society, 2 Vols.

Reference Reading:
1. J. Barrawclough, The Medieval Papacy.
2. Cambridge History of Islam, 2 Vol.
3. Will Durant, The Story of Civilization (vols. I & II).
4. T.W. Wallbank & N.M. Bailey, Civilization –Past and Present.
5. R. Coulborne, Feudalism in History.

Core Paper V
HISTORY OF INDIA-III (c. 750 -1206)

Unit –I: Studying Early Medieval India: Political Structures
1. Sources: Literary and Archaeology
2. Evolution of Political structures: Rajputs and Cholas
3. Legitimization of Kingship; Brahmanas and Temples
4. Arab conquest of Sindh: Causes and Impact

Unit-II: Agrarian Structure and Social Change:
1. Agricultural Expansion; Crops
2. Landlords and Peasants
3. Proliferation of Castes
4. Peasantization of Tribes

Unit-III: Trade and Commerce:
1. Inter-regional Trade
2. Maritime Trade and Forms of Exchange
3. Process of Urbanization
4. Merchant Guilds of South India

Unit-IV: Religious and Cultural Developments:
1. Puranic Traditions; Buddhism and Jainism
2. Islamic Intellectual Traditions: Al-Biruni
3. Regional Languages and Literature
4. Art and Architecture: Evolution of Regional styles: Kalingan and Dravidian style of Temple Architecture

Suggested Text Books:
1. B.D. Chattopadhyaya, The Making of Early Medieval India.
2. R.S. Sharma and K.M. Shrimali, (eds), Comprehensive History of India, Vol. IV (A & B).

Reference Reading:
1. Satish Chandra, Medieval India, Vol. I, Har Anand.
2. D. D. Koasambi, The Culture and Civilization of Ancient India: In Historical outline New Delhi; Vikas 1971.5th Print.
3. K. A. Nilakantha Sastri, The Colas, South Indian History.
4. Mittal, Socio-Cultural History of India.
5. R.C.Majumdar (ed) History and Culture of Indian people. Bombay; Bharatiya Vidya Bhavan 1960.Relevant Vol.

Core Paper VI

RISE OF THE MODERN WEST - I

Unit-I: Transition from Feudalism to Capitalism:
1. The problems of Transition: Economic Expansion, Industrial production
2. Trade and Commerce
3. Urban Development, Town Life

Unit-II: Early Colonial Expansion:
1. Motives, Voyages and Explorations.
2. The Conquests of America
3. Mining and Plantation, The African Slaves.

Unit-III: Renaissance and Reformation:
1. Its Social Roots Spread of Humanism in Europe.
2. The Renaissance: Art, Architecture, Sculpture, Painting and Literature
3. Origins and Spread of Reformation Movements.
4. Emergence of European State system: Spain, France, England, Russia

Unit-IV: Economic Developments of the Sixteenth Century:
1. Shift of economic balance from the Mediterranean to the Atlantic.
2. Commercial Revolution- Causes and Nature
3. Growth of Industries and its Impact

Suggested Text Books:
1. Charles A. Nauert, Humanism and the Culture of the Renaissance (1996).
2. Harry Miskimin, The Economy of Later Renaissance Europe: 1460 û1600.

Reference Reading:
1. Meenaxi Phukan, Rise of the Modern West: Social and Economic History of Early Modern Europe.
2. F. Rice, The Foundation of Early Modern Europe.
3. Toynbee, A.J, A Study of History (12 volumes).
4. Maurice Dobb, Transition from Feudalism to Capitalism.
5. Wallbank, T.W. & Bailey, N.M. Civilization: Past and Present.

Core Paper VII

HISTORY OF INDIA IV (c.1206 - 1526)

Unit-I: Sultanate: Political Structures
1. Survey of Sources: (a) Persian Tarikh Tradition, (b) Vernacular Histories; (c) Epigraphy.
2. Consolidation of the Sultanate of Delhi: Balban, Alauddin Khaljis and Mahammad-bin Tughluqs.
3. Theories of kingship: The Ruling Elites: Ulema, Sufis and the Imperial Monuments

Unit-II: Emergence of Regional Identities
1. Bahamanis, Vijayanagar and Odisha.
2. Regional Art, Architecture and Literature in Vijayanagar and Odisha

Unit-III: Society and Economy:
1. Iqta and the Revenue-free Grants.
2. Agricultural production, Technology.
3. Market Regulations, Growth of Urban Centers.
4. Trade and Commerce, Indian Overseas Trade.

Unit-IV: Religion, Society and Culture:

1. Sufi Silsilas: Chishtis and Suhrawardis; doctrines and practices, Social roles
2. Bhakti Movements and Monotheistic Traditions: Kabir, Nanak, Ravidas and Sri Chaitanya.
3. Social Impact of the Bhakti Tradition: Rise of Liberal Thought, Ideology of Equality and Gender Relations

Suggested Text Books:
1. Satish Chandra, Medieval India, Vol. I, Har Anand Publications, New Delhi.
2. J.L. Mehta, An Advanced Study of the History of Mevieval India, Vol.I.

Reference Reading:
1. Irfan Habib, Medieval India: The Study of a Civilization, NBT, New Delhi.
2. ABM Habibullah, The Foundation of Muslim Rule in India.
3. SBP Nigam, Nobility under the Sultans of Delhi.
4. R.P. Tripathy, Some Aspects of Muslim Administration in India.
5. R.S.Sharma, Early Medieval Indian Society: Orient Blackswan 2001.

Core Paper VIII
RISE OF THE MODERN WEST - II

Unit-I: The English Revolution and European Politics in the 18th century:
1. Background: Socio-Economic and Political Crisis in 17ᵗʰ Century Europe.
2. Major Issues-Political and Intellectual Currents;
3. Parliamentary Monarchy;
4. Patterns of Absolutism in Europe

Unit-II: Rise of Modern Science
1. Development of Science from Renaissance to the 17ᵗʰ century
2. Impact of Modern Science on European society

Unit-III: Mercantilism and European Economy
1. Origin and spread of Mercantilism
2. Impact of Mercantilism on European economy
3. Agricultural and Scientific Background to the Industrial Revolution

Unit-IV: The American Revolution
1. Political currents
2. Socio-Economic Issues
3. Significance of the American Revolution

Suggested Text Books:
1. H. Butterfield, The Origins of Modern Science.
2. Meenaxi Phukan, Rise of the Modern West: Social and Economic History of Early Modern Europe.

Reference Reading:
1. Harry Miskimin, The Economy of Later Renaissance Europe: 1460 - 1600.
2. C.A Fisher, History of Modern Europe.
3. F. Rice, The Foundation of Early Modern Europe
4. David Thomson, Europe since Napoleon, Pelican Books, 1985

5. Swain, J.E., A History of World Civilization, Eurasia Publishing House Pvt. Ltd., New Delhi, 1994

Core Paper IX
HISTORY OF INDIA V (c. 1526 - 1750)

Unit-I: Establishment of Mughal Rule:
1. India on the eve of advent of the Mughals
2. Military Technology: Fire Arms,
3. Sher Shah: Administrative and Revenue Reforms

Unit-II: Consolidation of Mughal Rule:
1. Incorporation of Rajputs and other Indigenous Groups in Mughal Nobility
2. Evolution of Administrative Institutions: zabti, mansab, jagir,madad-i-maash
3. Emergence of the Marathas; Shivaji; Expansion under the Peshwas

Unit-III: Society and Economy:
1. Land rights and Revenue system: Zamindars and Peasants
2. Trade Routes and patterns of Internal Commerce; overseas trade
3. Urban Centres, Craft and Technology

Unit-IV: Cultural Ideals:
1. Religious tolerance and sulh-i-kul; Sufi mystical and Intellectual Interventions
2. Art and Architecture
3. Mughal and Rajput Paintings: Themes and Perspectives

Suggested Text Books:
1. J.L. Mehta, An Advanced Study of the History of Mevieval India, Vol.II.
2. Satish Chandra, Medieval India, vol.2, Har Anand Publications, New Delhi.

Reference Reading:
1. Irfan Habib, Agrarian System of Mughal India, 1526-1707.
2. A.B.Pandey, Later Medieval Period.
3. R.P.Tripathi, Rise and Fall of the Mughal Empire
4. S.Nurul Hassan, Thoughts on Agrarian Relations in Mughal India.
5. Ishwari Prasad, Life and Times of Humayun.

Core Paper X
HISTORICAL THEORIES & METHODS

Unit-I: Meaning and Scope of History
1. Definition, Nature and Scope of History.
2. Object and Value of History.
3. History, Science and Morality.

Unit-II: Traditions of Historical Writing
1. Ancient Greek Traditions – Herodotus, Thucydides
2. Ancient Roman Traditions - Polybius, Livy and Tacitus

3. Medieval Understanding: Western – St. Augustine, Arabic – Ibn Khaldun.

Unit-III: History as Interdisciplinary Practice
1. History and Archaeology, History and Anthropology.
2. History and Psychology, History and Literature.
3. History and Political Science

Unit-IV: Historical Methods
1. Sources of History: Written, Oral. Visual & Archaeological.
2. Historical facts.
3. Historical Causation.
4. Historical Objectivity

Suggested Text Books:
1. B. Sheik Ali, History: Its Theory and Method, Macmillan, Reprinted, 1996.
2. E. H. Carr, What is History? , Penguine Books, Reprinted, 1983.

Reference Reading:
1. E. Sreedharan, A Text Book of Historiography, Orient Longman, Reprinted, 2004.
2. Marc Bloch, The Historians Craft.
3. R.G. Collingwood, The Idea of History
4. G.T.Reiner, History: Its Purpose and Method.
5. K.Rajayyan, History: it's Theory & Method

Core Paper XI
History of Modern Europe- I (c. 1780-1880)

Unit-I: The French Revolution (1789):
1. Socio, Religious, Economic and Political Conditions
2. Intellectual Currents.
3. Role of the Middle Classes

Unit-II: Revolution and its European Repercussions:
1. National Constituent Assembly
2. National Legislative Assembly
3. Napoleonic Consolidation- Reform and Empire

Unit-III: Restoration and Revolution: c. 1815 - 1848
1. Congress of Vienna Restoration of old Hierarchies
2. Revolutionary and Radical Movements-

   A) July Revolution (1830) and
   B) February Revolution (1848)

Unit-IV: Socio-Economic Transformation and Remaking of States (Late 18th Century to Late 19th Century)

1. Process of Capitalist Development: Agrarian and Industrial Revolutions in England and German States.
2. Evolution of Social Classes: Land Owners, Peasantry: Bourgeoisie and Proletariat

3. Popular Movements and the Formation of National Identities in Germany and Italy, Ireland

Suggested Text Books:
1. T.S. Hamerow, Restoration, Revolution and Reaction: Economics and Politics in Germany [1815 - 1871].
2. Anthony Wood, History of Europe, 1815 to 1960 (1983).

Reference Reading:

1. E.J. Hobsbawm, Nations and Nationalism.
2. A .Wesley Rohem, The Record of Mankind, Health and Company, Boston, 1952.
3. CMD Ketelbey, History of Modern Times since 1789, OUP, 2009.
4. David Thomson, Europe since Napoleon, Pelican Books, 1985.
5. Edward Mac Nall Burns et al, World Civilizations, vols. A,B,C,Goyal Saab, New Delhi.

Core Paper XII
HISTORY OF INDIA VII (c. 1750 - 1857)

Unit-I: Expansion and Consolidation of Colonial Power:
1. Foreign Trade and Early forms of Economic Exploitations in Bengal
2. Dynamics of Expansion, with special reference to Bengal, Mysore and Odisha

Unit-II: Colonial State and Ideology:
1. Arms of the Colonial state: army, Police, Law.
2. Imperial Ideology: Orientalism and Utilitarianism
3. Education: Indigenous and Modern.

Unit-III: Economy and Society:
1. Land revenue systems- Permanet, Ryotwari and Mahalwari.
2. Commercialization of Agriculture- Consequences
3. Drain of Wealth- Causes and Consequences
4. Growth of Modern Industry

Unit-IV: Popular Resistance:
1. Santhal Uprising (1856-57)
2. Indigo Rebellion (1860)
3. Movement of 1857- Causes and Consequences

Suggested Text Books:
1. Dharma Kumar and Tapan Raychaudhuri, (ed.)., The Cambridge Economic History of India, Vol. II.
2. Bipan Chandra, K.N. Panikkar, Mridula Mukherjee, Sucheta Mahajan and Aditya Mukherjee, India's Struggle for Independence.

Reference Reading:

1. Sumit Sarkar, Modern India (1885-1947), Mac Milan.
2. A.R.Desai, Social Background of Indian Nationalism
3. R. Vlyanovsky, Agrarian India between the World Wars.
4. Sekhar Bondhapadhaya, From Plessey to Partition.
5. G.Kaushal, Economic History of India, 1757-1956

Core Paper XIII

C.C. XIII: HISTORY OF INDIA VIII (c. 1857 - 1950)

Unit-I: Cultural Changes, Socio and Religious Reform Movements:
1. The advent of Printing and its Implications
2. Reform and Revival: Brahmo Samaj, Arya Samaj, Aligarh Movement.
3. Emancipation of Women, Sanskritization and Anti-Caste Movements

Unit-II: Nationalism: Trends up to 1919:
1. Political Ideology and Organizations, Formation of INC
2. Moderates and Extremists.
3. Swedish Movement
4. Revolutionaries

Unit-III: Gandhian Nationalism after 1919: Ideas and Movements:
1. Mahatma Gandhi: His Perspectives and Methods
2. Non- Cooperation, Civil Disobedience, Quit India,
3. Subhas Chandra Bose and INA
4. Nationalism and Social Groups: Peasants, Tribes, Dalits and Women

Unit-IV: Communalism and Partition:
1. Ideologies and Practices, Muslim League
2. Hindu Maha Sabha
3. Partition and Independence
4. Making of the Constitution

Suggested Text Books:
1. Sumit Sarkar, Modern India, 1885-1947.
2. Bipan Chandra, K.N. Panikkar, Mridula Mukherjee, Sucheta Mahajan and Aditya Mukherjee, India's, Struggle for Independence, Penguin

Reference Reading:
1. Sekhar Bandopadhyaya, From Plessey to Partition
2. N.S. Bose, Indian Awakening and Bengal
3.A. R. Desai, Social Background of Indian Nationalism, Popular, Bombay.
4.S.Gopal, British Policy in India, 1858-1905.
5.Bipan Chandra, Indian National Movement.

Core Paper XIV

HISTORY OF MODERN EUROPE II (c. 1880 - 1939)

Unit-I: Liberal Democracy, Working Class Movements and Socialism in the 19th and 20th Centuries:
1. The Struggle for Parliamentary Democracy and Civil Liberties in Britain.
2. Forms of Protest during early Capitalism: Food Riots in France and England: Luddites and Chartism.
3. Early Socialist Thought; Marxian Socialism

Unit-II: The Crisis of Feudalism in Russia and Experiments in Socialism:
1. Emancipation of Serfs
2. Revolutions of 1905; the Bolshevik Revolution of 1917.
3. Programme of Socialist Construction.

Unit-III: Imperialism, War, and Crisis: c. 1880-1939:
1. Growth of Militarism; Power Blocks and Alliances: Expansion of European Empires –First World War (1914 – 1918)
2. Fascism and Nazism.
3. The Spanish Civil War.
4. Origins of the Second World War.

Unit-IV: Intellectual Developments since circa 1850: Major Intellectual Trends:
1. Mass Education and Extension of Literacy.
2. Institutionalization of Disciplines: History, Sociology and Anthropology.
3. Darwin and Freud.

Suggested Text Books:
1. C.M. Cipolla, Fontana Economic History of Europe, Volume II the Present (1981). I : The Industrial Revolution.
2. T.S. Hamerow, Restoration, Revolution and Reaction: Economics and Politics in Germany [1815 - 1871].

Reference Reading:
1. George Lichtheim, A Short History of Socialism.
2. K.B. Keswani, International Relations in Modern World (1990-1995).
3. C.D.M. Ketelby, A History of Modern Times.
4. Carr.E.H., International Relations between the Two World Wars, 1919-1939, New York, 1966.
5. Garden Green Wood, The Modern World –A History of Our Times.

Discipline Specific Elective Paper-1

History and Culture of Odisha - I

Units: I
1. Historical Geography: Kalinga, Utkal, Kosal
2. Kalinga War (261 B.C.) and its Significance.
3. Kharavela –Career and Achievements

Unit: II
1. Matharas and Eastern Gangas and Sailodbhavas
2. Bhaumakaras
3. Somavamsis

Unit: III

1. Imperial Gangas
2. Suryavamsi Gajapatis
3. Post- Gajapati Political developments upto 1568.

Unit: IV

1. Social and Cultural Life in Early and Medieval Odisha
2. Growth and Decay of Urban Centres
3. Trade and Commerce
4. Taxation and Land Revenue

Suggested Text Books:

1. K.C. Panigrahi, History of Odisha, Kitab Mahal.

2. Sahu, Mishra & Sahu, History of Odisha.

Reference Reading:

1. S.K. Panda, Political and Cultural History of Odisha.
2. A. C Pradhan, A Study of History of Orissa
3. B.K. Mallik, etal (eds) Odia Identity, Page Maker Publications, Bhubaneswar, 2019.
4. R. D Banarjee, History of Orissa, 2 vols.
5. M.N. Das(ed), Sidelights on History and Culture of Orissa, Vidyapuri, Cuttack, 1977

Discipline Specific Elective Paper-II

History and Culture of Odisha -II

Units: I

1. Afghan Conquest and Mughal Rule in Odisha- Administration
2. Maratha rule in Odisha – Administration
3. British Occupation and Early Colonial Administration: Land Revenue, Salt Policy, Jail and Police Administration.

Unit: II

1. Resistance Movements: Ghumsar Rebellion, Paik rebellion, Revolt of 1857 and Surendra Sai, Keonjhar Uprisings.
2. Famine of 1866 – Causes and Consequences
3. Growth of Education and Language Movement

Unit: III

1. Growth of Nationalism
2. Formation of Separate Province of Orissa.
3. Prajamandal Movement

Unit: IV

1. Nationalist Politics in Odisha
2. Quit India Movement
3. Merger of Princely States

Suggested Text Books:

1.P.K. Mishra & J.K. Samal, A Comprehensive History and Culture of Orissa- Vol. I &
II.

2. A. C. Pradhan, Sidelights on Freedom Struggle in Orissa.

Reference Reading:
1.K.M. Patra, Freedom Struggle in Odisha.
2.J.K.Samal, Orissa under the British Crown.
3.K.M.Patra, Orissa State Legislature & Freedom Struggle.
4.B.C. Ray, Orissa under the Mughals, Punthi Pustak.
5.B.C. Ray, Orissa under the Marathas, Punthi Pustak.

Discipline Specific Elective Paper-III

History and Culture of Odisha - III

Unit: I
1. Buddhism in Odisha
2. Jainism in Odisha
3. Saivism in Odisha

Unit: II
1. Saktism and Tantricism in Odisha
2. Growth of Vaishnavism in Odisha and Cult of Jagannath
3. Growth of Odia Literature : Sarala Mahabharata
4. Pancha-Sakha Literature

Unit: III
1. Buddhist Art and Architecture
2. Jaina Art
3. Evolution of Temple Architecture -Parsurameswar, Mukteswar, Lingaraja, Jagannath and Konarka

Unit: IV
1. Christian Missionaries – Education and Health
2. Mahima Movement and its Impact
3. Neo-Hindu Movements – Brahmo, Arya Samaj.

Suggested Text Books:

1.A.C. Pradhan, A Study of the History of Odisha, Panchasheel.

2. B.K. Mallik, Paradigm of Dissent and Protest :- Social Movements in Eastern India (1400-1700 AD)

Reference Reading:
1.K.S. Behera, Temples of Orissa.
2.P.K. Mishra(ed), Comprehensive History and Culture of Orissa, Vol-I Pt. II.
3.N.K. Bose, Canons of Orissan Architecture
4.M.N. Das (ed), Sidelights on History and Culture of Orissa.

5. N.K. Sahu, Buddhism in Orissa.

Discipline Specific Elective Paper-IV (Optional/Project)
History of Contemporary Odisha (1947-1980)

Unit I: Political Developments
  1. Second Congress Ministry (1946-1950):
  a) Integration of Princely States with Odisha
  b) New Capital
  c) Hirakud Dam Project

  2. Years of Uncertainties (1950-1980)
  a) Third Congress Ministry and Abolition of Zamindary System
  b) Biju Patnaik's First Ministry Achievements

Unit II: United Political Initiatives
  1. Coalition Politics-Achievements and Challenges
      a) R.N. Singdeo,
      b) Sadasiba Tripathy

  2. Panchayati Raj Institutions-Its Working and Impacts.
      a) Rural Stages
  b) Urban Stages

Unit III: Economic Development
  a) Growth of Industries- Roulkela Steel Plant and Odisha Sponge Iron Ltd.
  b) Irrigation and Agricultural Infrastructure
  c) Development in Transport and State communication- National and State High Ways in Odisha

Unit IV: Social Developments and Problems
  a) Government Community Development Programmes- Its Impact
  b) Peasant Movements: Causes and Effects
  c) Growth of Art and Craft: Raghunathpur, Pipli and Bargarh

Suggested Text Books:
  1. Hemant K. Mohapatra, Odisara Etihasha (Odia), Friends Publishers, Cuttack, 2019.
  2. Sukadeva Nanda, Coalition Politics in Odisha, Sterling Publishers, Delhi.

Reference Reading:
  1. Sunit Ghosh, Orissa in Turmoil: A Study in Political Developments, Bookland International, Bhubaneswar, 1991.
  2. Basant Das, Odisha Rajanitira Gopan Katha (Odia), Anusandhan Publication, Bhubaneswar, 2001.
  3. B.B. Jena & J.K. Baral (eds), Government and Politics in Orissa, Print House (India), Lucknow, 1988.
  4. Chittaranjan Das, Nabakrushna Chaudhury, NBT, New Delhi.
  5. Dasarathi Bhuyan, Orissa Politics: From 1936 to Contemporary Politics, Mangalam Publishers, New Delhi, 2010.

Project Report

The Students may be allotted topics of their interest in the beginning of 5ᵗʰ Semester Classes. They may write the Project Reports on local History and Culture, local personalities with their significant contribution to change the Society and economy with historical perspective containing up to 50 double spaced typed pages. The students may consult the sources like local archaeology, manuscripts, community documents, oral traditions, oral narratives, local biographies and family sources for writing the project dissertation. The Teachers will guide the students to complete their Project assignments. The students may be allowed to fill up their forms after their submission of the projects assigned to them. The student has to secure fifty percent of marks from the evaluation of the project and fifty percent of the marks in the viva voce test which are compulsory.

Generic Elective Paper I
History of India - I (Early Times to 1750)

Unit – I : Reconstructing Ancient Indian History
1. Sources of Historical Writings.
2. Vedic Age : Society, Polity and Culture
3. Buddhism and Jainism : Principles and Impact

Unit – II : Polity and Administration
1. The Mauryan Empire : Conquest and Administration
2. Gupta Society : Land Grants, Peasantry and beginning of Feudal Society
3. Gupta Polity : Conquests and Administration
4. Harshavardhan : Achievements

Unit – III: Early Medieval Society, Economy and Culture
1. Post Gupta Trade and Commerce
2. Delhi Sultanate : Conquests and Administration
3. Bhakti and Sufi Movements in India
4. Development of Regional Language and Literature

Unit – IV: India on the Eve of the Advent of the Mughals
1. Sher Shah : Administration and Reforms
2. Mughal Administrative Institutions : Zabti, Mansab and Jagir
3. Religious Tolerance Sulh-i- Kul
4. Mughal Art and Architecture

Suggested Text Books:
1. Upinder Singh, History of Ancient & Early Medieval India.

2. Romila Thappar, The Early India

Reference Reading:

1. Irfan Habib, Medieval India, NBT, New Delhi
2. R.S. Sharma, India's Ancient Past
3. S.A.A. Rizri, Wonder that was India, Vol.II, Rupa
4. Cultural Heritage of India, Bharatiya Vidyabhaban Series, Vol-1-IV
5. A.L. Basheon (ed), Cultural History of India, OUP, New Delhi, 2011

Generic Elective Paper II

History of India - II (1750-1950)

Unit – I Foundation and Expansion of British Rule_

1. Battle of Plessey (1757) and Conquest of Bengal

2. Conquest of Mysore and Maharashtra

3. Expansion through Diplomacy : Subsidiary Alliance and Doctrine of Lapse

Unit – II Consolidation of British Rule and Indian Responses

1. Peasant & Tribal Resistance against British Rule: Sanyasi Reballion (1763); Kondh Rebellion in Ghumusar, Santal Rebellion

2. Revolt of 1857 : Nature and Significance

3. Land Revenue Settlements : Permanent Settlement, Ryotwari and Mahalwari Settlement

Unit – III – Social and Cultural Policies

1. Socio-Religious Reform Movements: Brahmo Samaj, Arya Samaj, Theosophical Society, Aligarh Movement.

2. Growth of Press and Education

3. Issues of Caste and Gender : Jyotiba Phule- Women Question and Issues, Depressed Class.

Unit – IV – Indian National Movement

1. Politics of Moderates and Extremists (1885-1920)

2. Gandhian Mass Movements (Non-Cooperation, Civil Disobedience and Quit India Movements), (1920-1940)

3. Communal Politics and Partition

4. Making of the Democratic Constitution

Suggested Text Books:

1. A.R. Desai, Social Background of Indian Nationalism, Popular, Mumbai

2. Priyadarshi Kar, Comprehensive History of Modern India.

Reference Reading:

1. Sumit Sarkar, Modern India : 1885-1947, Mac Millon.
2. B.R.Mani, Debrahminising History: Dominance and Resistance in Indian Society, Manohar, New Delhi, First Published 2005.
3. Chandra Bharil, Social and Political Ideas of B.R. Ambedkar, Aalekh Publishers, Jaipur, 1977.

4. Sumit Sarkar, Modern India (1885-1947), Mac Millan, Delhi, First Published 1983.
5. Hirendra N.Mukherjee, Gandhi, Ambedkar and the Extirpation of Untouchablility, PPT, New Delhi.

Generic Elective Paper III

RISE OF THE MODERN WEST - I

Unit-I: Transition from Feudalism to Capitalism
1. The problems of Transition: Economic Expansion, Industrial production
2. Trade and Commerce
3. Urban Development, Town Life

Unit-II: Early Colonial Expansion
1. Motives, Voyages and Explorations.
2. The Conquests of America
3. Mining and Plantation, The African Slaves.

Unit-III: Renaissance and Reformation
1. Its Social Roots Spread of Humanism in Europe.
2. The Renaissance: Art, Architecture, Sculpture, Painting and Literature
3. Origins and Spread of Reformation Movements.
4. Emergence of European State system: Spain, France, England, Russia

Unit-IV: Economic Developments of the Sixteenth Century
1. Shift of economic balance from the Mediterranean to the Atlantic.
2. Commercial Revolution- Causes and Nature
3. Growth of Industries and its Impact

Suggested Text Books:
1. Charles A. Nauert, Humanism and the Culture of the Renaissance (1996).
2. Harry Miskimin, The Economy of Later Renaissance Europe: 1460 û1600.

Reference Reading:
1. Meenaxi Phukan, Rise of the Modern West: Social and Economic History of Early Modern Europe.
2. F. Rice, The Foundation of Early Modern Europe.
3. Toynbee, A.J, A Study of History (12 volumes).
4. Maurice Dobb, Transition from Feudalism to Capitalism.
5. Wallbank, T.W. & Bailey, N.M. Civilization: Past and Present.

Generic Elective Paper IV

G.E. IV: RISE OF THE MODERN WEST - II

Unit-I: The English Revolution and European Politics in the 18th century

1. Background: Socio-Economic and Political Crisis in 17th Century Europe.
2. Major Issues-Political and Intellectual Currents;
3. Parliamentary Monarchy;

4. Patterns of Absolutism in Europe

Unit-II: Rise of Modern Science
1. Development of Science from Renaissance to the 17th century
2. Impact of Modern Science on European society

Unit-III: Mercantilism and European Economics
1. Origin and spread of Mercantilism
2. Impact of Mercantilism on European economy
3. Agricultural and Scientific Background to the Industrial Revolution

Unit-IV: The American Revolution
1. Political currents
2. Socio-Economic Issues
3. Significance of the American Revolution

Suggested Text Books:
1. H. Butterfield, The Origins of Modern Science.
2. Meenaxi Phukan, Rise of the Modern West: Social and Economic History of Early Modern Europe.

Reference Reading:
1. Harry Miskimin, The Economy of Later Renaissance Europe: 1460 - 1600.
2. C.A Fisher, History of Modern Europe.
3. F. Rice, The Foundation of Early Modern Europe
4. David Thomson, Europe since Napoleon, Pelican Books, 1985
5. Swain, J.E., A History of World Civilization, Eurasia Publishing House Pvt. Ltd., New Delhi, 1994

HISTORY Papers for PASS students

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

Marks per paper – Mid term: 20 Marks, End term: 80 marks; Total – 100 marks

Credit per paper – 6

Teaching hours per paper – 40 hours (theory) + 20 hours (tutorial)

Course Structure of U.G. History Pass				
Semester	**Course Opted**	**Course Name**	**Credit**	**Total Marks**
I	DSC I	History of India from c. 300 to 1206	6	100
II	DSC II	History of India from c. 300 to 1206	6	100
III	DSC III	History of India from c. 1206-1707	6	100
IV	DSC IV	History of India from c. 1707-1950	6	100
V	DSE I	Society and Economy of Modern Europe (c. 15th to 18th Century)	6	100
VI	DSE II	Some Aspects of European History (1780-1945)	6	100
		Total:	36	600

Discipline Specific Core Paper I
History of India From Earliest Times up to 300 CE

Unit I:

1. A broad survey of Paleolithic, Mesolithic and Neolithic Cultures.

2. Harappan Civilization: Origin, Extent, dominant features &decline.

3. The Vedic Period: Polity, Society, Economy and Religion.

Unit II:

1. Territorial States and the rise of Magadha:

   a) Conditions for the rise of Mahajanapadas

   b) The Causes of Magadha's success

2. Alexander's Invasion and impact

3. Jainism and Buddhism: Causes, Doctrines, Spread, Decline and Contributions

Unit III:

1. The Satavahanas Phase; Aspects of Political History, Material Culture, Administration, Religion

2. Emergence and Growth of Mauryan Empire;

   a) State

   b) Administration

   c) Economy

   d) Ashoka's Dhamma

   e) Art & Architecture

Unit IV:

1. The Sangam Age: Sangam Literature, Polity, Society & Culture

2. The Kushanas: Aspects of Polity, Society, & Religion.

Suggested Text Books:
1. Basham, A.L. The Wonder that was India
2. Thapar, Romila, History of Early India

Reference Reading:
1. Allchin, F.R. and B., Origins of a Civilization: The Prehistory and Early Archaeology of South Asia
2. Sastri, K.A.N., A History of South India
3. Sharma, R.S., Aspects of Political Ideas and Institutions in Ancient India (1991 edn.)
4. Agrawal, D.P. The Archaeology of India
5. Chakrabarti, D.K. Archaeology of Ancient Indian Cities

Discipline Specific Core Paper II

History of India From. C.300 to1206

Unit I:
1. The Rise & Growth of the Guptas: Administration, Society, Economy, Religion, Art, Literature, and Science & Technology.

Unit II:
1. Harsha & His Times: Harsha's Kingdom, Administration, Buddhism & its spread
2. The Cholas and Pandyas: Polity, Society, and Economy & Culture

Unit III:
1. Towards the Early Medieval: Changes in Society, Polity Economy and Culture with reference to the Pallavas, & Chalukayas

Unit IV
1. Arabs in Sindh: Polity, Religion &Society.
2. Struggle for power in Northern India & Establishment of Sultanate: Mahmud of Ghazani, Muhammad of Ghor.

Suggested Text Books:
1. R. S. Sharma: Indian Feudalism-India's Ancient Past
2. B. D. Chattopadhaya: Making of Early Medieval India

Reference Reading:
1. Derryl N. Maclean: Religion and Society in Arab Sindh
2. K. M. Ashraf: Life and Conditions of the People of Hindustan
3. M. Habib and K.A. Nizami: A Comprehensive History of IndiaVol.V
4. Tapan Ray Chaudhary and Irfan Habib (ed.) : The Cambridge Economic History of India, Vol.I
5. Satish Chandra: A History of Medieval India, 2 Volumes

Discipline Specific Core Paper III

History of India From 1206 to 1707

Unit I:
1. Foundation, Expansion &consolidation of the Delhi Sultanate: Iltutmish & Balban
2. Miltary, administrative &economic reforms under the Khiljis &the Tughlaqs: Alauddin Khilji & Mahammud-bin-Tughlaq

Unit II:
1. Bhakti &Sufi Movements.
2. Emergence and consolidation of Mughal State: Babur and Akbar

Unit III:
1. Akbar to Aurangzeb: administrative structure-Mansab & Jagirs, State &Religious policies.
2. Economy, Society &Culture under the Mughals.

Unit IV:
1. Emergence of Maratha Power: Shivaji, Conquest & Administration.

Suggested Text Books:
1. Satish Chandra: A History of Medieval India, 2 Volumes
2. J.L. Meheta, An Advanced History of Medieval India.

Reference Reading:
1. S.A.A.Rizvi: Muslim Revivalist Movements in Northern India during 16th and 17th Centuries
2. R.P. Tripathi: The Rise and Fall of the Mughal Empire, 2 vol.
3. I. H. Siddiqui: Some Aspects of Afghan Despotism
4. Kesvan Veluthat: Political Structure of Early Medieval South India
5. Stewart Gordon, : The Marathas 1600-1818

Discipline Specific Core Paper IV
History of India; 1707-1950

Unit I:
1. Political condition of India and Advent of European Trading Companies.
2. Expansion & consolidation of Colonial Power up to 1857: Anglo-French Rivalry, Battle of Plassey & Buxar, Subsidiary Alliance & Doctrine of Lapse.

Unit II:
1. Revolt of 1857: Causes, Nature &Aftermath.
2. Colonial economy: Agriculture, Trade & Industry- Permanent Settlement, Ruin of Indigenous Industries & Monopoly of Trade

Unit III:
1. Socio-Religious Movements in the 19th century: Raja Rammohan Ray, Dayananda Saraswati, Ramakrishna Paramahans, Swami Vivekananada & Theosophical Society.
2. Emergence & Growth of Nationalism: Causes, Swadeshi Movement, Non-cooperation Movement, Civil Disobedience Movement & Quit India Movement

Unit IV:
1. Communalism: Origin, Growth and partition of India.
2. Advent of Freedom: Constituent Assembly, establishment of Republic & Salient Features of Indian Constitution.

Suggested Text Books:
1. Sugata Bose and Ayesha Jalal: Modern South Asia: History, Culture, Political Economy, New Delhi, 1998
2. Sekhar Bandyopadhyay: From Plassey to Partition

Reference Reading:
1. Sumit Sarkar: Modern India 1885 to 1947, Mamillan, 1983
2. Bipan Chandra: Modern India, Orient Blackswan.
3. Bipan Chandra: India's Struggle for Idependence
4. R.P. Dutt: India Today.
5. K.G. Subramanian: The Living Tradition: Perspectives on Modern Indian Art

Discipline Specific Elective Paper I

Society & Economy of Modern Europe: 15ᵗʰ – 18ᵗʰ Century

Unit I:
1. Feudalism: Origin, Growth & Decline

Unit II:
1. Renaissance: Origin, Spread & its Impact
2. European Reformation: Origin, nature & Impact

Unit III:
1. Geographical Discovery
2. Beginning of Colonization and Economic Exploitation

Unit IV:
1. Growth of Capitalism; Industrial Revolution- Causes and Consequences

Suggested Text Books:
1. J H Plumb, The Pelican Book of the Renaissance, Penguin,1982
2. G. R. Elton, Reformation Europe 1517,1559, Wiley, 1999

Reference Reading:
1. Ralph Davis, The Rise of the Atlantic Economies, New York,1973
2. Arvind Sinha, Europe in Transition, Delhi, 2010
3. Rodney Hilton, The Transition from Feudalism to Capitalism, Delhi, 2006.
4. Fernand Braudel, Civilization and Capitalism, Vols. I, II, III, California, 1992
5. Butterfield, Herbert, The origins of modern science. Vol. 90507. Free Press, 1997

Discipline Specific Elective Paper II

Some Aspects of European History: C. 1780-1945

Unit I:
1. The French Revolution: Causes, Nature & Consequences
2. Napoleonic Era: First Consul, Achievements & Downfall.

Unit II:
1. Revolutions of 1830 & 1848: Causes & Effects.
2. Unification of Italy &Germany.

Unit III:
1. Imperialist Conflicts: First World War-Causes and Consequences.
2. League of Nations

Unit IV:
1. Rise of Fascism in Italy and Nazism in Germany.
2. Second World War-Causes and Consequences.

Suggested Text Books:
1. E.J. Hobsbawm: The Age of Revolution.

2. Lynn Hunt: Politics, Culture and Class in the French Revolution.

Reference Reading:

1. Andrew Porter: European Imperialism, 18760 -1914 (1994).
2. E.J. Hobsbawm: The Age of Extremes, 1914 - 1991, New York: Vintage, 1996
3. Carter V. Findley and John Rothey: Twentieth-Century World, Boston: Houghton-Mifflin, 5th ed. 2003
4. David Thomson, Europe Since Napaleon.

SYLLABUS FOR UNDERGRADUATE COURSE IN ZOOLOGY

(Bachelor of Science Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course Structure of U.G. Zoology Honours				
Semester	**Course**	**Course Name**	**Credit**	**Total marks**
Semester-I	AECC I	AECC I	4	100
	Core I (Theory)	Non-chordates I: Protista to Pseudocoelomates	4	75
	Core I (Practical)	Non-chordates I: Protista to Pseudocoelomates	2	25
	Core II (Theory)	Principles of Ecology	4	75
	Core II (Practical)	Principles of Ecology	2	25
	GE 1 (Theory)	GE 1 (Theory)	4	75
	GE I (Practical)	GE I (Practical)	2	25
Semester-II	AECC 2	AECC 2	4	100
	Core III (Theory)	Non chordates II: Coelomates	4	75
	Core III (Practical)	Non chordates II: Coelomates	2	25
	Core IV (Theory)	Cell biology	4	75
	Core IV (Practical)	Cell biology	2	25
	GE II (Theory)	GE II (Theory)	4	75
	GE II (Practical)	GE II (Practical)	2	25
Semester-III	Core V (Theory)	Diversity of Chordates	4	75
	Core V (Practical)	Diversity of Chordates	2	25
	Core VI (Theory)	Physiology: Controlling and Coordinating systems	4	75
	Core VI (Practical)	Physiology: Controlling and Coordinating systems	2	25
	Core VII (Theory)	Fundamentals of Biochemistry and microbiology	4	75
	Core VII (Practical)	Fundamentals of Biochemistry and microbiology	2	25
	SEC 1	SEC 1	4	100
	GE III (Theory)	GE III (Theory)	4	75
	GE III (Practical)	GE III (Practical)	2	25
Semester-IV	Core VIII (Theory)	Comparative anatomy of Vertebrates	4	75

	Core VIII (Practical)	Comparative anatomy of Vertebrates	2	25
	Core IX (Theory)	Physiology: Life Sustaining Systems	4	75
	Core IX (Practical)	Physiology: Life Sustaining Systems	2	25
	Core X (Theory)	Biochemistry of Metabolic Processes	4	75
	Core X (Practical)	Biochemistry of Metabolic Processes	2	25
	SEC 2	SEC 2	4	100
	GE IV (Theory)	GE IV (Theory)	4	75
	GE IV (Practical)	GE IV (Practical)	2	25
Semester-V	Core XI (Theory)	Molecular Biology	4	75
	Core XI (Practical)	Molecular Biology	2	25
	Core XII (Theory)	Principles of Genetics	4	75
	Core XII (Practical)	Principles of Genetics	2	25
	DSE I (Theory)	DSE 1	4	75
	DSE I (Practical)	DSE 1	2	25
	DSE II (Theory)	DSE II	4	75
	DSE II (Practical)	DSE II	2	25
Semester-VI	Core XIII (Theory)	Developmental Biology	4	75
	Core XIII (Practical)	Developmental Biology	2	25
	Core XIV (Theory)	Evolutionary Biology	4	75
	Core XIV (Practical)	Evolutionary Biology	2	25
	DSE III (Theory)	DSE III	4	75
	DSE III (Practical)	DSE III	2	25
	DSE IV (Theory with Practical /Project)	Project/ Economic Zoology	6	100
		Total	**148**	**2600**

ZOOLOGY

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (Out of 9 suggested papers)

Generic Elective for Non Zoology students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm: 15 marks, End term: 60 marks (Theory) + 25 marks (Practical),

Total – 100 marks

Credit per paper – 6

Teaching hours per paper – 40 hours (theory) + 10 hours (practical)

Core Paper I

Non-Chordates I: Protista to Pseudocoelomates

Unit 1: Protista, Parazoa, Metazoa and Porifera

General characteristics and Classification up to classes. Study of *Euglena*, *Amoeba*. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*. Locomotion and Reproduction in Protista.General characteristics and Classification up to classes, Canal system and spicules in sponges.

Unit 2: Cnidaria & Ctenophora

General characteristics and Classification up to classes, Metagenesis in *Obelia*, Polymorphism in Cnidaria, Corals and coral reefs. General characteristics and Evolutionary significance of Ctenophora.

Unit 3: Platyhelminthes

General characteristics and Classification up to classes. Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium.*

Unit 4: Nemathelminthes

General characteristics and Classification up to classes. Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*. Parasitic adaptations in helminthes.

Note: Classification to be followed from "Barnes, R.D. (1982). Invertebrate Zoology, V Edition"

PRACTICAL

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, Binary fission and Conjugation in *Paramecium.*

2. Examination of pond water collected from different places for diversity in protista.

3. Study of *Sycon* (T.S. and L.S.), *Hyalonema*, *Euplectella*, *Spongilla.*

4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia,*

Metridium, Pennatula, Fungia, Meandrina, Madrepora.

5. One specimen/slide of any ctenophore.

6. Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/microphotographs).

7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs).

8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate Zoology,

8th edition, Holt Saunders International Edition"

TEXT BOOKS
1.   Kotpal RL; Modern Textbook of Zoology – Invertebrates; Rastogi Publications - Meerut; 2016 edition
2.   Richard Busca, W. Moore, Stephen M. Shuster. Invertebrates; OUP USA; 3rd edition (19 January 2016)

SUGGESTED READINGS
   1.   Richard Fox , Robert D. Barnes, Edward E. Ruppert, Invertebrate Zoology: A
         Functional Evolutionary Approach, Brooks/Cole; 7th edition 2003
   2.   Barrington, E.J.W.Invertebrate Structure and Functions. II Edition, E.L.B.S. and
         Nelson.
   3. Hyman, L.H. Invertebrate Series (Recent edition)
   4. Verma P. S. A Manual of Practical Zoology: Invertebrates. S Chand Publication
   5. Parker JJ and WA Haswel Textbook of Zoology. Vol I and II

Core Paper II

Principles of Ecology

Unit 1: Ecosystem and Applied Ecology
Ecology: Autecology and synecology, Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids Nutrient and biogeochemical cycle with one example of Nitrogen cycle. Ecology in Wildlife Conservation and Management. Laws of limiting factors, Study of physical factors- (Light, temperature).

Unit 2: Population
Attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies. Population regulation - density-dependent and independent factors, Population interactions, Gause's Principle with laboratory and field examples.

Unit 3: Community
Community characteristics: species richness, dominance, diversity, abundance,vertical stratification, Ecotone and edge effect; Ecological succession with one example. Theories pertaining to climax community.

Unit – 4: Biometry

Biological data, graphical representation of data (frequency polygon and histogram), sampling techniques, measures of central tendency (Mean, median and mode), Measures of dispersion (range, quartile deviation, mean deviation and standard deviation), Hypothesis and hypothesis testing (Chi-square test, t- test)

PRACTICAL
1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton collection, preservation and mounting, Measurement of temperature, turbidity/penetration of light, determination of pH, Dissolved Oxygen content (Winkler's method), BOD, COD, Free CO_2, Hardness, TDS.
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.
5. Chi-square analysis using seeds/beads/*Drosophila*.
6. Problems on standard deviation.
7. Graphical representation of data (Frequency polygon and Histogram).

Text Book
1. Odum, E.P. and Barrett, G.W., (2018). Fundamentals of Ecology, 5th Edition
2. Smith and Smith, Elements of Ecology, Global Edition; Pearson Education India; ninth edition (14 May 2015)
3. Myra Samuels, J. Witmer, A. Schaffner, Statistics for the life sciences, Prentice Halls, Boston, 4th edition, 2012

Suggested Readings
1. Kormondy, (2017). Concepts of Ecology, Updated 4/e, Pearson
2. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Ricklefs, R.E., (2000). Ecology. 5th Edition. Chiron Press
4. Dash M.C., Fundamentals of Ecology. Mc GrawHill
5. Smith TM and Smith RL, Elements of Ecology, 8th Edition, Pearson education INC, USA
6. Miller, G.T. and Spoolman, S.E. (2017) Environmental Science, 14th Edition. Cengage Publication, New Delhi.
7. Baneerjee Pranab Kumar, Introduction to biostatistics, S Chand & Company; 3rd Rev. Edn. 2006 edition
8. Chainy GBN, Mishra G, Mohanty PK, 2016, Basic Biostatistics, Kalyani Publisher 3rd edition

Core Paper III

Non- Chordates II: Coelomates

Unit 1: Coelomates and Annelids
Evolution of coelom and metamerism. General characteristics and Classification up to classes; Excretion in Annelida.

Unit 2: Arthropoda and Onychophora
General characteristics and Classification up to classes. Vision and Respiration in Arthropoda. Metamorphosis in Insects. Social life in bees and termites. Onychophora: General characteristics and Evolutionary significance.

Unit 3: Mollusca
General characteristics and Classification up to classes. Respiration in Mollusca. Torsion and detorsion in Gastropoda. Evolutionary significance of trochophore larva.

Unit 4: Echinodermata
General characteristics and Classification up to classes. Water-vascular system in Asteroidea, Larval forms in Echinodermata, Affinities with Chordates.

Note: Classification to be followed from "Ruppert and Barnes (2006)Invertebrate Zoology,8th edition, Holt Saunders International Edition"

PRACTICAL

1. Study of following specimens:
2. Annelids - *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*
3. Arthropods – *Tachypleus,Carcinoscorpious, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina*, Cancer, *Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta*, termites and honey bees
4. Onychophora –*Peripatus*
5. Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus*
6. Echinodermates - *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon*
7. Study of digestive system, nephridia of earthworm (Virtual).
8. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
9. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta.*
10. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Text Books
1. Kotpal RL (2014) Text book of Zoology, Invertebrate, Rastogi Publication
2. Jordan and Verma PS (2009) Invertebrate Zoology. S Chand publication.

Suggested Readings
1. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.
2. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Verma P S. (2010) A Manual of Practical Zoology: Non-chordates. S Chand Publication

Core Paper IV

Cell biology

Unit 1: Overview of cells and plasma membrane

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions, Various models of plasma membrane structure. Transport across membranes: Active and Passive transport, Facilitated transport. Cell junctions: Tight junctions, Desmosomes, Gap junctions.

Unit 2: Cytoskeleton & Endomembrane System

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments; Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes.

Unit 3: Mitochondria and Peroxisomes

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis; Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis. Peroxisomes.

Unit 4: Nucleus, Cell Division and Cell signalling

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome); Mitosis, Meiosis, Cell cycle and its regulation; GPCR and Role of second messenger (cAMP)

Practical

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
i. DNA by Feulgen reaction
ii. DNA and RNA by MGP
iii. Mucopolysaccharides by PAS reaction
iv. Proteins by Mercuric bromophenol blue/Fast Green
5. Demonstration of osmosis (RBC/ Egg etc.).

Text Books
1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. S Harisha (2007) Biotechnology procedures and experiments handbook., Infinity Science Press, Hingham

Suggested Readings
1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). MolecularBiology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
3. Suvarna S, Lyton C, Bancroft JD (2013) Theory and practice of histological techniques, Churchill Livingstone, Elsevier, UK
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.

Core Paper V

Diversity and distribution of Chordates

Unit 1: Protochordates and Origin of Chordates

Protochordata: General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata.

General characteristics and outline classification Chordata. Dipleurula concept and the Echinoderm theory of origin of chordates.

Unit 2: Agnantha, Pisces & Amphibia

General characteristics of Agnatha: General characteristics and classification of cyclostomes up to class Chondrichthyes and Osteichthyes: classification up to order, Migration, Parental care in fishes, Accessory respiratory organs in pisces, Evolutionary significance of Dipnoi.

Amphibian: Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to order. Parental care in Amphibia.

Unit 3: Reptilia& Aves

General characteristics and classification up to order in reptiles; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes. General characteristics and classification up to order in Aves *Archaeopteryx* - a connecting link; Flight adaptations and Migration in birds.

Unit 4: Mammals & Zoogeography

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages. Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.

PRACTICAL

1. Protochordata: *Balanoglossus, Herdmania, Branchiostoma,* Colonial Urochordata, Sections of *Balanoglossus* through proboscis and branchio-genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slides of Herdmania spicules.
2. Agnatha: *Petromyzon* and *Myxine*.
3. Fishes*: Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas,* Flat fish.

4. Amphibia: *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamander.*
5. Reptilia: *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus.* Key for Identification of poisonous and non-poisonous snakes
6. Aves: Study of six common birds from different orders. Types of beaks and claws. Study of feathers.
7. Mammalia: *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, Loris, *Herpestes*, *Erinaceous.*
8. Power point presentation on study of any two animals from two different classes by students. Submission of album of local species.

TEXT BOOKS
1. Kotpal RL; Modern Textbook of Zoology –Vertebrates; Rastogi Publications - Meerut; 2016 edition
2. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.
3. Tiwari SK (2006) Fundamentals of World Zoogeography, Sarup & Sons

SUGGESTED READINGS
1. Pough H. Vertebrate life, VIII Edition, 2007 Pearson International.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
3. Hickman CP, Roberts LS, Keen S, Larson A, I'AnsonH, Isenhour DJIntegrated Principle of Zoology, 14th edition, 2008, McGrawHill publication
4. Verma PS and Srivastava PC. (2011)Advanced Practical Zoology. S Chand Publication.

<center>Core Paper VI</center>

<center>Physiology: Controlling and Coordinating Systems</center>

Unit 1: Tissues & Tissue system
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue. Structure and types of bones and cartilages, Ossification, bone growth and resorption.

Unit 2: Muscle & Nervous System
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction. Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision.

Unit 3: Reproductive System
Histology of testis and ovary; Physiology of male and female reproduction; Hypothalamus-Pituitary & Gonadal axis. Puberty, Ovarian Cycle, Methods of contraception in male and female, Placental hormones.

Unit 4: Endocrine System
Histology of endocrine glands – Hypothalamus (Neuroendocrine gland) pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones and mechanism of hormone action, (steroidal and non-steroidal hormones).

PRACTICAL
1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
2. Study of permanent slides- Squamous epithelium, Striated muscle fibres and nerve cells.
3. Study of permanent slides-Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
4. Microtomy: Preparation of permanent slides/photographs/computer models of any five types of mammalian (Goat/rat,etc) tissues

TEXT BOOKS
1. Marieb EN and Hoehn K, Human Physiology,(2013), 9th edition, Pearson Education, USA.
2. Endocrinology, Hadley ME and Levine JE (2009), Pearson Education India; 6 edition
3. Textbook of Medical Physiology, Guyton & Hall, Elsevier, 12th edition, 2016

SUGGESTED BOOKS
1. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition., Lippincott W. & Wilkins
2. Martini F H, Nath J L and Bartholomew E F.(2015) Fundamentals of Anatomy and Physiology. Pearson Education Publication,
3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company.
4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.

Core Paper VII

Fundamentals of Biochemistry and microbiology

Unit 1: Carbohydrates & Lipids
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides andGlycoconjugates; Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.

Unit 2: Proteins
Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids.
Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Renaturation, Denaturation; Introduction to simple and conjugate proteins
Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants.

Unit 3: Enzymes
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

Unit 4: Microbiology

Bacteria: Classification, structure and reproduction

Virus: classification, structure and reproduction, bacteriophages, viriods, prions, microbes of food, agriculture and industry

Bacterial (typhoid, cholera and tuberculosis) and viral (swine flu, zika fever and AIDS) diseases of human

PRACTICAL
1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase./Urease/acid or alkaline phosphatase
5. Demonstration of proteins separation by SDS-PAGE.
6. Identification of different bacteria and viruses through slide/photographs

TEXT BOOKS
1. Satyanarayan and Chakrapani , (2017) Biochemistry, Elsevier; Fifth edition
2. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and   Co., New York.
3. Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto, Biochemistry, 8th edition, 2015.
4. Victor W., Rodwell, David A., Bender, Kathleen M., Botham, Peter J., Kennelly, P. Anthony,Harper's Illustrated Biochemistry, 31st edition.
5. Tortora GJ, Funke BR and Case CL (2016) Microbiology: An introduction, Pearson India Education Services Pvt.Ltd.11th edition

SUGGESTED READING
1. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
2. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Publication.
3. Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.
4. Devasena T. (2010). EnzymologyOxford University Press; 1 edition
5. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
6. Pelezar Jr.MJ,Chan E.C.S. and Krieg NR (2001) Microbiology, Mc-Graw Hill Education

<div align="center">

Core Paper VIII

Comparative Anatomy of Vertebrates

</div>

Unit 1: Integumentary & Skeletal System
Structure, functions and derivatives of integument (Scale, claw, nail, hair, feather and

dentition). Axial and appendicular skeleton, Jaw suspensorium, Visceral arches.

Unit 2: Digestive & Respiratory System
Alimentary canal and associated glands; Respiration through skin, gills, lungs and air sacs; Accessory respiratory organs.

Unit 3: Circulatory and Urinogenital system
General plan of circulation, evolution of heart and aortic arches; Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri.

Unit 4: Nervous System & Sense Organs
Comparative account of brain;Nervous system, Spinal cord, Cranial nerves in mammals. Classification of receptors: Brief account of visual and auditory receptors in man. Chemo and mechano receptors

PRACTICAL
1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, *Varanus*, Fowl, Rabbit.
3. Carapace and plastron of turtle /tortoise (Photographs, charts etc).
4. Mammalian skulls: One herbivorous and one carnivorous animal.
5. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted).
6. Project on skeletal modifications in vertebrates (may be included if dissection not permitted).

TEXT BOOKS
1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
3. R. K. Saxena and Sumitra Saxena (2016). Comparative Anatomy of Vertebrates 2nd edition.

SUGGESTED READINGS
1. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate tructure, John
Wiley and Sons
2. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House

Core Paper IX

Physiology: Life Sustaining Systems

Unit 1: Physiology of Digestion
Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in gastrointestinal tract.

Unit 2: Physiology of Respiration
Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory

pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration.

Unit 3: Renal Physiology and Blood

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance. Components of blood and their functions; Structure and functions of haemoglobin haemostasis: Haemopoiesis, Blood clotting system, Blood groups: Rh factor, ABO and MN.

Unit 4: Physiology of Heart

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation.

PRACTICAL

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examination of sections of mammalian slides: oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.

TEXT BOOKS

1. Marieb E.N. and Hoehn K.N. (2009) Human Physiology. Pearson Education Publication , 9th edition
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
3. Guyton & Hall, (2016) Textbook of Medical Physiology. Elsevier, 12th edition,

SUGGESTED READINGS

1. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
2. Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills.
3. Moyes C.D., Schulte PM (2016), Principles of physiology, 2nd edition, Pearson education, 3rd.
4. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE   Ltd. W.B. Saunders Company.

Core Paper X

Biochemistry of Metabolic Processes

Unit 1: Overview of Metabolism
Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms.

Unit 2: Carbohydrate Metabolism
Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.

Unit 3: Lipid and protein Metabolism
β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis
Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

Unit 4: Oxidative Phosphorylation
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

PRACTICAL
1. Estimation of total protein in given solutions
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
3. To study the enzymatic activity of Trypsin/ Lipase.
4. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
5. Dry Lab (Virtual): To trace the labelled C atoms of Acetyl-CoA till they evolve as CO_2 in the TCA cycle.

TEXT BOOKS
1. Satyanarayan and Chakrapani , (2017) Biochemistry, Elsevier; Fifth edition.
2. Cox, M.M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

SUGGESTED READINGS
1. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007).Biochemistry, VI Edition, W.H. Freeman and Co., New   York.
3. Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

Core Paper XI

Molecular Biology

Unit 1: Nucleic Acids, DNA Replication & Repair
Salient features of DNA and RNA, Watson and Crick model of DNA.,Nucleic acids cot curves, denaturation and renaturation of DNA, DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres, Pyrimidine dimerization and mismatch repair.

Unit 2: Transcription & Translation
RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors and regulation of transcription.

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNAsynthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

Unit 3: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.

Unit 4: Gene Regulation & Regulatory RNAs
Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, RNA interference, miRNA, siRNA.

PRACTICAL
1. Study of Polytene chromosomes from *Chironomous / Drosophila* larvae
2. Preparation of liquid culture medium (LB) and raise culture of E. coli
3. Estimation of the growth kinetics of E. coli by turbidity method
4. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking
5. Quantitative estimation of Salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A_{260}nm measurement)
6. Quantitative estimation of RNA using Orcinol reaction
7. Study and interpretation of electron micrographs/ photograph showing

(a) DNA replication, (b) Transcription and (c) Split genes.

TEXT BOOKS
1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. Lewin B. (2013). Gene XI, Jones and Bartlett.
3. De Robertis E.D.P. (2017) Cell and Molecular Biology 8Ed.
4. Arnold Berk , Chris A. Kaiser, Harvey Lodish , Angelika Amon , Hidde Ploegh, Anthony Bretscher, Monty Krieger Kelsey C. Martin(2016) Molecular Cell Biology. 8th edition.

SUGGESTED READINGS
1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular   Biology ofthe Cell, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach**,** V Edition, ASM Press and Sinauer Associates.
4. McLennan A., Bates A., Turner, P. and White M. (2015). Molecular Biology IV Edition. GS, Taylor and Francis Group, New York and London.

Core Paper XII

Principles of Genetics

Unit 1: Mendelian Genetics, Linkage, Crossing Over and Chromosomal Mapping
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance. Polygenic inheritance with suitable examples; simple numericals based on it.
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 2: Mutations
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Unit 3: Sex Determination & Extra-chromosomal Inheritance
Chromosomal mechanisms of sex determination in *Drosophila* and Man; Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects.

Unit 4: Recombination in Bacteria and Viruses & Transposable Genetic Elements
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage.
Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in human.

PRACTICAL
1. Study of Mendelian laws and gene interactions.
2. Linkage maps based on data from conjugation, transformation and transduction.
3. Linkage maps based on data from *Drosophila* crosses.
4. Study of human karyotype (normal and abnormal).
5. Pedigree analysis of some human inherited traits.

TEXT BOOKS
1. Benjamin Pierce, (2015) Genetics- A Conceptual Approach, 5th edition, WH Freeman publication
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition.

SUGGESTED READINGS
1. Benjamin Cummings. Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
4. Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor and Francis Group, New York and London.

Core Paper XIII

Developmental Biology

Unit 1: Introduction to Developmental Biology, Gametogenesis & Fertilization
Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy.

Unit 2: Early Embryonic Development
Cleavage: Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.

Unit 3: Late Embryonic Development
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Unit 4: Post Embryonic Development & Implications of Developmental Biology
Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories. Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis.

PRACTICAL
1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture.

4. Study of different sections of placenta (photomicropgraph/ slides).
5. Project report on *Drosophila* culture/chick embryo development.
6. Study of developmental stages by raising chick embryo in the laboratory

TEXT BOOKS
1. Lewis Wolpert (2010). Principles of Development. II Edition, Oxford University Press.
2. Gilbert, S. F. (2017). Developmental Biology, XI Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

SUGGESTED READINGS
1. Carlson, R. F. Patten's Foundations of Embryology.
2. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
3. Verma PS and Agrawal VK, Chordata Embryology (2010) (S Chand Publication).

Core Paper XIV

Evolutionary Biology

Unit 1: Theories, Evidences of Evolution and Extinction
Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism.Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Sources of variations: Heritable variations and their role in evolution. Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

Unit 2: Process of Evolutionary changes
Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection). Genetic Drift (mechanism, founder's effect, bottleneck phenomenon); Role of Migration and Mutation in changing allele frequencies.

Unit 3: Species concept and Speciation
Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Parapatric. Adaptive radiation / macroevolution (exemplified by Galapagos finches);

Unit 4: Concept of Origin and Evolution of man
Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*, molecular analysis of human origin. Phylogenetic trees, Multiple sequence alignment, construction and interpretation of phylogenetic trees.

PRACTICAL
1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

TEXT BOOKS
1. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
2. Rastogi B.B., (2018). Organic Evolution, MedTech; 3rdedition

SUGGESTED READINGS
1. B.K. and Hallgrimson, B. (2008). Evolution IV Edition. Jones and Barlett Publishers.
2. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates. Snustad. S Principles of Genetics.
3. Ridley,M (2004) Evolution III Edition Blackwell publishing Hall.

Discipline Specific Elective Paper-1

Animal Behaviour and Chronobiology

Unit 1: Animal Behaviour
Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers.

Unit 2: Patterns of Behaviour
Stereotyped Behaviours (Orientation, Reflexes); Individual behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour
Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Chronobiology

Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks, Relevance of biological clocks, Types and characteristics of biological rhythms: Short- and Long-term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

PRACTICAL
1.   To study nests and nesting habits of the birds and social insects.
2.   To study the behavioural responses of wood lice in dry and humid condition.
3.   To study geotaxis behaviour in earthworm.
4.   To study the phototaxis behaviour in insect larvae.
5.   Study and actogram construction of locomotor activity of suitable animal models.
6.   Study of circadian functions in humans (daily eating, sleep and temperature patterns).
7.   Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioral activities of animals and prepare a short report.

TEXT BOOKS
1. John A (2009) Animal Behaviour.9th edition, Sinauer Associate Inc., USA.
2. Vinod Kumar (2002) Biological Rhythms: Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

SUGGESTED READINGS
1. AK Pati. Chronobiology: The Dimension of Time in Biology and Medicine. PINSA (Bilogical Sciences). Part B 67 (6). 323-372, Dec., 2001.
2. David McF. Animal Behaviour. Pitman Publishing Limited, London, UK.
3. Manning A and Dawkins MS. An Introduction to Animal Behaviour. Cambridge University Press, USA.
4. Paul WS and John A (2013) Exploring Animal Behaviour. 6th Edition. Sinauer Associate Inc., Massachusetts, USA.
5. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Chronobiology Biological Timekeeping: J, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

OR

Animal Biotechnology

Unit 1. Introduction to Animal Biotechnology

Concept and scope of biotechnology, Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC and Expression vectors (characteristics).
Restriction enzymes: Nomenclature, detailed study of Type II, Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Transformation techniques: Calcium chloride method and electroporation

Unit 2. Molecular Techniques

Southern, Northern and Western blotting, DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA microarray

Unit 3. Genetically Modified Organisms
Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock-out mice.

Unit 4. Culture Techniques and Applications
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Thalassemia, Haemophilia and Sickle cell anemia),Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

PRACTICAL
1. Genomic DNA isolation from *E. coli* / Animal tissue
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of plasmid DNA / Lambda Phage DNA
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
    a. Southern Blotting
    b. Northern Blotting
    c. Western Blotting
    d. DNA Sequencing (Sanger's Method)
    e. PCR
    f. DNA fingerprinting

TEXT BOOKS
1. BD Singh, (2014) Biotechnology: Expanding Horizons, Kalyani Publishers
2. U.Satyanarayan and U Chakrapani, (2014) Biotechnology, Books & Allied Ltd

SUGGESTED READINGS
1. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to GeneticAnalysis. IX Edition. Freeman and Co., N.Y.,USA.
2. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- Genes and Genomes- AShort Course. III Edition, Freeman and Co., N.Y.,USA.
3. Brown, T.A. (2015). Gene Cloning and DNA Analysis. 7th Edition, Academic Press, California, USA.

<div align="center">OR</div>

<div align="center">ENDOCRINOLOGY</div>

Unit 1: **Introduction to Endocrinology**
History of endocrinology, Types of endocrine glands and hormones, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones.

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis
Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms Structure of pituitary gland, Hormones and their functions, Hypothalamohypophysial portal system, Disorders of pituitary gland.

Unit 3: Peripheral Endocrine Glands

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas. Structure, Hormones, Functions and Regulation of Ovary and Testis.
Hormones in homeostasis, Disorders of endocrine glands.

Unit 4: Regulation of Hormone Action

Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action.

PRACTICAL

1. Dissect and display of Endocrine glands in laboratory bred rat*
2. Study of the permanent slides of all the endocrine glands
3. Compensatory ovarian/ adrenal hypertrophy in vivo bioassay in laboratory bred rat*
4. Demonstration of Castration/ ovariectomy in laboratory bred rat*
5. Estimation of plasma level of any hormone using ELISA
6. Designing of primers of any hormone
7. Report on endocrine disorders in human
(*Subject to UGC guidelines)

TEXT BOOKS

1. C. Donnell Turner (2012) General Endocrinology Pub- Affiliated East-West press Pvt. Ltd.-New Delhi; 6th Edition
2. Hadley, M.E. and Levine J.E. (2007). Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey

SUGGESTED READINGS

1. Stephen Nussey and Saffron Whitehead (2001). Endocrinology: An Integrated Approach; Oxford: BIOS Scientific Publishers

Discipline Specific Elective Paper-1I

Basics of Neuroscience

Unit 1: Introduction to Neuroscience & Nervous System

Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology. Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons.

UNIT 2: Cellular and Molecular Neurobiology

Molecular and cellular approaches used to study the CNS at the level of single molecules, The ionic bases of resting membrane potential; The action potential- its generation and properties; The action potential conduction. Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission.

Unit 3. Neurotransmitters

Different types of neurotransmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

UNIT 4: Neurobiology and Neuropharmacology of Behaviour

The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, Addiction.

PRACTICAL

1. Dissection and study of *Drosophila* nervous system using GFP reporter.
2. Observation and quantitation of *Drosophila* photoreceptor neurons in healthy and diseased condition.
3. Nerve Cell preparation from the spinal cord.
4. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.
6. Study of novelty, anxiety and spatial learning in mice.

TEXT BOOKS

1. Kandel, Schwartz and Jessell (2000) Principles of Neural Science-4th Edn-Eds. - McGraw- Hill Companies
2. Mark F. Baer; Barry W. Connors,(2015) Neuroscience: Exploring the brain . Lippincott Williams and Wilkins

SUGGESTED READINGS

1. From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham.
2. Neuroscience-Eds. Dale Purves (3rd Edn)-Sinauer Associates, Inc.-2004.
3. Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young-CUP-2003.
4. Essential Psychopharamacology- Neuroscientific Basis and Practical Applications-2nd Edn.-Stephan M. Stahl-CUP-2000.
5. Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998 The Human Brain Book - Rita Carter-2009

OR

Reproductive Biology

Unit 1: Reproductive System and Endocrinology

Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia,mechanism of sex differentiation.

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female.

Unit 2: Functional anatomy of male reproduction

Outline and histology of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Unit 3: Functional anatomy of female reproduction

Outline and histology of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization, prevention of polyspermy; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto- maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Unit 4: Reproductive Health

Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

PRACTICAL

Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.

1. Examination of vaginal smear rats from live animals.
2. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.
3. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
4. Human vaginal exfoliate cytology.
5. Sperm count and sperm motility in rat
6. Study of modern contraceptive devices.

TEXT BOOKS
1. Austin, C.R. and Short, R.V. (1982) Reproduction in Mammals. Cambridge University Press.
2. C. Donnell Turner (2012) General Endocrinology Pub- Affiliated East-West press Pvt. Ltd.-New Delhi; 6th Edition
3. Tandulwadkar Sunita R (2015) The Art & Science of Assisted Reproductive Technology,Jaypee Brothers Medical Publishers

SUGGESTED READINGS
1. Tony M. Plant and Anthony J. Zeleznik (2015) Knobil and Neill's Physiology of Reproduction, Academic Press

Immunology

Unit 1: Innate and Adaptive Immunity
Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system. Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

Unit 2: Antigens and Immunoglobulins
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes, Immunoglobulins: Structure and functions of different classes of immunoglobulins, Antigen antibody interactions, Immunoassays (ELISA-Direct, Indirect, Competitive, Sandwich and RIA)

Unit 3: Major Histocompatibility Complex, Cytokines and Complement system
Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation; Cytokines -Properties and functions of cytokines, Therapeutics Cytokines Complement System -Components and pathways of complement activation.

Unit 4: Hypersensitivity and Vaccines
Gell and Coombs' classification and brief description of various types of hypersensitivities Vaccines -various types of vaccines, Advances in vaccine production.

PRACTICAL
1. Study of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of White blood cells.
4. ABO blood group determination.
5. Total WBC counting.
6. Demonstration of ELISA.
7. Demonstration of Bone marrow smears to study Immune cells.

TEXT BOOKS
2. Abbas K. Abul and Lechtman H. Andrew (2017) Cellular and Molecular Immunology. V Edition. Saunders Publication.
3. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2017). Immunology, VI Edition. W.H. Freeman and Company.

SUGGESTED READINGS
1. Peter J. Delves and Seamus J. Martin (2017) Roitt's Essential Immunology, Wiley-Blackwell; 13th edition

Discipline Specific Elective Paper-III

Fish and Fisheries

Unit 1: Systematics, Morphology and Physiology
Systematic classification of native/exotic fishes (upto classes), Types of fins and their modification; Locomotion in fishes; Hydrodynamics; Types of scales, Use of scales in classification and determination of age of fish; Gills and gas exchange; Swim bladder; Reproductive strategies (Special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Migration

Unit 2: Fisheries
Inland fisheries; Marine fisheries; Environmental factors influencing the seasonal variation in fish; Fishing crafts and Gears; Depletion of Fisheries resources; Fisheries laws and regulations.

Unit 3: Aquaculture
Sustainable aquaculture; Extensive, semi-intensive and intensive culture of fish; Polyculture; Composite fish culture; brood stock management; Induced breeding of fish; Management of fin fish hatcheries; Preparation and maintenance of fish aquarium. Factors affecting aquaculture.

Unit 4:Fish Pathology and Transgenesis
Fish diseases: bacterial, viral and parasites; Preservation, diagnosis and treatment, Processing of harvested fish, Fishery byproducts; Transgenic fish, zebrafish as a model organism in research.

PRACTICAL
1. Study of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas*
2. Study of different types of scales (Through permanent slides and photographs)
3. Study of crafts and gears used in fisheries.
4. Water quality criteria for aquaculture: assessment of pH, conductivity, total solids and total dissolve solids.
5. Study of air breathing organs in *Channa, Heteropneustes, Anabas and Clarias*.
6. Demonstration of induced breeding in fishes (Virtual).
7. Demonstration of parental care in fishes (Virtual).
8. Project report on a visit to any fish farm/ pisciculture unit/ zebra fish rearing lab

TEXT BOOKS
1. Q Bone and R Moore (2008), Biology of fishes, Taylor and Francis group, CRC Press, UK
2. S.S. Khanna and H.R. Singh (2014) A textbook of fish biology and fisheries, Narendra Publishing House, 3rd edition.

SUGGESTED READINGS
1. D H Evans and J D Claiborne, The Physiology of fishes, Taylor and Francis group, CRC, UK
2. R J Mogdans and B G Kapoor, The senses of fish: Adaptations for the reception of natural stimuli, Springer, Natherland

3. C B L Srivastava, Fish biology, Narendra Publishing House
4. J R Norman, A History of fishes, Hill and Wang Publishers.

<div align="center">

OR

Wildlife Conservation And Management

</div>

Unit 1: Wildlife
Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies, Conservation and protection Laws, wild animal of India and Odisha.

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 2: Management of habitats
Setting back succession; Grazing logging; Mechanical treatment; Advancing thesuccessional process; Cover construction; Preservation of general genetic diversity;Restoration of degraded habitats, In situ and Ex situ conservation, Wild life Protection act, wildlife trade and related laws.

Unit 3: Population estimation
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Census methods; Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animals.

Unit 4: Management planning of wildlife in protected areas
Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence, National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

PRACTICAL
1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna India and Odisha.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System,Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, animal sounds.
4. Demonstration of different field techniques for flora and fauna.
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
6. Submission of field study report (national park/ reserve forest/ sanctuary)

TEXT BOOKS
1. Gopal Rajesh (2011) Fundamentals of Wildlife Management, Natraj Publishers.
2. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

SUGGESTED READINGS
1. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.
2. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
3. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences.
4. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory.Blackwell Publishing.

Discipline Specific Elective Paper-IV

Economic Zoology

Unit 1: Bee-keeping and Bee Economy (Apiculture)
Varieties of honey bees and Bee pasturage; Setting up an apiary: Langstroth's/Newton's hive, bee veil, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet; Honey extraction techniques; Physico-chemical analysis of honey; Other beneficial products from bee.

Unit 2: Silk and Silk Production (Sericulture)
Different types of silk and silk worms in India; Rearing of *Bombyx mori*, Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons; Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles and their management; Silk reeling techniques and Quality assessment of silk fibre.

Unit 3: Aquaculture
Induced breeding of fish; Management of hatchery of fish; Management of nursery, rearing and stocking ponds; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish; Fishery by-products. Prawn farming; Culture of crab; Pearl culture.

Unit 4: Dairy and Poultry Farming
Introduction; Indigenous and exotic breeds; Rearing, housing, feed and rationing; Commercial importance of dairy and poultry farming; Varietal improvement techniques; Diseases and their management; Dairy or poultry farm management and business plan; Visit to any dairy farm or Poultry farm.

PRACTICAL
1. Submission of report on anyone field visits related to Aquaculture/Apiculture/ Sericulture/Poultry/ Dairy farm.
2. Study of different types of bees (Queens, Drones and Worker bees).
3. Study of different types of silk moths.
4. Study of different types of pearls.
5. Study of different types of fish diseases.
6. Identification of different types of scales in fishes.
7. Study of different types of fins.

8. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
9. Identification of various types of natural silks.

TEXT BOOKS
1. Sarkar, Kundu and Chaki. (2014) Introduction to Economic Zoology. NCBA Publisher.
2. T.V.R. Pillay (Author), M.N. Kutty (2011) Aquaculture: Principles and Practices, Wiley India Pvt Ltd; Second edition

SUGGESTED READINGS
1. Dhyan Singh Bisht, Apiculture, ICAR Publication.
2. Dunham RA (2004) Aquaculture and Fisheries Biotechnology – Genetic Approaches. CABI publications, U.K.
3. Hafez ESE (1962) Reproduction in Farm Animals. Lea and Fabiger Publishers.
4. Knobil E and Neill JD (2006) The Physiology of Reproduction. Vol.2. Elsevier Publishers, USA.
5. Prost PJ (1962) Apiculture. Oxford and IBH, New Delhi.
6. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi.
7. Srivastava CBL (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.

OR

Project Work

Each student has to undertake a project work under the guidance of a teacher and submit the project report in the form of a thesis. There will be a presentation of the project work before an external examiner.

Generic Elective Paper I

Animal Diversity

Unit 1: Protista, Porifera, Radiata, Aceolomates and Pseudocoelomates
General characters of Protozoa; Life cycle of *Plasmodium,* General characters and canal system in Porifera, General characters of Cnidarians and polymorphism, General characters of Helminthes; Life cycle of *Taenia solium*, General characters of Nemethehelminthes; Parasitic adaptations

Unit 2: Coelomate Protostomes, Arthropoda, Mollusca and Coelomate Deuterostomes

General characters of Annelida, Metamerism, General characters, Social life in insects,General characters of mollusca, torsion in gastropod, pearl formation, General characters of Echinodermata, larval form in Echinodermata.

Unit 3: Protochordata , Pisces, Amphibia
Salient features, Osmoregulation, Migration of Fishes, General characters, Adaptations for terrestrial life, Parental care in Amphibia.

Unit 4: Reptiles, Aves and Mammals
Amniotes, Origin of reptiles, Terrestrial adaptations in reptiles, Origin of birds; Flight adaptations, early evolution of mammals; Primates; Dentition in mammals.

PRACTICAL

1. Study of following specimens:

Non Chordates*: Euglena, Noctiluca, Paramecium, Sycon, ,Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, T. gigas, Limulus, Hermitcrab, Daphnia, Millipede, Centipede*, Beetle, *Chiton, Dentalium, Octopus, Asterias* and *Antedon*.

Chordates: *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper*, model of *Archaeopteryx*, any three common birds-(Crow, duck, Owl), Squirrel and Bat.

2. Study of following Permanent Slides:
Cross section of *Sycon*, Sea anemone and *Ascaris* (male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva
3. Temporary mounts of Septal & pharyngeal nephridia of earthworm.
Unstained mounts of Placoid, cycloid and ctenoid scales.

TEXT BOOKS
1.Kotpal RL. (2016) Modern Textbook of Zoology –Vertebrates; Rastogi Publications – Meerut.
2. Kotpal RL.(2016) Modern Textbook of Zoology –Invertebrates; Rastogi Publications – Meerut.

SUGGESTED READINGS
1. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
2. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
3. Raven, P.H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications, New Delhi.
4. Kardong, K.V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

OR

Insect Vectors and Diseases

Unit 1: Insects, Concept of Vectors, Insects as Vectors

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with reference to. feeding habits, Brief introduction of Carrier and Vectors (mechanical and biological vector),Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity, Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit 2: Dipteran as Disease Vectors
Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly, Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit 3: Siphonaptera and Siphunculata as Disease Vectors
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas, Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse

Unit 4: Hempitera as Disease Vectors
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

PRACTICAL
1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculushumanuscorporis, Phithirus pubis, Xenopsylla cheopis, Cimexlectularius, Phlebotomus argentipes, Musca domestica* through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors.
4**.** Submission of a project report on any one of the insect vectors and disease transmitted.

TEXT BOOKS
    1. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwel
    2. Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK

SUGGESTED READINGS
    1. Mike Service (2012) Medical Entomology for StudentsCambridge University Press; 5th edition.
    2. Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication
5

Generic Elective Paper II

Aquatic Biology

UNIT 1: Aquatic Biomes
Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands,
Streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs

UNIT 2: Freshwater Biology
Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry,
Physico–chemical Characteristics: Light, Temperature, Thermal stratification,
Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen,
Sulphur and Phosphorous

Streams: Different stages of stream development, Physico-chemical, environment, Adaptation of hill-stream fishes.

UNIT 3: Marine Biology
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT 4: Management of Aquatic Resources
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment-BOD and COD.
015
PRACTICAL
1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free, Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from nearby lake/ water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

TEXT BOOKS
1.   Wetzel RG (2001)Limnology: Lake and River Ecosystems, Academic Press; 3rd edition

SUGGESTED READINGS
1.   Anathakrishnan : Bioresources Ecology 3rd Edition
2.   Odum and Barrett : Fundamentals of Ecology, 5th Edition
3.   Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
4.   Trivedi and Goyal : Chemical and biological methods for water pollution studies
5.   Welch : Limnology Vols. I-II

OR

Food, Nutrition And Health

Unit 1: Basic concept of food and nutrition
Food Components and food-nutrients, Concept of a balanced diet, nutrient needs and dietary pattern for various groups, adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

Unit 2: Nutritional Biochemistry:
Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role
Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance
Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions

Unit 3: Health

Introduction to health- Definition and concept of health, Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications, Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention, Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene:

Potable water- sources and methods of purification at domestic level Food and Water borne infections: **Bacterial infection**: Cholera, typhoid fever, dysentery; **Viral infection**: Hepatitis, Poliomyelitis, **Protozoan infection**: amoebiasis, giardiasis; **Parasitic infection**: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention.
Brief account of food spoilage: Causes of food spoilage and their preventive measures
01
PRACTICAL
1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
3. Estimation of Lactose in milk
4. Ascorbic acid estimation in food by titrimetry
5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/ photograph (*Sitophilus oryzae*, *Trogoderma granarium, Callosobruchus chinensisand Tribolium castaneum*): their identification, habitat and food sources, damage caused andcontrol. Preparation of temporary mounts of the above stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups. OR Identify nutrient rich sources of foods **(fruits and vegetables),** their seasonal availability and price OR Study of nutrition labeling on selected foods

TEXT BOOKS
1.   Mudambi, SR and Rajagopal, MV (2018). Fundamentals of Foods, Nutrition and Diet Therapy; Sixth Ed; New Age International Publishers.
2.   Bamji MS, Rao NP, and Reddy V.(2017) Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd., 4th edition

SUGGESTED READINGS
1.   Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
2.   Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
3.   Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO

Generic Elective Paper III

Human Physiology

Unit 1: Digestion and Respiratory Physiology

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (in brief), Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fiber); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

Unit 3: Renal Physiology and Cardiovascular Physiology

Functional anatomy of kidney, Mechanism and regulation of urine formation, Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Unit 4: Endocrine and Reproductive Physiology

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle.

PRACTICAL

1. Preparation of temporary mounts: Neurons and Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

TEXT BOOKS

1. Marieb EN and Hoehn K, (2015) Human Physiology, 10th global edition, Pearson Education, USA.
2. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.

SUGGESTED READINGS

1. Widmaier, E.P., Raff, H. and Strang, K.T. (2008). Vander's HumanPhysiology, XI Edition, McGraw Hill.
2. Kesar, S. and Vashisht, N. (2007). Experimental Physiology, Heritage Publishers.
3. Prakash, G. (2012). Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Company Ltd.
4. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc.

OR

Environment and Public Health

UNIT 1: Environmental hazards
Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT 2: Pollution
Air, water, noise pollution sources and effects, Pollution control; Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Waste Management Technologies
Sources of waste, types and characteristics, Sewage disposal and its management,
Solid waste disposal, biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath

Unit 4 Diseases
Causes, symptoms and control of: Tuberculosis, Asthma, Cholera, Typhoid, Malaria and AIDS

PRACTICAL (Credits 2)
1. To determine pH, Cl, SO_4, NO_3 in soil and water samples from different locations.

TEXT BOOKS
1. Cutter, S.L. (1999) Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Park K (2017) Parks Text Book Of Preventive & Social Medicine, Banarsidas Bhanot Publishers

SUGGESTED BOOKS
1. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff 1996. "Risk Assessment and Management Handbook", McGraw Hill Inc., New York.
2. Kofi Asante Duah 1998 "Risk Assessment in Environmental management", John Wiley and sons, Singapore.
3. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., 2003. Global Environmental Risks, V.N.University Press, New York,
4. Joseph F Louvar and B Diane Louver 1997 Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey.
5. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
6. Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
7. Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.

UNIT 1: Introduction and Techniques in Gene manipulation

Concept and Scope of Biotechnology, Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes, Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors, Construction of Genomic libraries and cDNA libraries, Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium, Phosphate Precipitation method.

UNIT2: Animal cell Culture

Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.
Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays

UNIT 3: Fermentation

Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized, Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization

UNIT 4: Transgenic Animal Technology and Application in Health

Production of transgenic animals: nuclear transplantation, retroviral method,
DNA microinjection method, Dolly and Polly, Development of recombinant Vaccines, Hybridoma technology, Gene Therapy, Production of recombinant Proteins: Insulin and growth hormones.

PRACTICAL

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6.Preparation of competent cells and Transformation of E. coli with plasmid DNA using CaCl2, Selection of transformants on X-gal and IPTG (Optional).
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays.

TEXTBOOKS
1. BD Singh, (2014) Biotechnology: Expanding Horizons, Kalyani Publishers
2. U.Satyanarayan and U Chakrapani, (2014) Biotechnology, Books & Allied Ltd

SUGGESTED READINGS
1. T.A. Brown (2008): Gene cloning and DNA analysis: An Introduction, Blackwell Science.
2. Animal Cell Culture Methods Academic Press
3. P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2017).

4. B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
5. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis, IX Edition, Freeman & Co., N.Y., USA
6. Verma S A, Das S and Singh (2014) A. Laboratory Manual for Biotechnology. S Chand Publication.

OR

Cell and Molecular Biology

Unit 1: Cells and Plasma Membrane
Prokaryotic and Eukaryotic cells, Various models of plasma membrane; Transport across membranes, The Endoplasmic Reticulum; Golgi apparatus; Lysosomes; Structure and function of mitochondria

Unit 2: Nucleus, cell division
Ultra structure of nucleus; Mitosis, Meiosis, Cell cycle and its regulation

Unit 3: Nucleic Acids and DNA Replication
Salient features of DNA double helix; Watson and Crick model of DNA, Structure of RNA, tRNA, DNA Replication in prokaryotes and eukaryotes; Mechanism of DNA replication

Unit 4: Transcription and Translation
Mechanism of transcription in prokaryotes and Eukaryotes, Process of protein synthesis in prokaryotes and translation

PRACTICAL
1. Study of prokaryotic and eukaryotic cell types through permanent slides.
2. Study of mitosis and meiosis through squashing in Grasshopper.
3. Demonstration of transport through cell membrane.
4. Preparation of DNA and RNA models.
5. Demonstration of protein synthesis through models.

TEXT BOOKS
1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

SUGGESTED READINGS
1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008) Molecular Biology of the Cell. 5th Edition. Garland publishing Inc., New York.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni G P (2009) The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
3. Cooper GM and Hausman RE (2009) The Cell: A Molecular Approach. 5th Edition. ASM Press, Washington D.C.
4. S Harisha (2007) Biotechnology procedures and experiments handbook., Infinity Science Press, Hingham
.

ZOOLOGY Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers
Marks per paper - Midterm: 15 marks, End term: 60 marks, Practical: 25 marks,
Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 20 hours (practical)

Semester	Course Opted	Course Name	Credit	Marks
Semester-I	DSC-1(Theory)	Non-Chordata, Chordata, Comparative Anatomy, Evolution and Animal Behaviour	4	75
	DSC-1 (Practical)	Non-Chordata, Chordata, Comparative Anatomy, Evolution and Animal Behaviour	2	25
Semester-II	DSC-2(Theory)	Cell Biology, Genetics, Conservation Biology, Biostatistics and Aquatic Biology	4	75
	DSC-2 (Practical)	Cell Biology, Genetics, Conservation Biology, Biostatistics and Aquatic Biology	2	25
Semester-III	DSC-3(Theory)	Developmental Biology, Immunology, Endocrinology and Microbiology	4	75
	DSC-3 (Practical)	Developmental Biology, Immunology, Endocrinology and Microbiology	2	25
Semester-IV	DSC-4(Theory)	Physiology,Biochmistry and Molecular Biology	4	75
	DSC-4 (Practical)	Physiology,Biochmistry and Molecular Biology	2	25
Semester-V	DSE-1(Theory)	Economic Zoology	4	75
	DSE-1 (Practical)	Economic Zoology	2	25
Semester-VI	DSE-2(Theory),	Wildlife Conservation And Management	4	75
	DSE-2 (Practical)	Wildlife Conservation And Management	2	25
		Total:	**36**	**600**

Discipline Specific Core Paper I

**Non-Chordata, Chordata, Comparative Anatomy, Evolution
and Animal Behaviour**

Unit 1: Non-Chordata
General characteristics and classification up to classes, Locomotion and reproduction in Protozoa, Canal system in sponges, Corals and coral reefs, Life cycle of *Fasciola hepatica*, Metamerism in Annelida, Metamorphosis in insects, Foot in Mollusca. Larval forms in Echinodermata.

Unit 2: Chordata & Comparative anatomy
General characters of Protochordata and Chordata with examples, Parental care in fishes and Amphibia, Poison apparatus and biting mechanism of snakes, Flight adaptation in birds, Dentition in mammals. Structure, functions and derivatives of integument, Alimentary canal and associated glands

Unit 3: Evolution
Lamarckism, Darwinism, Neo-Darwinism, Phylogeny of human, Natural selection, Modes of speciation (Allopatric, Sympatric and Parapatric).

Unit 4: Animal Behaviour
Primary and secondary orientation, Taxes of animals, Social structure in honey bee, Pheromones, Biological clocks.

PRACTICAL
1. Morphology of Paramecium, Binary fission and conjugation in Paramecium.
2. Life stages of *Plasmodium vivax*.
3. Study of *Sycon* (including T.S. and L.S.), Hyalonema, and Euplectella.Temporary mounts of spicules, gemmules, Study of *Obelia, Physalia, Millepora, Aurelia, Ephyra* larva.
4. Study of adult *Fasciola hepatica* Study of adult *Ascaris lumbricoides*
5.*Balanoglossus, Herdmania* and *Branchiostoma*
6. *Torpedo, Notopterus, Mystus, Heteropneustes*, *Hippocampus, Exocoetus, Echeneis, Anguilla,   Tetrodon, Diodon, Anabas* and Flat fish. *Ichthyophis/Ureotyphlus, Necturus, Duttaphrynus, Polypedates, Hyla, Alytes* and *Salamandra.Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja* and *Hydrophis.*

TEXT BOOKS
1. Kotpal RL; Modern Textbook of Zoology – Invertebrates; Rastogi Publications - Meerut; 2016 edition
2. Kotpal RL; Modern Textbook of Zoology –Vertebrates; Rastogi Publications - Meerut; 2016 edition
3. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.
4. R. K. Saxena and Sumitra Saxena (2016). Comparative Anatomy of Vertebrates, Viva Books 2nd edition.
5. Rastogi B.B., (2018). Organic Evolution, MedTech; 3rdedition
6. Mathor Reena (2014) Animal behavior, Rastogi Publication

Discipline Specific Core Paper II

Cell Biology, Genetics, Conservation Biology, Biostatistics and Aquatic Biology

Unit 1: Cell Biology
Prokaryotic and Eukaryotic cells, Plasma membrane, Lysosomes, Mitochondria, Ultra structure of nucleus.

Unit 2: Genetics
Ultrastructure of chromosomes, Sex-linked inheritance, Chromosomal mechanisms of sex determination, Chromosomal and Gene mutation.

Unit 3: Conservation Biology & Aquatic Biology
Importance of conservation, Ex situ and In situ conservation methods, Evaluation and management of wildlife, Wildlife (Protection) Act, 1972,Protected areas (Sanctuaries, National Parks, Biosphere reserves). Physico-chemical condition of water of fish pond, Composite pisciculture, Ornamental pisciculture,

Unit 4: Biostatistics
Measures of central tendency (mean, median and mode), Measures of dispersion (Standard deviation), Hypothesis and testing of hypothesis (chi square test, t test and Z test),Correlation and regression analysis.

PRACTICAL
1.Study various stages of mitosis from permanent slides.
2.Study various stages of meiosis from permanent slides.
3.Preparation of temporary squashing of onion root tip.
4.Study of oral squamous cells.
5.Study of different types of aquatic insects and aquatic weeds.
6.Study of different types of major carps, minor carps and catfishes.
7.Mounting of cycloid and ctenoid scales of fish.

TEXT BOOKS
1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition.
3. GopalRajesh (2011) Fundamentals of Wildlife Management, Natraj Publishers.
4. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
5. Myra Samuels, J. Witmer,A. Schaffner, Statistics for the life sciences, Prentice Halls, Boston, 4th edition, 2012
6. Sarkar, Kundu, Chaki (2016) Introduction to Economic Zoology, New Central Book Agency; New edition edition

Developmental Biology, Immunology, Endocrinology and Microbiology

Unit 1: Developmental Biology
Gametogenesis (Spermatogenesis, Oogenesis), Types of eggs, early development of frog and chick up to gastrulation, Placenta.

Unit 2: Immunology
Cells and organs of the immune system, Antigens, Structure and functions of different classes of immunoglobulin, Vaccines.

Unit 3: Endocrinology
Types of endocrine glands of human body, Classification of hormones and mechanism of hormone action, Structure and function of Pituitary, Thyroid and Gonads.

Unit 4: Microbiology
Structure of a typical bacterium, Structure of bacteriophage, Bacterial and viral diseases of human, Microbes of food, agriculture and industry.

PRACTICAL
1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
2. Temporary preparation of chick embryo.
3. ABO blood group determination.
4. Cleaning of glass wares, Principle and methods of sterilization-moist heat, dry heat and filtration methods.
5. Media preparation: Liquid media, Solid media.
6. Slides of different mammalian endocrine glands.

TEXT BOOKS
1. Tortora GJ, Funke BR, Case CL (2016) Microbiology – an introduction, Pearson Education India; Eleventh edition
2. Abbas KA and Lechtman HA (2003) Cellular and Molecular Immunology. 5th Edition. Saunders Publication, Philadelphia.
3. Gilbert SF (2010) Developmental Biology. 9th Edition. Sinauer Associates, Inc., USA.
4. Hadley, M.E. and Levine J.E. (2007). Endocrinology, 6th Edition. Pearson Prentice-Hall,

Physiology, Biochemistry and Molecular Biology

Unit 1: Physiology I
Digestion, Structural organization, histology and functions of gastrointestinal tract and its associated glands, Mechanical and chemical digestion of food, Respiration: Transport of respiratory gases, Structure of heart and cardiac cycle, Composition and clotting of blood, Blood group.

Unit 2: Physiology II
Excretion in human, Structure of neuron and transmission of nerve impulse, Structure of skeletal muscle and muscle contraction.

Unit 3: Biochemistry I
Structures and properties of important mono-, di- and polysaccharides, Fatty acids, triglycerides and steroids, Amino acids and Proteins. Glycolysis, Citric acid cycle, β-oxidation of saturated fatty acids, Urea cycle.

Unit 4: Molecular Biology
Structure and types of DNA and RNA, DNA replication, Genetic code, Transcription and Translation.

PRACTICAL
1.   Enumeration of red blood cells using haemocytometer.
2.   Estimation of haemoglobin using Sahli'shaemoglobinometer.
3.   Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
4.   Colour tests of functional groups in protein solutions.
5.   Action of salivary amylase under optimum conditions.

TEXT BOOKS

1.   Marieb E.N. and Hoehn K.N. (2009) Human Physiology. Pearson Education Publication , 9th edition
2.   Satyanarayan and Chakrapani , (2017) Biochemistry, Elsevier; Fifth edition.
3.   Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc

Discipline Specific Elective Paper I

Economic Zoology

Unit 1: Bee-keeping and Bee Economy (Apiculture)
Varieties of honey bees, Setting up an apiary: Lang troth's/Newton's hive, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet, Diseases of honey bee, honey extraction techniques, -chemical analysis of honey, Other beneficial products from bee; Visit to an apiculture institute and honey processing Units.

Unit 2: Silk and Silk Production (Sericulture)
Different types of silk and silkworms in India, Rearing of *Bombyx mori*, Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons, Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles, and their management; Silk reeling techniques and Quality assessment of silkfibre.

Unit 3: Aquaculture I
Brood stock management; Induced breeding of fish, Management of hatchery of fish, Management of nursery, rearing and stocking ponds, Preparation and maintenance of fish aquarium, Preparation of compound diets for fish, Role of water quality in aquaculture, Fish diseases: Bacterial, viral and parasitic, Preservation and processing of harvested fish, Fish by-products. Prawn farming, Culture of crab, Pearl culture and Culture of air breathing fishes.

Unit 4: Dairy and Poultry Farming
Introduction, Indigenous and exotic breeds, Rearing, housing, feed and rationing, Commercial importance of dairy and poultry farming, Varietal improvement techniques, Diseases and their management, Dairy or poultry farm management and business plan, Visit to any dairy farm or Poultry farm.

* Submission of report on anyone field visits mentioned above.

PRACTICAL
1. Study of different types of bees (Queens, Drones and Worker bees).
2. Study of different types of silk moths.
3. Study of different types of pearls.
4. Study of different types of fish diseases.
5. Identification of different types of scales in fishes.
6. Study of different types of fins.
7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
8. Identification of various types of natural silks.

TEXT BOOKS
1. Sarkar, Kundu and Chaki. (2014)Introduction to Economic Zoology. NCBA Publisher.
2. T.V.R. Pillay (Author), M.N. Kutty (2011) Aquaculture: Principles and Practices, Wiley India Pvt Ltd; Second edition

Discipline Specific Elective Paper II

Wildlife Conservation And Management

Unit 1: Wildlife: Values of wildlife, positive and negative; Our conservation ethics, Importance of conservation, Causes of depletion and World conservation strategies. Habitat analysis; Management of habitats; Biological parameters: food, cover, forage, browse and cover estimation, Standard evaluation procedures: remote sensing and GIS

Unit 2: Population estimation: Population density, Natality, Birth rate, Mortality, fertility Schedules and sex ratio computation, Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method

Unit 3: National Organizations involved in wildlife conservation, Wild life Legislation: Wildlife (Protection) Act, 1972, its amendments and implementation, Management planning of wildlife in protected areas, Estimation of carrying capacity, Eco tourism/wildlife tourism in forests, Concept of climax persistence.

Unit 4: Management of excess population & translocation, Bio- telemetry, Care of injured and diseased animal, Quarantine and common diseases of wild animal, Protected areas National parks & sanctuaries, Community reserve, Important features of protected areas in India, Tiger conservation: Tiger reserves in India and Management challenges in Tiger reserve.

PRACTICALS
1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna.
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).

TEXT BOOKS
1. Gopal Rajesh (2011) Fundamentals of Wildlife Management, Natraj Publishers.
2. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

OPTIONAL FOR SECC II PAPER

SKILL ENHANCEMENT COURSE (SECC II Option I)

Apiculture

Unit 1: History – Biology and classification of honey bee species of honey bees, Social Organization of honey bee colony.

Unit 2: Bee hive, Flora for apiculture, Selection of bees for apiculture, Method of bee Keeping and Indigenous method of extraction of honey.

Unit 3: Modern methods of apiculture, Appliances for modern method, Products of bee keeping: Honey, Bee wax, Chemical composition and economic importance of honey bee wax.

Unit 4: Diseases of honey bee and control measures, Bee enemies, Bee keeping industry, Modern method in employing honey bees for cross pollination in horticultural gardens.

TEXT BOOKS:

1. Abrol, D.P. (2013) Beekeeping : A Compressive Guide To Bees And Beekeeping, Scientific Publishers, India
2. Singh S. (1982) Beekeeping in India, Indian Council of Agricultural Research, New
3. Delhi.

SKILL ENHANCEMENT COURSE (SECCII Option II)

Aquarium Fish Keeping

Unit 1: The potential scope of aquarium Fish Industry as a cottage Industry, Exotic and endemic species of aquarium Fishes, Food and feeding of aquarium fishes, Use of live fish feed organisms, Preparation and composition of formulated fish feeds.

Unit 2: Common characters and sexual dimorphism of fresh water and marine aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.

Unit 3: Live fish transport, Fish handling, packing and forwarding techniques, General aquarium maintenance, budget for setting up an aquarium fish farm as a cottage industry.

Unit 4: Health education in India, WHO programmes, Government and voluntary Organizations and their health services, Precautions, First Aid and awareness on sporadic diseases.

TEXT BOOKS
1. Srivastava CBL (2006) Fishery Science and Indian Fisheries. KitabMahal publications, India.
2. Gina Sandford (2003) Aquarium Owner's Manual, Dorling Kindersley; 2Rev Ed edition

SKILL ENHANCEMENT COURSE (SECC Option III)

Medical Diagnostics

Unit 1: Introduction to Medical Diagnostics and its Importance
Diagnostic methods used for analysis of Blood, Blood composition, Preparation of blood smear and Differential Leucocyte Count(D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte, Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.).

Unit 2: Diagnostic Methods Used for Urine Analysis
Urine, Composition of urine, Urine Analysis: Physical characteristics; Abnormal constituents of urine.

Unit 3:Non-infectious Diseases and Infectious Diseases
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using
Glucometer/Kit, Commercial diagnostic kits for identification of infectious diseases. Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis.

Unit 4: Tumours
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

TEXT BOOKS
1. Vinay Kumar, Abul K. Abbas , Jon C. Aster (2014) Robbins and Cortan, Pathologic Basis of Disease, Elsevier India; 1 edition
2. Godkar P.B. and Godkar D.P. (2005) Textbook of Medical Laboratory Technology, Vol. I & II, Bhalani Publishing House.

SUGGESTED READINGS
1. Guyton A.C. and Hall J.E. Guyton & Hall Physiology Review, Saunders; 3 edition (13 July 2015)
2. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
3. Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis forTraining Courses
4. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S.
5. Chand and Co. Ltd.

SKILL ENHANCEMENT COURSE (SECC Option IV)

Research Methodology

Unit 1: Foundations of Research
Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs applied.

Unit 2: Research Design
Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

Unit 3: Data Collection, Analysis and Report Writing
Observation and Collection of Data-Methods of data collection- Sampling, Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis, writing, Preparation of Tables and Bibliography. Data Presentation using digital technology.

Unit 4: Ethical Issues
Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

TEXT BOOKS
1. Nicholas Walliman, (2017) Research Methods: The Basics:Routledge
2. C.R.Kothari and Gaurav Garg (2019) Research Methodology, New Age International.

SUGGESTED READINGS
1. Anthony, M, Graziano, A.M. and Raulin, M.L. (2009) Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, , Universal Law publishing
3. Coley, S.M. and Scheinberg, C.A. (1990) "Proposal writing". Stage Publications.

SKILL ENHANCEMENT COURSE (SECC Option V)

Sericulture

Unit 1: Biology of Silkworm
Life cycle of *Bombyx mori*, Structure of silk gland and secretion of silk, Sericulture: Definition, history and present status; Silk route, Types of silkworms, Distribution and Races, Exotic and indigenous races, Mulberry and non-mulberry Sericulture.

Unit 2: Rearing of Silkworms
Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances, Disinfectants: Formalin, bleaching powder, RKO, Silkworm rearing technology: Early age and Late age rearing, Types of mountages, Spinning, harvesting and storage of cocoons.

Unit 3: Pests and Diseases
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates, Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial, Control and prevention of pests and diseases.

Unit 4: Entrepreneurship in Sericulture
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various, sericulture centers.

TEXT BOOKS
1. P. Venkatanarasaiah (2013) Sericulture, APH Publishing
2. S.R. Ullal and M.N. Narasimhanna (1987), Handbook of Practical Sericulture: CSB, Bangalore

SUGGESTED READINGS

1.   M. S. Jolly, Appropriate Sericultural Techniques; (Ed., Director,) CSR & TI, Mysore.
2.   M. N. Narasimhanna (1988), Manual of Silkworm Egg Production;, CSB, Bangalore.
3.   K. Sengupta (1989) A Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore.
4.   S. Krishnaswamy (1986) Improved Method of Rearing Young age silkworm;reprinted CSB,Bangalore.

Part of syllabus (ZOOLOGY B.Sc.) to be covered in Refresher Course

Theory

1. Linear and Y-shaped food chains
2. Energy flow through the ecosystem
3. Ecology in Wildlife Conservation and Management.
4. Laws of limiting factors
5. Gause's Principle with laboratory and field examples
6. Hypothesis and hypothesis testing (Chi-square test, t- test)
7. Global warming and Climate change
8. Impacts of environmental disturbances
9. Biodiversity patterns and global biodiversity hot spots; India as a mega-biodiversity nation
10. Solid waste management: Control measures of urban and industrial wastes
11. Convention on Biological Diversity (CBD)
12. Mitochondrial Respiratory Chain
13. Chemi-osmotic hypothesis
14. Cell signaling
15. Origin of chordates and Tetrapoda (Evolution of terrestrial ectotherms)
16. Adaptive radiation in mammals
17. Plate tectonic and Continental drift theory
18. **Distribution of vertebrates in different realms**
19. Ossification, bone growth and resorption
20. Neural receptors and transmission
21. Hypothalamus-Pituitary & Gonadal axis
22. Mechanism of hormone action
23. Structural organization of Proteins
24. Hypo-Hyperchromaticity of DNA
25. Enzyme kinetics
26. Respiratory pigments
27. Regulation of water and acid-base balance
28. Haemoglobin and haemopoiesis
29. Cardiac cycle
30. Biological oxidation reduction reactions
31. Oxidative Phosphorylation
32. Electron Transport System
33. DNA Damage & Repair
34. Regulation of transcription and translation
35. RNA editing
36. Operon concept
37. Gene silencing
38. RNA interference
39. Polygenic inheritance
40. Chromosome mapping

41. Molecular mechanisms of recombination
42. Detection of mutations
43. Molecular mechanism of sex determination in *Drosophila* and Man
44. Transposons
45. Cell-Cell interaction
46. Pattern formation
47. Differential gene expression
48. Metamorphosis and Regeneration
49. Teratogenesis
50. *In vitro* fertilization
51. Stem cell
52. Natural selection
53. Genetic drift
54. Species concept and Speciation
55. Phylogenetic trees
56. Insect vectors borne diseases and their control
57. RNA world & origin of life
58. Extinctions
59. Hardy-Weinberg Law
60. Coral reefs diversity and their role in ecosystem
61. Origin and morphometry of lakes
62. Adaptation of hill-stream fishes.
63. Eutrophication and management of aquatic resources and conservation (legislations), Sewage
64. Nutritional Biochemistry
65. Life style related diseases
66. Social health problems
67. Food spoilage and their preventive measures
68. Environmental hazards
69. Effect of climate change on public health
70. Biomedical waste handling and disposal
71. Nuclear waste handling and disposal
72. Waste from thermal power plants
73. Cloning Vectors
74. Genomic libraries and cDNA libraries
75. Cloning in mammalian cells, Integration
76. Animal cell culture and organ culture
77. DNA sequencing
78. DNA Fingerprinting and DNA microarrays
79. Ttransgenic animals
80. Development of recombinant Vaccines
81. Gene Therapy
82. Artificial beehives and cross pollination
83. Aquarium Fish Industry

84. Hypertension
85. Commercial diagnostic kits
86. Research Design
87. Technical Reports and Thesis writing
88. Intellectual property Rights and Patent law
89. Plagiarism
90. Entrepreneurship in Sericulture
91. Behaviour as a basis of evolution
92. Social Behaviour in Honey bee
93. Biological clocks, and Circadian rhythms
94. Restriction enzymes
95. DNA Finger Printing
96. Transgenic animals
97. Molecular diagnosis of genetic diseases
98. Cells of the Nervous system
99. Neurotransmitters
100. Neurodegenerative diseases
101. Psychological disorders
102. MHC molecules
103. Therapeutics Cytokines
104. Complement System
105. Hypersensitivity
106. Advances in vaccine production
107. Sustainable aquaculture
108. Census methods in wildlife
109. Common diseases of wild animals
110. Eco tourism
111. Bee Economy
112. Dairy or poultry farm management and business plan
113. Developing Projects for students

Practical
1. Examination of pond water collected from different places for diversity in protista.
2. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
3. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
4. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
5. Preparation of permanent slide to demonstrate: DNA by Feulgen reaction; DNA and RNA by MGP; Mucopolysaccharides by PAS reaction; Proteins by Mercuric bromophenol blue/Fast Green
6. Microtomy: Preparation of permanent slides/photographs/computer models of any five types of mammalian (Goat/rat,etc) tissues
7. Paper chromatography of amino acids.

8. Effect of pH, temperature and inhibitors on the action of salivary amylase./Urease /acid or alkaline phosphatases
9. Demonstration of proteins separation by SDS-PAGE.
10. Determination of ABO Blood group
11. Estimation of total protein in given solutions
12. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
13. To study the enzymatic activity of Trypsin / Lipase.
14. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
15. Study of Polytene chromosomes from *Chironomous* / *Drosophila* larvae
16. Preparation of liquid culture medium (LB) and raise culture of *E. coli*
17. Study of Mendelian laws and gene interactions.
18. Linkage maps based on data from conjugation, transformation and transduction.
19. Linkage maps based on data from *Drosophila* crosses.
20. Study of human karyotype (normal and abnormal).
21. Pedigree analysis of some human inherited traits.
22. Study of homology and analogy from suitable specimens
23. Study and verification of Hardy-Weinberg Law by chi square analysis
24. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
25. Determine the area of a lake using graphimetric and gravimetric method.
26. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
27. Estimation of Lactose in milk
28. Ascorbic acid estimation in food by titrimetry
29. Estimation of Calcium in foods by titrimetry
30. Preparation of temporary mounts: Neurons and Blood film.
31. Preparation of genomic DNA from *E. coli*/animals/ human.
32. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays.
33. Study of mitosis and meiosis through squashing in Grasshopper.
34. Plasmid DNA isolation (pUC 18/19) from *E. coli*
35. Restriction digestion of plasmid DNA / Lambda Phage DNA
36. Construction of circular and linear restriction map from the data provided.
37. Estimation of plasma level of any hormone using ELISA
38. Observation and quantitation of *Drosophila* photoreceptor neurons in healthy and diseased condition.
39. Nerve Cell preparation from the spinal cord.
40. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
41. Human vaginal exfoliate cytology.
42. Sperm count and sperm motility in rat
43. Demonstration of ELISA.
44. Demonstration of Bone marrow smears to study Immune cells.
45. Demonstration of different field techniques for flora and fauna.
46. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

List of instruments/equipments

SL No	Name of the equipment
1	Students' Compound Microscope
2	Stereo Microscope
3	Haemocytometer
4	pH Meter
5	UV-Visible Spectrometer
6	Bench Top Centrifuge
8	Paper Chromatography Unit
9	Digital Weighing balance
10	Laminar Airflow
11	BOD Incubator
12	Refrigerator
13	Hot Air Oven
14	Autoclave
15	Magnetic Stirrer with Hot Plate
16	Microtome
17	Gel electrophoresis unit with accessories
18	Trans illuminator
19	Water bath

STATE MODEL SYLLABUS FOR
UNDER GRADUATE
COURSE IN EDUCATION
(Bachelor of Arts Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course structure of UG Education Honours

Semester	Course	Course Name	Credits	Total marks
I	AEC-I	AEC-I	04	100
	C-I	Educational Philosophy	04	75
	C-I Practical		02	25
	C-II	Educational Psychology	04	75
	C-II Practical		02	25
	GE-I	GE-I	04	75
	GE-I Practical		02	25
			20	
II	AEC-II	AEC-II	04	100
	C-III	Educational Sociology	04	75
	C-III Practical		02	25
	C-IV	Changing Pedagogical Perspective	04	75
	C-IV Practical		02	25
	GE-II	GE-II	04	75
	GE-II Practical		02	25
			20	
III	C-V	Educational Assessment and Evaluation	04	75
	C-V Practical		02	25
	C-VI	Educational Research	04	75
	C-VI Practical		02	25
	C-VII	Statistics in Education	04	75
	C-VII Practical		02	25
	GE-III	GE-III	04	75
	GE-III Practical		02	25
	SEC-I	SEC-I	04	100

Semester	Course	Course Name	Credits	Total marks
			26	
IV	C-VIII	History of Education in India	04	75
	C-VIII Practical		02	25
	C-IX	Curriculum Development	04	75
	C-IX Practical		02	25
	C-X	Guidance and Counseling	04	75
	C-X Practical		02	25
	GE-IV	GE-IV	04	75
	GE-IV Practical		02	25
	SEC-II	SEC-II	04	100
			26	
Semester	Course	Course Name	Credits	Total marks
V	C-XI	Development of Education in Odisha	04	75
	C-XI Practical		02	25
	C-XII	Information And Communication Technology in Education	04	75
	C-XII Practical		02	25
	DSE-I	A. Pedagogy of language (English) B. Pedagogy of language (Odia)	04	75
	DSE-I Practical		02	25
	DSE-II	A. Pedagogy of Social Sciences B. Pedagogy of Mathematics	04	75
	DSE-II Practical		02	25
			24	
VI	C-XIII	Contemporary Trends and Issues in Indian Education	04	75
	C-XIII Practical		02	25
	C-XIV	Educational Management and Leadership	04	75
	C-XIV Practical		02	25
	DSE-III	A. Policy and Practices in School Education in India	04	75

DSE-III Practical	B. Policy and Practices in Higher Education in India	02	25
DSE-IV	Inclusive Education (Theory)	04	75
DSE-IV Practical		02	25
OR			
DSE-IV	Dissertation	06	100*
		24	

EDUCATION

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers
Generic Elective for Non Education students – 4 papers. -

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical : 25 marks
 Total – 100 marks
Credit per paper – 6

Core Paper I

EDUCATIONAL PHILOSOPHY

 Learning Objectives:

On completion of this course, the learners shall be able to:
* State and analyze the meaning of education and form own concept on education
* Explain philosophy as the foundation of education
* Analyze aims of education
* Describe the essence of different formal philosophies and draw educational implications
* Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

 (i) Etymological meaning of education
 (ii)Narrower and broader meaning of education, Lifelong Education
(iii)   Aims of Education- Individual and Social Aims of Education
(iv)   Meaning and nature of philosophy
(v)   Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications
(vi)   Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

 (i) Idealism, Naturalism, Pragmatism with reference to: Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

 (i) Common Characteristics of Indian Philosophy
 (ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

    Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

 UNIT 4: Educational Thought of Western and Indian Thinkers

 (i) Plato

(ii) Dewey

(iii) Gopabandhu Das

(iv) Gandhi

(v) Tagore

(vi) Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both the of internal core -1 internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education.* New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).

- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education.* Delhi: PHI Learning Pvt. Ltd.

- Taneja, V.R. (2000). *Educational thought and practice.* New Delhi: Sterling Publishers Pvt. Limited.

Reference Books
- Aggrawal, J.C. (2013). *Theory and principle of education.* New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al*. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT.
- Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1916/1977). Democracy and education. New York: MacMillan.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul.

Radhakrishnan, S. Indian philosophy Vol. I and Vol. II

- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt. Limited.

Core Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives:

On completion of this course, the learners shall be able to:
- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Describe the theoretical perspectives of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics of growth and development during childhood and adolescence.
- Specify the contexts and factors influencing development.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii) Application of educational psychology in understanding learner
(iv) Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas: Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education

(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.

(iii) Measurement of intelligence- individual and group test, verbal, non-verbal test

(iv) Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning

(ii) Theories of learning with experiment and educational implications-

(iii) Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning

(iv) Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality

(ii) Theories- type theory and trait theory

(iii) Assessment of personality- subjective, objective and projective techniques

(iv) Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.

(v) Adjustment mechanism: Concept and Types

PRACTICAL

- Administration and interpretation of any psychological test relating to intelligence or personality

N.B: It will be evaluated by both the Internal and External examiners.

Text Books
- Woolfolk, A. (2015). *Educational psychology (9th Ed.).* New Delhi: Pearson Publication
- Chauhan, S.S. (2010). *Advanced educational psychology.* New Delhi: Vikas Publishing House Pvt. Ltd.
- Mangal, S.K. (2002). *Advanced educational psychology.* New Delhi: Prentice Hall of India.

Reference Books
- Arnett, J. (2007). Adolescence and emerging adulthood: A cultural approach. (3rd Edn.). Upper Saddle River, N.J.: Pearson.
- Berk, Laura E. (2011). Child development (9th Edn.). New Delhi: Prentice Hall of India.
- Flavell, J.H. (1963). The developmental psychology of Jean Piaget. New York: Van

Nostrand
- Hurlock, E. B. (1980). Developmental psychology: All span approach. New York: McGraw Hill Book.
- Hurlock, E.B. (1980). Child development (6th Edn.). Tokyo: McGraw-Hill, Kogakusha Ltd.
- Hurlock, E.B. (2007). Child growth and development. New York: McGraw Hill.
- Kail, Robert V (2011). Children and their development (6th Edition). Englewood Cliffs, N.J: Prentice Hall.
- Stephens, J. M.; Evans, E. D.(1973). Development and classroom learning: An introduction to educational psychology. New York: Holt, Rinehart and Winston

Core Paper III

EDUCATIONAL SOCIOLOGY

Learning Objectives:
On completion of this course, the students shall :
- State the relationship between education and society.
- Understand the meaning of Educational Sociology and function of education as a social system.
- State different agencies of education and their functions.
- Justify the importance of education for social change.
- Describe the role of education in modernization and globalization.
- Describe the function of education to ensure equality and equity.

UNIT 1: Education and Society

  (i)   Relationship between education and society, school as a miniature society
  (ii) Educational Sociology- Concept, nature, scope and importance;
  (iii) Relationship between education and sociology.
  (iv) Education as a process of Socialization.
  (v)   Education and Politics, Education and Economic Development

UNIT 2: Agencies of Education

  (i)   Family- Importance, functions and role for education and socialization of the children
  (ii) School - Importance, functions and role for education and socialization of the children
  (iii) Society- Importance, functions and role for education and socialization of the children
  (iv) Mass Media- Importance, functions and role for education and socialization of the children

UNIT 3: Education, Social change and Modernization

  (i)   Concept of social change and factors affecting Social Change
  (ii) Education as an instrument of social change and social control
  (iii) Concept and Attributes of modernization

(iv) Education for accelerating the process of modernization

(v) Impact of Globalization on Education

UNIT 4: Equalization of Educational opportunities for ensuring equity and Inclusion

(i) Concept of equality, equity and inclusion: its educational implication

(ii) Ensuring equality in the Education of SC and ST

(iii) Education for Women Empowerment

(iv) Inclusive Education with reference to children with special needs(CWSN)

PRACTICAL

Field Visit: Study of a social unit (Home/School/Village/slum) and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books
- Mathur, S. S. (2000). *A sociological approach to Indian education.* Agra : Vinod Pustak Mandir.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson.
- Bahttacharya, S. (2006). Sociological Foundation of Education. New Delhi: Atlantic

Reference Books
- Ravi, Samuel.S.(2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.

- Safaya, R.N. & Shaida, B.D. (2010), *Modern theory and principles of education*. New Delhi: Dhanpati Publising Company Pvt. Ltd.

- Aggrawal, J.C.(2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.

- Anand, C.L. et.al. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.

- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.

- Dewey, John (1916/1977). Democracy and education. New York: MacMillan.

- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.

- Dewey, John (1997). Experience and education. New York: Touchstone.

- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.

- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.

  Ministry of Education (1966).   Education and national development. New Delhi: Ministry of Education, Government of India.

- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.

  Saraswati, T.S. (Ed.) (1999).Culture, socialization and human development. Theory, research and applications in India. New Delhi: Sage Publication.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling

  Publishers Pvt. Limited.

<div align="center">

Core Paper IV

CHANGING PEDAGOGICAL PERSPECTIVE

</div>

Learning Objectives:

On completion of this course, the students shall:
- Explain the concept of pedagogy
- Differentiate pedagogy from other allied concepts
- Explain different teaching task with example
- Establish relationship between teaching and learning
- List out different approaches and methods of teaching
- Prepare a lesson plan following different designs

UNIT 1: Concept of Teaching and Learning

(i) Meaning and definition of teaching and learning
(ii) Relationship between teaching and learning
(iii)Variables involved in teaching task: independent, dependent and intervening
(iv)Phases of teaching: Pre- active, inter- active and post- active
(v) Levels of teaching: memory, understanding and reflective
(vi)Lesson plan design- The Herbartian steps, 5 E and ICON design model

UNIT 2: Theories of Teaching

(i) Meaning and nature of teaching theory
(ii) Types of teaching theories:
(iii)Formal theories of teaching- communication theory of teaching
(iv)Descriptive theories of teaching– Gagne's hierarchical theory of instruction and Bruner's cognitive theory of instruction
(v) Normative theories of teaching - Mitra's psychological theory of teaching and Clarke's general theory of teaching

UNIT 3: Principles and maxims of teaching

(i) General principles of teaching
(ii) Psychological principles of teaching
(iii)Maxims of teaching
(iv)Core teaching skills: Introducing the lesson, explaining, illustrating with examples, stimulus variation, and reinforcement, questioning, probing questions, closure.

UNIT 4: Approaches and methods of Teaching

(i) Concept of approach, method, strategy and techniques
(ii) Methods of teaching: inductive-deductive, analytic- synthetic, problem solving and project
(iii)Shift in focus from teaching to learning- constructivist approach to learning

PRACTICAL
- Preparation of rating scale/ checklist /observation schedule to evaluate classroom teaching and reporting.

  NB: It will be evaluated by both the internal and external examiners

Text Books

- Kochar, S.K.(2011). *Methods and Techniques of teaching*. Sterling Publisher Pvt. Ltd., New Delhi
- Chauhan, S.S.(1995). *Innovations of teaching learning process*. Vikash Publishing House, New Delhi
- Sharma, R.A.(1986).*Technology of Teaching*. International Publishing House, Meerut.

Reference Books

- Aggarwal, J.C.(1995). *Essentials of Educational Technology*. Vikash Publishing House, New Delhi

- Walia, J.S. (2013). *Educational Technology*. Jalandhar, Punjab: Ahim Publications.

- Mangal, S.K. and Mangal, U.(2010) *Essentials of Educational Technology*, New Delhi, PHI Learning Pvt. Limited

- Mangal, S.K.(1988) *Foundations of Educational Technology,* Ludhiana, Tandan Publications

- Nageswar Rao, S., Sreedhar, P. & Rao, B.(2007). *Methods and techniques of teaching*, Sonali Publications, New Delhi

- Oliver,R.A. (1963) *Effective teaching*, JM Dent & Sons

- Pathak, R.P. & Chaudhary, J. (2012) *Educational Technology*, Pearson, New Delhi

- Ryburn, W.M.(1955) *Principles of Teaching*, Geoffrey Cembridge, OUP

- Sampath,K, Pannir Salvam,A.,& Santhanam, S.(1981) *Introduction to Educational Technology*, Sterling Publisher, New Delhi

Core Paper V

EDUCATIONAL ASSESSMENT AND EVALUATION

Learning Objectives:

On completion of this course, the students will.

- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics .

UNIT 4: Characteristics of a good Test

(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability

(iii) Objectivity- concept and methods of estimating objectivity

(iv) Usability- concept and factors ensuring usability

PRACTICAL

- Construction of Unit test on a school subject based on blueprint and reporting.

  NB: It will be evaluated by both Internal and External examiners.

Text Books
- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
- Goswami, M. (2011). *Measurement and evaluation in psychology and education*. Hyderabad: Neelkamal Publishers
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books
- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES*. Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and assessment. an introduction to the tests and measurement*. California: Mayfield Publishing Co.
- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize student learning*. Thousand Oaks, California: Corwin Press
- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation*. Boston: Allyn and Bacon.
- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching*. London: Merrill Prentice Hall.
  Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction*. Boston: Allyn and Bacon
- Mohan, R. (2016). *Measurement evaluation and assessment in education*. Delhi: PHI Learning Pvt. Ltd.
- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms*. New Delhi: NCERT
- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement*. Boston: Houghton Miffin.

<center>

Core Paper VI

EDUCATIONAL RESEARCH

</center>

Learning Objectives:

On completion of this course, the student will:
- Describe nature, scope and limitation of educational research.
- Understand different types and methods of educational research.
- Explain sources from where knowledge could be obtained.
- Describe the process of research in education.
- Analyze research design in education.
- Illustrate procedure of collecting and analyzing data.
- Prepare the research report.

UNIT 1: Concept and Types of Educational Research

(i) Concept and nature of research
(ii) Meaning, nature and scope of educational research
(iii) Types of research by purpose- Fundamental, Applied and Action
(iv) Types of research by approach- Quantitative and Qualitative

UNIT 2: Design of Research and preparation of research proposal

(i) Steps of Research
(ii) Review of Related Literature; and identification of problem
(iii) Hypothesis: Meaning, Types, Sources and Characteristics of hypothesis
(iv) Concept of population and sample
(v) Sampling procedures- Probability and Non-Probability
(vi) Tools and techniques for data collection(i.e. questionnaire, interview, observation and Procedure of data collection , Preparation of research proposal

UNIT 3: Methods of Research

Meaning nature and steps of:
(i) Survey method
(ii) Case-study method
(iii) Historical research
(iv) Experimental research

UNIT 4: Writing Research Report

(i) Data analysis and interpretation in research.
(ii) Steps for reporting research
(iii) Reporting style (APA Style)
(iv) Plagiarism checking
(v) Referencing Style (APA Style): Bibliography, Webliography

PRACTICAL

- Preparation of a Research Proposal on any Educational Topic (Issues/ Trends/ Problems/ Psychological Topics)

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Best J.W. and Kahn, J. V. (2006). *Research in education (*9th Ed.) New Delhi: Pearson Education Inc.
- Kaul, L. (1984). *Methodology of educational research.* New Delhi: Vikas Publication
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books
- Nanda, G.C. & Khatoi, P.K. (2012). *Fundamentals of Educational Research and Statistics.* New Delhi: Ludhiana.
- Gay, L.R. (1990). *Educational research-competencies for analysis and application* (3rd Ed.), Macmillan Publishing Company, New York Ary, D., Jacobs, L. C., &Razavieh, A. (2002). *Introduction to research in education* (6th Ed.). Belmont, CA: Wadsworth/Thomson Learning.
- Bhandarkar, P.L. and Wilkinson,T.S. (2010). *Methodology and techniques of social research*. Himalaya Publishing House, New Delhi.
- Creswell, J.W. (2014). *Educational research-planning, conducting and evaluating quantitative and qualitative research (4th Ed.).* New Jersey, USA: Pearson Education Inc. (Indian Reprint available at PHI Learning Pvt.Ptd.)
- Kerlinger, F.N. (1973). *Foundation of behavioral research.* New York: Holt Rinehart & Winston.
- Rao, U. (2007). *Action research.* Himalaya Publishing House, New Delhi.
- Borg, W.R. & Gall, M.D. (1989). *Educational research: An introduction*. New York: Longman.
- Corey, S. M. (1953), *Action research to improve school practice*, New York: Teachers College Press
- Johnson, B. & Christensen, L. (2008). *Educational research: quantitative, qualitative, and mixed approaches*. London: Sage Publication
- McMillan, J.H. & Schumacher, S. (1989). *Research in Education- a Conceptual Introduction.* New York: Harper Collins.
- Mertler, C.A. (2006). *Action research: teachers as researchers in the classroom*. London: Sage Publication

Core Paper VII

STATISTICS IN EDUCATION

Learning Objectives:

On completion of this course, the students will:
- Describe the importance of statistics in education.
- Organise and represent educational data in tabular and graphical form.
- Compute and use various statistical measures of average, variation and bi-variate distribution to in analysis and interpretation of educational data.
- Describe the concept and importance of normal probability curve and interpret test scores in using normal probability curve.

- Understand the divergence of data from normality.

UNIT 1: Educational Statistics

(i) Educational Statistics-Meaning, Nature, Scope and Uses
(ii) Organization of Data: Frequency Distribution, Cumulative Frequency Distribution
(iii) Graphical Representation of Data (Histogram, Frequency polygon , Ogive and Pie-Diagram)

UNIT 2: Measures of Central Tendency and Variability

(i) Mean, Median and Mode- concept, computational process, uses and limitations
(ii) Range, Average Deviation, Quartile Deviation and Standard Deviation- Concept, computational process, uses and limitations

UNIT 3: Co-relational Statistics

(i) Meaning and types of Correlation
(ii) Computation of Coefficient of Correlation by Rank Difference Method; Product Moment Method

UNIT 4: Normal Probability Curve and Divergence from Normality

(i) Normal Probability Curve- concept, properties and applications
(ii) Skewness and Kurtosis
(iii) Interpretation of Derived scores: Z- score and T- score

PRACTICAL
- Analysis of Achievement Data of a particular class and Reporting

  NB: It will be evaluated by both Internal and External examiners.

Text Books
- Aggarwal,Y.P.(2009).*Statistical methods: concepts, application and computation*.New Delhi: Sterling Publishers Pvt. Ltd*.*
- Garrett, H.E. (1971). *Statistics in psychology and education.* New Delhi: Paragon International Publisher
- Mangal, S.K. (2008). *Statistics in education and psychology*. New Delhi: Prentice-Hall of India Private Limited

Reference Books
- Ferguson, G.A.(1971). *Statistical analysis in psychology and education.* Kogakusha, Tokyo: McGraw-Hill
- Guilford, J.P. &Fruchter, B. (1981). *Fundamental statistics in psychology and education.* New York: McGraw Hill
- McCall, R. (1993). *Fundamental statistics for the behavioral Science.* New York: Harcourt Brace
- Ravid, Ruth. (2000). *Practical statistics for education*. New York: University Press of America.

- Seigel. S. & Castel Ian N.J. (1988). *Non-parametric statistics for the Behavioral Science.* Singapore: Graw- Hill Book Co.

Core Paper VIII
HISTORY OF EDUCATION IN INDIA

Learning Objectives:

On completion of this course, the student will
- Understand the development of education in India during ancient period, medieval period and pre-independence period.
- Describe the development of education in India during post-independence period.
- Describe major recommendations of different policies and committee reports on education in India.

UNIT 1: Education during Ancient Period

(i) Features of Vedic period with special reference to aims, curriculum and methods of teaching
(ii) Features of Buddhist period with special reference to aims, curriculum and methods of teaching
(iii) Relevance of Gurukul system and Buddhist centers of learning
(iv) Ancient seats of Learning

UNIT 2: Education during Medieval Period

(i) Features of education during Medieval Period with special reference to aims, curriculum and methods of teaching
(ii) Educational institutions during Muslim period, important centers of education.
(iii) Relevance of Islamic period

UNIT 3: Education during pre-independence period

(i) Charter's Act(1813)
(ii) Maculay's Minute(1835)
(iii) Wood's Despatch (1854)
(iv) Indian Education Commission(1882)
(v) Calcutta University Commission(1917)
(vi) Hartog committee(1929)

UNIT 4: Education during post-independence period

Major recommendations of the following commissions and committees relating to the aims of education and curriculum:
(i) University Education Commission (1948)
(ii) Major recommendations of Secondary Education Commission (1954)
(iii) Major recommendations of Education Commission (1966)
(iv) National Policy on Education (1986), revised in 1992

PRACTICAL

- Study on implementation of NPE(1986) in respect of recommendations for elementary level

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggrawal, J.C.(2010). *Landmarks in the history of modern Indian education*. New Delhi: Vikash Publishing Pvt Ltd.
- Dash, B.N. (1911). *Development of education in India*. New Delhi: Ajanta Prakashan
- Das, K.K. (1993). *Development of education in India*. New Delhi: Kalyani Publishers.

Reference Books

- Naik, J.P. & Narullah, S. (1996). *A student's history of education in India.*New Delhi: Mc Millan India Ltd
  Rawat, P.L. (1989). *History of Indian education* New Delhi: Ram Prasad & Sons.
- Govt. of India. (1992, 1998). National policy on education, 1986 (As modified in 1992). Retrieved from http://mhrd.gov.in/sites/upload_files/mhrd/files/NPE86-mod92.pdf
- Keay, F.E. & Mitra, Sukumar (1978). A history of education in India. New Delhi: Oxford University Press.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ministry of Human Resource Development (2004).Learning without Burden: Report of the National Advisory Committee. New Delhi: Min. of HRD.
- Mookharjee, R.K. (1989). The Gupta Empire. Delhi: Motilal Banarsi Dass Publishers Pvt Ltd. Mukherji, S.M., (1966). History of education in India. Vadodara: Acharya Book Depot.
- Naik, J.P. and Syed, N., (1974). A student's history of education in India. New Delhi: MacMillan.
- Rawat, P.L.(1989). History of Indian education. New Delhi: Ram Prasad & Sons. Website, www.mhrd.gov.in

Core Paper IX

CURRICULUM DEVELOPMENT

Learning Objectives:
On completion of this course, the students will

- Differentiate curriculum from courses of study, text book.
- Analyse bases and sources of curriculum.
- Describe different types of curriculum.
- Critically examine National curriculum framework- 2000 and 2005.
- Describe process of curriculum development and differentiate different models of curriculum development.
- Evaluate curriculum using different evaluation models.

UNIT 1: Curriculum

(i) Concept of syllabus, courses of study, text book and curriculum
(ii) Bases of curriculum- philosophical, sociological and psychological
(iii) Components of curriculum: Learning Objectives, Contents, Methods and Evaluation
(iv) Concept of Curriculum design

UNIT 2: Types of Curriculum

(i) Subject centered curriculum
(ii) Learner centered curriculum
(iii) Experience centered curriculum
(iv) Core curriculum

UNIT 3: Curriculum Organization

(i) Principles of curriculum construction
(ii) Selection and organization of content
(iii) Selection and Organization of learning experiences
(iv) National curriculum framework- 2005 and its guiding principles

UNIT 4: Curriculum Development and Evaluation

(i) Curriculum development- its process, role of local authority, state level agencies like SCERT, BSE and National Agencies like CBSE, NCERT
(ii) Tyler and Taba Model of curriculum development
(iii) Meaning and nature of curriculum evaluation

PRACTICAL

- Content Analysis of any text book of elementary level

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Ornstein, A.C. & Hunkins, E (1998). *Curriculum. Foundations, Principles and Issues*. Boston: Allyn & Bacon, Boston.
- Oliva, P.F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman.
- Talla, M. (2012). *Curriculum Development: Perspectives, Principles and Issues*. New Delhi: Pearson Publications.

Reference Books

- Beane, J.A. ,Conrad, E.P. Jr. and Samuel JA, Jr. (1986). Curriculum planning and development, Boston: Allyn & Bacon.
- Brady, L. (1995). Curriculum development, New Delhi: Prentice Hall.
- Doll, R.C. (1996).Curriculum development: decesion-making and process, Boston: Allyn & Bacon. Krug, E.A.(1956). Curriculum planning. New York: Harper and Row

Publishers.

- Oliva, P.F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman.
- Pratt, D.(1980). Curriculum design and development. New York: Macmillan Publishing Co. Inc.
- Popham, W.J. (1993). Modern educational measurement. Englewood Cliffs, N.J.: Prentice Hall.
- Saylor, J.G., Alexander, W.M. and Lewis, A.J.(1981). Curriculum planning for better teaching and learning. New York: Holt Rienehart & Winston.
- Taba, H. (1962). Curriculum development-theory and practice. New York: Harcourt Brace, Jovanoich. Tanner, D. and Tanner, L.(1975) Curriculum development- theory and practice. New York: Macmillan Publishing Co. Inc.
- Tyler, R.W.(1941). Basic principles of curriculum and instruction .Chicago: University of Chicogo Press.

Core Paper X
GUIDANCE AND COUNSELLING

Learning Objectives:

On completion of this course, the students will
- State the concept, need, principles and bases of guidance.
- Use various tools and techniques of guidance in appropriate contexts.
- Explain the role of school in organizing different guidance programmes.
- State the concept, scope and type of counseling.
- Narrate the process, tools and techniques of counseling.
- Explain the qualities and role of a counselor.
- Describe different programmes for with differently abled children.
- Explain the role of teacher and head master in organizing different guidance programmes.

UNIT 1: CONCEPT OF GUIDANCE

(i) Meaning, nature and scope of guidance
(ii) Philosophical, psychological and sociological bases of guidance
(iii)Need, importance, purpose and scope of educational guidance in schools
(iv)Need, importance, purpose and scope of vocational guidance

UNIT 2: EDUCATIONAL GUIDANCE

(i) Basic data necessary for educational guidance
(ii) Basic principles and main types of pupil personnel records
(iii)Cumulative records in a guidance programme
(iv)Case study procedure in guidance

UNIT 3: CONCEPT OF COUNSELLING

    (i) Meaning, nature and scope of counseling
    (ii) Relationship between Guidance and Counselling
    (iii)Different types of counseling
    (iv)Steps and techniques of counseling
    (v) Necessary qualities of a good counselor
    (vi)Role of a counselor in secondary schools

UNIT 4: ORGANISATION OF GUIDANCE SERVICE

    (i) Placement Service
    (ii) Follow-up service
    (iii)Individual inventory service
    (iv)Occupational information service
    (v) Launching school guidance programme

PRACTICAL-25

- Case Study of a Child with Special Needs or a child coming from socially disadvantaged background

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Goswami, Marami (2016). *Essentials of Guidance and Counselling*. New Delhi: Lakshi Publishers And Distributors.
- Kochhar. S.K. (2017). *Educational and Vocational Guidance in Secondary Schools*. New Delhi: Sterling Publishers
- Siddiqui, M.H. (2009). *Guidance And Counselling*. New Delhi: APH Publishing Corporation

Reference Books
- Sharma, R. N., & Sharma, R. (2013). *Guidance and counselling in India*. New Delhi: Atlantic Publishers and Distributors (P) Ltd.
- Bhatnagar,AshaGupta, Nirmala (Eds) (1999).Guidance and counseling: A theoretical perspective (Vol.I). New Delhi: Vikas
- Bhatnagar, Asha and Gupta, Nirmala (Eds) (1999).Guidance and counseling:A practical approach(Vol.II). New Delhi: Vikas.
- Dave, Indu (1984). The basic essentials of counseling. New Delhi: Sterling Pvt. Ltd.
- Gazda George R.M.(1989). Group counseling: A development approach. London: Allyn and Bacon. Gibson, R.L. & Mitchell, M.H. (1986). Introduction to guidance. New York: McMillan.
- Nugent, Frank A. (1990). An Introduction to the profession of counseling. Columbus: Merrill publishing Co.
- Pietrofesa, J.J., Bernstein, B.,and Stanford,S.(1980). Guidance: An introduction. Chicago: Rand McNally.
- Rao, S.N. (1981). Counseling psychology. New Delhi: Tata McGraw Hill.
- Saraswat, R.K. & Gaur, J.S.(1994). Manual for guidance counselors. New Delhi:

NCERT.

Core Paper XI

DEVELOPMENT OF EDUCATION IN ODISHA

Learning Objectives

On completion of the course the students will:
- Grasp the structure of educational system of Odisha
- State the function of institutions/units at the state and district levels
- Appreciate the contribution of Utkalmani Gopabandhu Das to the thoughts and
- Practices of Indian Education narrate the Learning Objectives and implementation process of the major education
- Schemes of central as well as state government being implemented in the state of Odisha
- Explain the role of various state and district level institutions in education
- Analyze the scenario of higher and technical education of Odisha
- Establish linkage between higher education and development of the state

UNIT 1: Status of Elementary Education

(i) History of primary education in Odisha
(ii) Efforts to Universalize Elementary Education: DPEP, SSA and Right to Education Act, 2009
(iii) Indicator wise position in terms of provision, enrolment, retention and achievement for elementary level programmes: NPEGEL and KGBV
(iv) Problem and issues in elementary education

UNIT 2: Status of Secondary and Higher Secondary Education

(i) History of secondary education in Odisha
(ii) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and its implementation in Odisha.
(iii) Role of BSE, Odisha- Problems and issues
(iv) Status of Higher Secondary Education and Role of CHSE; Problems and Issues
(v) Status of Higher Secondary Vocational Education-Problems and Issues

UNIT 3: Status of Higher Education

(i) History of Collegiate Education
(ii) Organization of higher education at the under graduation level and University level- Present status
(iii) RUSA and its implementation
(iv) Autonomous colleges and their functioning
(v) Problems and issues relating to higher education

UNIT 4: Status of Teacher Education

(i) History of Teacher Education in Odisha
(ii) Pre-service and In-service teacher education for elementary schools teachers
(iii) Pre-service and In-service teacher education for secondary school teachers
(iv) Role of DIET, CTE, IASE and SCERT
(v) Problems and issues in teacher education

Practical: 25 Marks

- Seminar Presentation (Each student has to present minimum two papers during this semester related to themes based on Core-11)

NB: It will be evaluated by both the Internal and External Examiners.

Text & Reference Books

- Govt. of Odisha, Department of S & ME (2011). *School Education at a Glance-2011-12*, Bhubaneswar
- Samal, J.K.(1984). History of Education in Odisha: 1905-1936, Sankar Bhattacharya, Punthi Pustak, 136/4B, Bidhan Sarani, Calcutta -700004 ;p-171
- Samal, J.K.(1989). History of Modern Orissa, Firma KLM private limited, 257B,B.B.Ganguly Street, Calcutta;p-188

Websites to be visited:

- *www.shodhganga.inflibnet.ac.in/bitstream/10603/.../08_chapter%202.pdf*: Education in Odisha- *1850-1900: Retrieved on dt.25.07.2012*
- *www.en.wikipedia.org/wiki/Odisha: Odisha   -   Wikipedia,   the   free encyclopedia/Retrieved on dt.25.07.2012*
- *www.newkerala.com/states-of-india/Odisha.php:* Odisha: Info on geography, history, government, districts, business ..: Retrieved on dt.25.07.2012*
- *www.Odisha.gov.in/e-magazine/Odishareview/2011/Jan/engpdf/57-61.pdf:*
- Gopabandhu Das:The National Education Planner of Odisha*: Retrieved ondt.25.07.2012*
- www.dheOdisha.in/ *Higher Education Department - Online Admission - e-Admission for ...*: Retrieved on dt.25.07.2012
- www.Odisha.gov.in/highereducation/index.htm: *Higher Education Department.... - Government of Odisha*: Retrieved on dt.25.07.2012
- www.Odisha2020.org/home/Odisha-higher-education-task-force:*Odisha   Higher Education Vision 2020*: Retrieved on dt.25.07.2012
- http://www.scertodisha.nic.in/
- http://www.chseodisha.nic.in/
- http://bseodisha.nic.in/
- http://mhrd.gov.in/rusa
- http://mhrd.gov.in/rmsa

Core Paper XII

INFORMATION AND COMMUNICATION TECHNOLOGY IN EDUCATION

Learning Objectives

On completion of this course, the student will:
- Explain the concept, nature and scope of ICT in education
- Explore ICT resources for Teaching and learning.
- Differentiate between Web1.0 and Web2.0
- Describe the importance of free and open source software in education
- Demonstrate the use of various application software in education.
- Develop the ability to use various tools connect the world
- Explain the content by using various subject tools.
- Explore tools and techniques of ICT for evaluation.

UNIT 1: Educational technology

(i) Meaning , nature and scope
(ii) Approaches to educational Technology: Hardware, Software and System Approach
(iii)Innovations in Educational Technology: Open Educational Resources (OER), Massive Open Online Course (MOOC) Learning Management System (LMS)
(iv)Importance of Educational Technology for the teacher and the student.

UNIT 2: ICT in Education

(i) Conceptual Understanding: Information Technology; Communication Technology; and Information and Communication Technology (ICT)
(ii) Relevance of ICT in Education
(iii)Nature and Scope of ICT in Education.
(iv)Content, Pedagogy and Technology Integration
(v) Challenges in Integrating ICT in Education
(vi)Use of Computers in Education- Computer Aided Learning

UNIT 3: Application of software and ICT assessment Tools in Education

(i) Word Processing Application
(ii) Spread sheet Application
(iii)Presentation Application
(iv)Free and Open Source Software (FOSS)
(v) Subject Tools: Digital Storytelling, Concept Map Software (C-Map)
(vi)Assessment Tools: Rubistar, Hot potatoes, E- portfolios

UNIT 4: Connecting with the World

(i) Use of browsers and search engines; choosing appropriate sites; search and retrieval of information and resources; Downloading, uploading and sharing information and resources;
(ii) Use and importance of Web 2.0 Tools: E-mail, Wikis, Social networking (WhatsApp, Twitter, Facebook and Blogging)
(iii) Use and importance of e-library, e-books, e-journals, Inflibnet.

PRACTICAL

- Development of an Objective Test using any assessment tool or development of a Rubric using Rubistar.

NB: It will be evaluated by both Internal and External examiners.

Text Books
- UNESCO (2002). *Information and communication technology in education: A curriculum for schools and programme of teacher development.* Paris: UNESCO.
- Kanvaria, V.K. (2014). *A Comprehension on Educational Technology and ICT for Education*. New Delhi: GBO.
- Vanaja and Rajasekar, S. (2016). *Information & Communication Technology (ICT) In Education*. New Delhi: Neelkamal

Reference books
- Senapaty, H.K. (2011). *Pedagogy-Technology Integration for the ProfessionalDevelopment of Teacher Educators.* Bhubaneswar: Regional Institute ofEducation, NCERT (Monograph).
- NCERT (2006). National Curriculum Framework 2005 Position Paper NationalFocus Group on Educational Technology. New Delhi: Author.
- Senapaty, H.K. (2009). *ICT Integrated Learning Materials on Basic School Subjectsfrom Constructivist Perspectives*. Bhubaneswar: Regional Institute ofEducation, NCERT (Monograph).
- Singh, L. C. (Ed.) (2010). *Educational Technology for Teachers and Educators.* NewDelhi: Vasunandi Publication.
  UNESCO(2008).*ICTCompetencyStandardsforTeachers:PolicyFramework.*Retrievedfrom http://portal.unesco.
  UNESCO (2002). Information and Communication Technologies in Teacher Education A Planning Guide. Paris: Author
  UNESCO (2005). How ICT can create new, open learning environments: Information and communication technologies in schools: A handbook for teachers. Paris: UNESCO.Mishra, S. (2008). Developing E-Learning Materials: Some Pedagogical Concerns. *Indian Journal of Open Learning*, 17 (2).

Core Paper XIII

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will:
- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues for ensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues for ensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues for ensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1: Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalisation of Elementary Education: efforts to achieve UEE, SSA
(iii) Problems and issues in implementing Right to Education Act 2009.
(iv) Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii) Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv) Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi) Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii) Higher education through open and distance learning mode
(iv) Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online examination)

(ii) Choice Based Credits System (CBCS): Concept, Learning Objectives, importance, problems and issues.

(iii) Human Rights Education: Concept, Learning Objectives, importance, problems and issues.

(iv) Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.

(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of perception of Stakeholder's of Education on any of the current issues based on Pass DSE-1 and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books
- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21st century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**
- Saxena, V. (2011). *Contemporary trends in education: A handbook for educators*. New
- Delhi: Pearson.

Reference Books
- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009*. New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.
- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.

- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

Core Paper XIV

EDUCATIONAL MANAGEMENT AND LEADERSHIP

Learning Objectives

On completion of this course, the students will
- Describe the concept, types and importance of educational management.
- Spell out the structure of educational management at different levels - from national to institution leve
- Describe different aspects and importance of educational management.
- Describe the concept, theories and style of leadership in educational management.
- Analyze the concept, principles and structures of total quality management approach in education.

UNIT 1: Educational Management

(i) Concept of educational Management- meaning, nature, scope and principles
(ii) Process of educational Management- planning, execution, staffing, control, supervision, monitoring, evaluation and feedback
(iii) Types of Management:
(iv) Centralized and decentralized
(v) Authoritarian, democratic, dynamic/creative and laissez-faire
(vi) Educational Management in Odisha- structure and function with reference to school and mass education, and Higher education

UNIT 2: Aspects of Institutional Management

(i) Human, material and financial resource management
(ii) Management of curricular and co curricular programmes
(iii)Management of students' welfare, auxiliary services including students' health services
(iv)School development plan
(v) Working with SMC and SMDC

UNIT 3: Leadership in Education

(i) Leadership- meaning, nature and importance in education
(ii) Leadership : Functions and skills
(iii)Theories of leadership- Redden's 3-D theory, and Hersey and Blanchard's situational theory
(iv)Styles of leadership-participating style, delegating style, selling style and telling style, Hersey and Blanchard)

UNIT 4: Total Quality Management

(i) Total Quality Management(TQM)- meaning, nature and importance
(ii) Principles of TQM- Demming's and Jurana's
(iii)Planning for TQM in school and higher education
(iv)Quality Assurance in Higher Education

PRACTICAL
- Studying the role of SMC/SMDC in school management and reporting

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Kochar, S.K (2011). *School Administration and Management*. New Delhi: Sterling Publishers Private Limited.
- Bhatnagar, R. P. & Aggrawal V (2015). Educational Administration, Supervision, Planning and financing. Meerut: R Lal Book Depot.
- Mukhopadhyay, M. (2005). i. New Delhi: Sage

Reference Books
- Adolph and Turner Harold, E. *Supervision for change & Innovation*. Houghton Miffin Company.
- Anderson, C.A & Bowman, M.J (1971).*Educational management*, London, U.K: Frankas
- Ashima V, Deshmukh & Naik A.P (2010). *Educational management*. Girgaon, Mumbai: Himalaya Publishing House.
- Bhatnagar, R.P & Verma, I.B (1978). *Educational administration*. Meerut, India: Loyal Book Depot.
- Chau, Ta-Ngoc (2003): *Demographic aspects of educational planning.* Paris: International Institute for Educational Planning.
- Hariss, B. M (1963).*Supervisory behaviour in education*.USA: Englewood Cliffs.

- Kimbrough, S.Ralph, Michall & Nunnery. *Educational administration*. New York: Mc Millan Company.
- Livack, et al (1998).*Rethinking Decentralization in developing countries*. Washington, D.C, USA: World Bank.
- Mukerji, S.N. *Administration of educational planning and financ*e. Baroda, India: Acharya Book Depot.
- Naik, J.P. (1965): *Educational planning in India*. New Delhi, India: Allied.
- Naik, J.P. (1982): *The educational commission & after*. New Delhi, India: Allied.
- Newman and summer. *The process of management: concept, behaviour and practice*. New Delhi, India: Prentice Hall of India Pvt. Ltd.
- Oliva, O (19760. *Supervision for today's school*. New York, USA: Harper & Row.
- Ramani, K.V (2004). *A text book of educational management*. New Delhi, India: Dominant Publisher
- Safya, R & Saida, B.D *(1964). School administration and organisation.* Jalandhar, India: Dhanpat Rai & Sons
- Shukia, P.O (1983). *Administration in India*. New Delhi, India: Vikas Publication.
- Simon, Herbart A. *Administrative behaviour*. New York,USA :McMillan Company.
- Tilak, J.B.G. (1992). *Educational planning at grassroots*. New Delhi: India.
- Waber, Clarence A. *Fundamentals of educational leadership*. New York ,USA: Exposition Press.Buch, T. et al. (1980). Approaches to school management. London: Harper and Row.
- Chalam K.S. (2003): Introduction to Educational Planning and Management: New Delhi, Anmol Publications Pvt. Ltd.
- Chandrasekharan P. (1997): Educational Planning and Management. New Delhi: Sterling Publishers Pvt. Ltd.
- Deshmukh, A.V. & Naik, A.P.(2010). School administration and management. Mumbai.
- Glasser, William(1990). The quality school. New York, NY: Harper Collins Publishers, Inc.
- Government of India (1986/92). National policy on education. New Delhi: MHRD.
- Government of India (1992). Programme of action. New Delhi: MHRD.
- Gupta, S.K. & Gupta, S.91991). Educational administration and management. Indore: Manorama Prakashan.
- Hallak, J.(1990).Investing in the future:Setting educational priorities in the developing world. Paris: UNESCO.
- Kalra, Alka (1977). Efficient school management and role of principals. New Delhi: APH Publishing Corporation.
- Kochar, S.K. (2011). School administration and management. New Delhi: Sterling Mukhopadhyay, M. (2001). Total quality management in education. New Delhi: NIEPA.
- Shaeffer, S. (1991). Collaborating for educational change: The role of parents and the community in school improvement. Paris: UNESCO.
- Tyagi R.S. and Mahapatra P.C. (2000), Educational Administration in Orissa : New Delhi, National Institute of Educational Planning and Administration (NIEPA)
- Vashist, Savita(ed.) (1998). Encyclopaedia of school education and management. New Delhi: Kamal Publishing House.

Discipline Specific Elective Paper-I

(A student has to choose any one from Pedagogy of English and Odia under DSE-1)
A.PEDAGOGY OF LANGUAGE (ENGLISH)

Learning Objectives

On completion of this course, the student will
- Analyze the issues relating to place of English in school curriculum, acquisition of skills in English, realization of aims and Learning Objectives of learning English and language policy as conceived in NPE, 1986 and NCF – 2005
- Use various methods, approaches and strategies for teaching-learning English and transact various types of lesson plans covering all aspects of English language following different approaches
- Develop test items to assess learning in English and provide feedback as well as prepare enrichment materials
- Use the understanding of phonetics for facilitating students' speaking in English
- Plan appropriate pedagogical treatment of the prescribed contents for effective classroom transaction

UNIT 1: English in School Curriculum

(i) Language policy in India with reference to NPE 1986 and NCF 2005
(ii) Place of English as a compulsory subject in school curriculum (both at elementary and secondary levels)
(iii) Learning Objectives of learning English at elementary and secondary levels
(iv) English language skills –components, their independence and interdependence

UNIT 2: Approaches, Methods and Strategies of Teaching English

(i) Understanding of different methods and strategies: Bi-lingual Method, Translation Method, Direct Method, Structural Approach, Communicative Approach.
(ii) Listening Skill: Tasks for developing Listening Comprehension
(iii) Speaking Skill: Tasks for developing Speaking skills
(iv) Reading skill: Types of Reading, Strategies to develop reading comprehension
(v) Writing Skill: Strategies to improve writing skill, Qualities of good writing (simplicity, logicality and organization in writing)

UNIT 3: Transaction of Contents

(i) Teaching of Prose (detailed and non-detailed), poetry, grammar and composition – Approaches, Methods and Strategies
(ii) Pedagogic analysis :Content analysis- analysis of topics of English text book for identification of language items(new vocabulary, structural words, grammar components),learning Learning Objectives, methods and strategies, teaching learning materials including ICT materials
(iii) Preparing Lesson Plan following 5E and Interpretation Construction Design Model(ICON)
(iv) Preparation of Lesson Plans following Herbartian approach.

UNIT 4: Lesson Delivery Strategies and Assessment

(i) Lesson Delivery Strategies: Lecturing, Role play and Dramatization, Collaborative Approach, Ability Grouping, Group Work; Learning through Narratives and Discourses; Concept Mapping and Brain Storming

(ii) Techniques of Assessment in English : Continuous Assessment of Learners performance in English, preparation of different types of objective-based test items (Extended Response Type, Restrictive

PRACTICAL

- School Internship (Delivery of 5 Lessons following Herbatian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Kohli, A.L (2010) *Techniques of teaching english.* New Delhi: Dhanpat Rai publishing Company
  Jain, R.K (1994). *Essentials of English teaching*, Agra: Vinod Pustak Mandir
- Sharma, K.L(1970) .*Methods of teaching English in India.* Agra : Laxmi Narayan Agrawal

Reference Books

- Agnihotri R. K. and Khanna A. L. (1994). *Second language acquisition: socio-cultural and linguistic aspects of English in India.* New Delhi: Sage Publications.
- Allen, H.B. (1965). *Teaching English as a second language: A book of readings*. New York: McGraw-Hill.
- Baruah, T.C (1984). *The English teacher's handbook.* New Delhi: Sterling Publishers Pvt.Ltd,
- Billows, F. L. (1975). *The techniques of language teaching.* London: Longman
- Bista, A.R(1965). *Teaching of English (Sixth Edition).* Agra: Vinod Pustak Mandir
- Bright, J.A(1976). *Teaching English as second language.* London: Long Man Group
- Catarby, E. V (1986) *Teaching English as a foreign language in school curriculum India*, New Delhi: NCERT
- Hudelson, Sarah. (1995). *English as a second language teacher resource handbook. A practical guide for K-12 ESL programs.* California.: Corwin Press, Inc.
- Joyce , Bruce and Weil, Marsha (2003). *Models of teaching.* New Delhi: Prentice Hall of India Pvt. Ltd.
- Krishna Swamy, N. and Sri Raman, T. (1994). English teaching in India. Madras : T.R. Publication.
- Mukalel, Joseph C. (2009). *Approaches to English language teaching.* New Delhi: Discovery Publishing House Pvt Ltd.
- Pal, H.R and Pal, R(2006). *Curriculum – yesterday, today and tomorrow*, New Delhi: Shipra Publications
- Sachdeva, M.S. (1973). A new approach to teaching of english in India. Ludhiana : Prakash Brothers
- Shrivastava, B.D(1968). *Structural approach to the teaching of English.* Agra: Ramprasad and Sons

Discipline Specific Elective Paper-I

(A student has to choose ANY ONE from Pedagogy of English and Odia under DSE-1)

B. PEDAGOGY OF LANGUAGE (ODIA)

Learning Objectives
On completion of this course, the student will:
- State the importance and place of Odia as mother tongue in school curriculum.
- Develop the strategies to address the problems of Odia language acquisition in multilingual context.
- Use various strategies for facilitating the acquisition of language skills in Odia.
- Decide appropriate pedagogic approaches to transact different types of lessons in Odia.
- Prepare appropriate tools for comprehensive assessment of learning in Odia.
- Explain the fundamentals of Odia linguistics and their relevance in teaching learning Odia.
- Plan appropriate pedagogic treatment of the prescribed textual contents (in Odia) of classes IX and X.

UNIT 1: Odia as Mother Tongue in School Curriculum

(i) Importance of mother tongue in the life and education of an individual
(ii) Place of Odia as mother tongue in school curriculum in Odisha (both at elementary and secondary levels) in the context of language policy recommended by NPE, 1986 (three language formula) and NCF-2005
(iii) Learning Objectives of teaching-learning Odia at elementary and secondary levels
(iv) Inter-dependence of language skills in Odia and Strategies for facilitating acquisition of four-fold language skills in Odia

UNIT 2: Pedagogic Approaches to Teaching-Learning Odia

(i) Psychology of language learning and acquisition with reference to Odia as mother tongue.
(ii) Problems and issues related to acquisition of Odia language in multi-lingual context
(iii) Traditional versus modern methods of teaching-learning Odia.
(iv) Different approaches and strategies to the teaching-learning of : − Odia prose (detailed and non- detailed) , Odia poetry , Odia composition , Odia grammar .

UNIT 3: Curricular Activities in Odia

(i) Pedagogic analysis :
(ii) Content analysis- analysis of topics of Odia text book for identification of language items(new vocabulary, structural words, grammar components), learning Learning Objectives,
(iii) methods and strategies, teaching learning materials lncluding ICT materials, assessment strategies
(iv) Preparing Lesson Plans following Herbartian, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Assessment

(i) Types of Assessment-self assessment, peer assessment, teacher assessment, internal

assessment and external assessment

(ii) Techniques of Assessment in Odia : Continuous Assessment of Learners performance in Odia, preparation of different types of objective-based test items (Extended Response Type, Restrictive Response Type and Objective Type), preparation of check list, rating scale and rubric, Portfolio assessment in Odia

PRACTICAL

- School internship (delivery of 5 Lessons following Herbartian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Barik, N. (2014). Odia shikshyadana paddhati. Cuttack: A.K.Mishra Publishers Pvt. Ltd.

- Kocchar, S.K. (2012). Teaching of Mother Tongue. Sterling Publishers, New Delhi.

- Mohanty, J., Barik, N. & Khandai, U. (1983). Odia sikshadana paddhati. Cuttack : Nalanda.

- Nayak, B.; Mohanty, J.(1999): Odia bhasa O Sahityara Bhitibhumi O Shikshyadan Padhati. Cuttack: Jagannath Process, Toni Road, Cutack-2.

Reference Books

- Daswani, C. J. Language Education in Multilingual India. New/Delhi (UNESCO)

- Dhal, G.B. (1974). Dhwani bijanana. Bhubaneswar : Odisha Rajya Pathya Pustaka Pranayana Sanstha.

- Dhal, G.B. (1972). English uchharana siksha. Cuttack : Friends Publisher.

- Mathur, S.A. Sociological Approach to Indian Education. Vinod Pustak Bhandar, Agra.

- Mohanty, B. (1970). Odia bhasara utpati O 65arma bikasha. Cuttack : Friends Publishers.

- Mohapatra, D. (1976). Odia Dhwani tattwa O sabdha sambhar. Cuttack : Grantha Mandir.

- Mohapatra, N. & Das, S. (1943). Sarbasara vykarana. Cuttack : New Student's Store

- Palmer, H.P. Principles of Language Teaching. George G. Harrep and Co. Ltd.

- Rybum, W.M.(1926). Suggestions for the Teaching of Mother Tongue. OUP.

- Saiyadain, K.G. Education and Social Order. Asia Publishing House, Bombay.

Discipline Specific Elective Paper-II

(A student has to choose ANY ONE from Pedagogy of Social Science and Mathematics under DSE-2)

A. PEDAGOGY OF SOCIAL SCIENCES

Learning Objectives

On completion of this course, the student will:
- State the meaning, scope and importance of Social science
- Specify the skills and competencies to formulate specific LEARNING OBJECTIVES for different History and Political Science lessons
- Identify the different methods and skills of teaching History and Political Science for transacting the contents effectively.
- Explain the importance of time sense and prepare / utilize timelines for effecting teaching of History
- Prepare Unit Plans and Lesson Plans in History and Political science
- Develop diagnostic achievement test, administer them and analyse the results for providing feedback

UNIT 1: Concept, Learning Objectives and Values Of Teaching Social Science

(i) Meaning, Nature and Scope of Social Science as NCF-2005
(ii) Learning Objectives of teaching Social Science at elementary and secondary levels
(iii) Importance of teaching Social Science In School Education
(iv) Identification of values/ competencies/ skills to be developed through Social Sciences

UNIT 2: Methods and Approaches to Teaching-Learning Social Science

(i) Story-telling
(ii) Narration-cum-discussion
(iii) Dramatization
(iv) Source Method
(v) Project method
(vi) Field Trips
(vii) Observation

UNIT 3: Curricular Activities in Social Sciences

Pedagogic analysis:
(i) Content analysis- analysis of topics of social science text book .
(ii) Learning Objectives,
(iii) methods and strategies,
(iv) teaching learning materials including ICT materials
(v) learning activities including student and teacher activities
(vi) assessment strategies
(vii) Preparing lesson plan following Herbart, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Development of Resource Materials and Assessment in Social Science

(i) Teaching-learning materials – Maps, Atlas, Globes, Charts, Graphs, Models, Filmstrips, T.V. Video, OHP, and Computer
(ii) Timeline – Concept, Aspects, Type and Use

(iii)Types of Assessment-self assessment, peer assessment, teacher assessment, internal assessment and external assessment

(iv)Techniques of Assessment in history and political science: Continuous Assessment of Learners performance in history and political science, preparation of different types of objective-based test-

(v) Items (Extended Response Type, Restrictive Response Type and Objective Type

PRACTICAL

- School internship (delivery of 5 Lessons following Herbatian /5E/ ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Kochhar, S.K. (1970). *Methods of Teaching Social Studies*. New Delhi, India: Sterling Publication.
- Mamgal, S.K. & Mangal, U. (2008). *Teaching of Social Studies*. New Delhi: PHI Learning Pvt, Ltd.
- Sharma, R.A. (2014). *Teaching of Sociaal Sceince*. Meerut: R Lal Book Depot.

Reference Books

- Kochhar, S.K. (1970). *Teaching of History*. New Delhi, India: Sterling Publishers Pvt. Ltd.
- Banks James, A. (1997). *Teaching Strategies for the Social Studies Enquiry, Valuing and Decision Making* . Massachusets,USA: Addition- Westely Publishing Co. Reading.
- Bining & Binning.(1952). *Teaching of Social Studies in Secondary Schools*. New York,USA: Mc Graw Hills.
- Burston,W.H.(1963). *Principles of History Teaching*. New Fetter Lance : Methuen & Co. Ltd.II.
- Burton W.H. (1972). Principles of history teaching, London: Methuen.

- Carretero, Mario, & Voss, James F. (Eds.) (1994). Cognitive and instructional processes in history and the social sciences. Hillsdale: Lawrence Erlbaum Associate.

- Choudhury, K.P. (1975).*The effective Teaching of History*. New Delhi,India: NCERT.
- Dhamiaja Neelam.(1993). *Multimedia Approaches in Teaching Social Studies*. New Delhi,India:Harmer Publishing House.
- Drake, Frederick D. & Lynn, R. Nelson (2005). Engagement in teaching history: Theory and practices for middle and secondary teachers. Columbus, OH: Pearson.

- Ghate, V.D. (1956). Teaching of history. Bombay: Oxford University Press. Gunnin, Dennis (1978). The teaching of history. Goom Helm Ltd. London.

- James H. (1953). *The Teaching of Social Studies in Secondary   Schools*. . London,UK: Longman Green & Co.
- James, T. H., Arthur,J. and Hunt, M. (2001). Learning to teach history in the secondary school: A companion to school experience. London: Routledge Falme.

- Kochhar, S.K.(1970). *Teaching of political science*. New Delhi: Sterling Publishers

- NCERT. (1970). *Teaching of History of Secondary Schools*.New Delhi,India: Author.

- NCERT.(1966). *A Handbook for History Teachers*.Bombay:India: Allied Publishers.
- Taneja,V.R.(1970). *Fundamentals of Teaching Social Studies*. Mahendra Capital Publishers.
- Verma, O.P.(1984). New Delhi, India: Sterling Publishers Pvt. Ltd.
- Verma,O.P. & Vedanayagam E.G. *Geography Teaching*. New Delhi,India: Sterling Publishers Pvt. Ltd .
- Yagnik, K.S.(1966). *The Teaching of Social Studies in India*. Bombay,India: Orient Longman Ltd.

Discipline Specific Elective Paper-II

(A student has to choose ANY ONE from Pedagogy of Social Science and Mathematics under DSE-II)

B. PEDAGOGY OF MATHEMATICS

Learning Objectives

On completion of this course, the students will
- Narrate the evolution and nature of Mathematics and its importance in the school curriculum in the context of the recent curricular reforms.
- Use various methods and approaches of teaching and learning mathematics especially suitable for the secondary school classes.
- Plan lessons in Mathematics using traditional and constructivist approaches for effective classroom transactions.
- Develop and collect activities and resource materials for their use in enhancing the quality of learning Mathematics at the secondary level.
- Conduct continuous and comprehensive assessment for enhancing the quality of Mathematics learning.
- Explain the concepts in Mathematics included in the secondary school curriculum and make pedagogical analysis of those concepts

UNIT 1: Foundations of Mathematics Education

(i) Nature and Scope of Mathematics,
(ii) Learning of Mathematics: Importance of Mathematics at elementary and secondary level, Learning Objectives of teaching-learning Mathematics at the two levels,
(iii) Curriculum Reforms in School Mathematics: Rationale, Learning Objectives, principles, designs and materials in Mathematics, recent curricular reforms at the National and State levels (NCF 2005).

UNIT 2: Methods of Teaching-learning Mathematics

(i) Learning by Discovery: Nature and purpose of learning by discovery; guided discovery strategies in teaching Mathematical concepts.
(ii) Teaching for Understanding Proof: Proof by induction and deduction; proof by analysis and synthesis.
(iii) Problem Solving in Mathematics: Importance of problem solving in Mathematics,

Steps of problem solving in Mathematics.
(iv) Constructivist approaches: Self-learning and peer learning strategies, Collaborative strategies; 5E and ICON Models.

UNIT 3: Curricular Activities in Mathematics

(i) Pedagogic analysis :
(ii) Content analysis- analysis of topics of mathematics text book .
(iii) Learning Objectives,
(iv) methods and strategies,
(v) teaching learning materials including ICT materials
(vi) learning activities including student and teacher activities
(vii) assessment strategies
(viii) Process of preparing lesson plan following Herbatian, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Assessment In Mathematics

(i) Assessment of Mathematics learning: Unit test – Designing blue print, item construction, marking schemes.
(ii) Assessment for Mathematics Learning: Assignments, Projects and portfolios in Mathematics, group and collaborative assessment in Mathematics,
(iii) Non-testing methods of assessment of/for Mathematics Learning: Observation of learners in action, rating of participation in various Mathematics tasks and activities,
(iv) Diagnosis of difficulties in learning Mathematics concepts, Remediation of the difficulties, enrichment programmes in Mathematics learning –National Mathematics Talent Search, Mathematics Olympiad.
(v) Planning for continuous assessment of classroom learning in Mathematics.

PRACTICAL

- School internship (Delivery of 5 Lessons following Herbatian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Sidhu, K.S (1985).*Teaching of mathematics*. New Delhi: Sterling publication.
- James, A. (2003). *Teaching of mathematics*. Neel Kamal Publication: Hyderabad. NCERT (2011). *Pedagogy of mathematics for two year B.Ed. course*. New Delhi:

Reference Books
- Cooney, Thomas J. et al. (1975). Dynamics of Teaching Secondary School Mathematics. Boston: Houghton Mifflin.
- Cooper, B. (1985). *Renegotiating secondary school mathematics*. The Hamer Press: East Sussex.
- Michel. (1982). *Teaching mathematics*. Nicholos Publication Co: New York.
- NCF (2005). *National curriculum framework*. NCERT: New Delhi
- NCERT (2006). *Position paper: National focus group (NFG) on teaching Mathematics*. NCERT: New Delhi.

- NCERT (2005). *Position paper: national focus group (NFG) on examination reform*. NCERT: New Delhi.
  Scopes, P.G. (1973). *Mathematics in secondary schools- a teaching approach*. Cambridge: Cambridge University Press
- Driscoll,M., Egan, M., Nikula, J., & DiMatteo, R. W. (2007). Fostering geometric thinking: A guide for teachers, grades 6-10. Portsmouth, NH: Heinemann.
- Driscoll,M.(1999). Fostering algebraic thinking: A guide for teachers, grades 5-10. Portsmouth, NH: Heinemann.
- Grouws, D.A. (ed) (1992). Handbook of research on mathematics teaching and learning. New York: Macmillan Publishing.
- Malone, J. and Taylor, P. (eds) (1993). Constructivist interpretations of teaching and learning mathematics.
- Perth: Curtin University of Technology.
- Marshall, S.P. (1995). Schemes in problem-solving. New York: Cambridge University Press.
- Moon, B. & Mayes, A.S. (eds.) (1995). Teaching and learning in secondary school. London: Routledge.
- NCERT (1998). A textbook of content-cum-methodology of teaching mathematics. New Delhi: NCERT.
- NCERT (2005). National curriculum framework 2005. New Delhi:NCERT.
- NCERT (2006). Position paper: National focus group on teaching mathematics. New Delhi:NCERT.
- TESS India (2015). Key resources. The Open University U.K.(http//creativecommons.org/licences/ and http//www.tess-india.edu.in/)

Discipline Specific Elective Paper-III

(A student has to choose any one from A & B under DSE-III)

A. POLICY AND PRACTICES IN SCHOOL EDUCATION IN INDIA

Learning Objectives
On completion of this course, the student will:
- Analyse various policies on education for school education in India
- Evaluate progress of schools education
- Examine the problems in implementation of the policies on school education
- Explore status of women education and education for SC, ST and Minorities in Indian

UNIT 1: Policies in School Education

(i) National education policy, 1986, revised in 1992 and its corresponding document Programme of Action with reference to Elementary Education and Secondary Education.
(ii) Implementation of Elementary Education with reference to RTE Act-2009 and Policy issues.

(iii) Implementation of Secondary Education with reference to Rashtriya Madhyamik Siksha Abhiyan (RMSA) and policy issues

(iv) Guiding principles of NCF-2005 and curriculum revision at the school level.

UNIT 2: Policies for Vocationalisation of Education

(i) Vocationalisation of education- A policy analysis with reference to the report of Patel Committee (1977), Adisheshia Committee (1978) and National Policy on Education (1986) revised NPE (1992)

(ii) Vocational Education at Higher Secondary level: Policy challenges

(iii) Work education in schools –concept to implementation

UNIT 3: Policies for Inclusive Education

(i) Education of Children with Special Needs (CWSN): Policy perspectives with reference to NPE,1986, 1992, Mental Health Act, 1987, Persons with Disabilities Act, 1995, Rehabilitation Council of India Act, 1992, National Trust Act,1999

(ii) Inclusive education- Policies, Progress and Problems.

UNIT 4: Policy on Access and equity in Education

(i) Women's education and empowerment of women with reference to National Policy on Women Empowerment, , NPE-1986

(ii) Progress of Women Education and Problems.

(iii) Access and Equity in Education with focus to SC, ST and Minorities

(iv) Policy for SC children- Implementation, Progress and Problems.

(v) Policy for ST children- Implementation, Progress and Problems with reference to Mother Tongue based Multilingual Education

(vi) Policy for Minority Children- Implementation, Progress and Problems.

PRACTICAL

- Analysis of any Policy documents being implemented at School Education level

NB: It will be evaluated by both Internal and External examiners

Text Books
- Aggarwal, J.C. (2010). Landmarks in the history of modern Indian education (7th Ed) New Delhi: Vikash Publishing Pvt. Ltd.
- Rawat, P.L. (1989). History of Indian education New Delhi: Ram Prasad & Sons.

Reference Books
- Das, K.K. (1993). *Development of education in India*. New Delhi: Kalyani Publishers
- Dash,B.N. (1991). *Development of education in India*. New Delhi: Ajanta Prakashan
- Keay, F. E. & Mitra, Sukumar (1978). A history of education in India. New Delhi: Oxford University Press
- Mukherjee, R.K. (1988). Ancient Indian education. New Delhi: Motilal Banarsidass
- Mukherjee, R.K. (1989). The Gupta Empire. New Delhi: Motilal Banarsidass
- Naik, J.P. & Narullah, S. (1996). A student's history of education in India.New Delhi: Mc Millan India Ltd

- Ghosh, S.C. (1989). Education policy in India since warren Hastings, Calcutta: N-Prakashan.
- Reference Books
- Altekar, A.S. (1934), Education in ancient India, Banaras: Indian book Shop.
- Das Gupta, S.N. (1988). A history of Indian philosophy. (5 Vols.) Delhi: Motilal Banarasi Dass.
- MHRD, GOI (1986). National policy on education. New Delhi: The Author
- MHRD, GOI (1993). Learning without burden. Yashpal Committee Report (1993). New Delhi: The Author
- Ministry of Education, GOI (1964-66). Education and national development. (Report of education commission (1964-66). New Delhi: The Author
- Sen, Bimal (1989). Development of technical education in India and state policy-a historical perspective. Indian Journal of History of Science, 24 (2): 224-248, Indian National Science Academy.
- Sen, S.N. (1988). Education in ancient and medieval India. Indian Journal of History of Science, 23 (1): 1-32.
- Shanker, Uday (1984). Education of Indian teachers. New Delhi: Sterling Publishers Pvt. Ltd.
- Singh. R.P. (1970). Education in ancient and medieval India. Delhi: Arya Book Depot.Rao, K.Sudha (Ed.) (2002). Educational policies in India: Analysis and review of promise and performance. New Delhi: NUEPA.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- MHRD, Gov. of India (1986). *National policy on education.* New Delhi: GoI.
- MHRD, Gov. of India (1992), *National policy on education (*revised) New Delhi: GoI. MHRD, (1992), *Programme of action.*, New Delhi: Govt. of India.
- NCTE (1998b). *Curriculum Framework for Quality Teacher Education.* New Delhi:NCTE.
- NCTE (2009). *National Curriculum Framework for Teacher Education TowardsPreparing Professional and Humane Teacher.* New Delhi:NCTE.
- Ministry of Law Justice (2009). The Right of Children to Free and Compulsory Education Act, 2009. *The Gazette of India*, Ministry of Law Justice, Govt. of India.
- Kurrien, J (1983). *Elementary Education in India*. New Delhi: Vikas. MHRD (). *Report to the People on Education 2011-12*. New Delhi: Author. MHRD (1986): *National Policy on Education*. New Delhi: MHRD.
- MHRD (2000). *Sarva Shiksha Abhiyan: A program for Universal Elementary Education A framework for implementation.* New Delhi: Author.
- Government of India, Ministry of Human Resource Development (2005), Report of the CABE Committee on Autonomy of Higher Education Institutions, Department of Secondary and Higher Education, New Delhi, June.

Websites to be referred:
- http://www.rehabcouncil.nic.in/
- writereaddata/RCI_Amendments_ACT.pdf
- http://socialjustice.nic.in/pwdact1995.php
- http://mhrd.gov.in/rmsa

Discipline Specific Elective Paper-III

(A student has to choose ANY ONE from A & B under DSE-III)
B. POLICY AND PRACTICES IN HIGHER EDUCATION IN INDIA

Learning Objectives
On completion of this course, the student shall:
- Analyse various policies on education for Higher education in India
- Evaluate progress of Higher education
- Examine the problems in implementation of the policies on higher education
- Explore status of higher education.
- Analyse role of various agencies of higher education in India.

UNIT 1: Policies in Higher Education

(i) NPE-1986, revised in 1992 and its corresponding document Programme of Action (POA) with reference to Higher Education.
(ii) Recommendations of National Knowledge Commission-2006.
(iii) Implementation of Policies, progress and problems.

UNIT 2: Future of Higher Education
(i) Rashtriya Uchattar Shiksha Abhiyan (RUSA)- goals, features, strategies and implementation- problems and issues.
(ii) Progress Higher Education in Odisha.
(iii) Autonomy and Accountability in Higher Education

UNIT 3: Curriculum and Assessment

(i) Curriculum issues in higher education
(ii) Choice Based Credits System, Semester system, Grading.
(iii) Role of UGC, NAAC and Accreditation
(iv) Quality Assurance in Higher Education
(v) ICT in Higher Education

UNIT 4: Educational Management System

(i) Funding and management of Higher Education
(ii) Open and Distance Learning System: Policy and Development-Role of IGNOU.
(iii) Research in higher education-problems and issues- Role of ICSSR, UGC, Association of Indian Universities
(iv) Capacity Building of Teachers in Higher Education.
PRACTICAL
- Analysis of any Policy Document being implemented in the field of Higher Education in India
NB: It will be evaluated by both Internal and External examiners

Text Books
- Rao, K.Sudha (Ed.) (2002). Educational policies in India: Analysis and review of promise and performance. New Delhi: NUEPA.

Reference Books

- Government of India, Ministry of Human Resource Development. 2011a. 'Indian Institutes of Development'. Available at http://mhrd.gov. in/itt_higher_english.
- Government of India, Ministry of Statistics and Programme Implementation. No date. NSS Survey Reports. Available at http:// mospi.nic.in/Mospi_New/site/inner. aspx?status=3&menu_id=31.
- Cheney, G. R., with B. B. Ruzzi and K. Muralidharan. 2005. India Education Report. NCEE (National Center on Education and the Economy). Available at http://www.ncee. org/wp-content/uploads/ 2013/10/ IndiaEducation-Report.pdf.
- UCG (University Grants Commission). 2008. Higher Education in India: Issues Related to Expansion, Inclusiveness, Quality and Finance. New Delhi: University Grants Commission. Available at http://www.ugc.ac.in/oldpdf/pub/report/12. pdf.
- Agarwal, P. 2006. 'Higher Education in India: The Need for Change'. ICRIER Working Paper No. 180, June. Delhi: Indian Council for Research on International Economic Relations.
- BhallaVeena& et al (1998), Accountability and Autonomy in Higher Education, AIU.
- Country paper (1998), Higher Education in India: Vision & Action, presented in UNESCO world conference of Higher Education in the Twenty-first century, Paris 5-9th Oct 1998, National Commission for Cooperation with UNESCO.
- UNESCO (1998), report on Higher Education in the Twentieth First Century Vision & Actions held at Paris 5-9th Oct 1998, UNESCO.
- Meek, V Lynn (2000), Diversity and marketisation of higher education: incompatible concepts? Higher Education Policy, 13 (2000), p-25 & 26.
- Government of India, Ministry of Human Resource Development (2005), Report of the CABE Committee on Autonomy of Higher Education Institutions, Department of Secondary and Higher Education, New Delhi, June.
- Tilak, J.B.G. (1996), "Higher Education under Structural Adjustment", Journal of Indian School of Political Economy 8 (2) (April-June): 266-93.
- UGC (2005), University Development in India: Basic Facts and Figures (1995-96 to 2001-02), University Grants Commission, Information & Statistics Bureau, New Delhi, November

Discipline Specific Elective Paper-IV

INCLUSIVE EDUCATION

Learning Objectives
On completion of the course the students shall be able to:
- Define meaning and scope of inclusive education.
- identify the assumptions of disability underlying current general and special education practices

- understand the various suggestions given by different recent commissions on education of children with disabilities for realizing the concept of "Universalization of Education";
- explore and utilize pedagogical approaches that can support students with a variety of learning profiles in respectful ways
- explain the meaning and implications of universal design in learning (UDL) for classroom pedagogy
- examine the different support services and collaboration for inclusive education

UNIT 1: Meaning, Genesis and Scope Inclusive Education

(i)   Special education and inclusive education: Concept and Principles
(ii) Historical developments of special and inclusive education in India.
(iii) Medical and social models of disability
(iv) Examining the practice of labeling
(v)   Social, psychological and educational contexts of inclusion

UNIT 2: Polices & Frameworks Facilitating Inclusive Education

(i)   International Declarations: Universal Declaration of Human Rights (1948), World Declaration for Education for All (1990)
(ii) International Conventions: United Nations Convention of Rights of Persons with Disabilities (UNCRPD) (2006)
(iii) International Frameworks: Salamanca Framework (1994), Biwako Millennium Framework of Action (2002)
(iv) Constitutional Obligations; RCI Act 1992; PwD 1995 and NTA 1999; RTE-SSA and RPD Act. 2016.

UNIT 3: Understanding and Support Needs of Students with Disability

(i)   Understanding and support needs of students with different Labels of Disability including: Autism, Learning Disabilities, Speech & Hearing Disability, Blindness, and Intellectual Disabilities in inclusive classroom.

UNIT 4: Frameworks, Support and Collaboration for Inclusive Education

(i)   Universal Design for Learning: Multiple Means of Access, Expression, Engagement & Assessment
(ii) Principles of Differentiated Instruction and Assessment
(iii) Capacity Building of Teachers for Inclusive Education
(iv) Assistive Technology & Devices for Inclusive Education

PRACTICAL

- Visit to a centre for students with special needs (special school/special institute). Observe the process of teaching learning and write a report.

NB: It will be evaluated by both Internal and External examiners

Text Books
- Panda, K.C. (nd). *Education of Exceptional Children*
- Daniels, H. (1999) . *Inclusive education*. London: Kogan.

- Mangal, S.K. (2013). Exceptional Childred. New Delhi: PHI Learning Pvt. Ltd.

Reference Books
- Bartlett, L. D., & Weisentein, G. R. (2003). *Successful inclusion for educational leaders*. New Jersey: Prentice Hall.
- Deiner, P. L. (1993). *Resource for Teaching Children with Diverse Abilities*. Florida: Harcourt Brace and Company.
- Dessent, T. (1987). *Making Ordinary School Special*. Jessica Kingsley Pub.
- Gargiulo, R.M. *Special Education in Contemporary Society: An Introduction to Exceptionality*. Belmont: Wadsworth.
- Gartner, A., & Lipsky, D.D. (1997). *Inclusion and School Reform Transferring America's Classrooms*. Baltimore: P. H. Brookes Publishers.
- Giuliani, G.A. & Pierangelo, R. (2007). *Understanding, Developing and Writing IEPs*. Corwin press:Sage Publishers.
- Gore, M.C. (2004) . *Successful Inclusion Strategies for Secondary and Middle School Teachers,* Crowin Press, Sage Publications.
- Hegarthy, S. & Alur, M. (2002). *Education of Children with Special Needs: from Segregation to Inclusion*. Corwin Press, Sage Publishers.
- Karant, P., & Rozario, J. ((2003). *Learning Disabilities in India*. Sage Publications.
- Karten, T. J. (2007). *More Inclusion Strategies that Work*. Corwin Press, Sage Publications.
- King☐Sears, M. (1994). *Curriculum☐Based Assessment in Special Edcuation*. California: Singular Publications.
- Kluth, P. (2009). *The autism checklist: A practical reference for parents and teachers*. San Francisco, CA: Jossey-Bass.
- Lewis, R. B., & Doorlag, D. (1995). *Teaching Special Students in the Mainstream*. 4th Ed. New Jersey: Pearson.
- Rayner, S. (2007). *Managing Special and Inclusive Education*, Sage Publications.
- Rose, D. A., Meyer, A. & Hitchcock, C. (2005). *The Universally Designed Classroom: Accessible Curriculum and Digital Technologies.* Cambridge, MA: Harvard Education Press.
- Ryandak, D. L. & Alper, S. (1996). Curriculum Content for Students with Moderate and Severe Disabilities in Inclusive Setting. Boston, Allyn and Bacon.
- Thousand, J., Villa, R., & Nevin, A. (2007). *Differentiating instruction: Collaborative planning and teaching for universally designed learning.* Thousand Oaks, CA: Corwin Press.
- Turnbull, A., Turnbull, R., Turnbull, M., & Shank, D.L. (1995). *Exceptional Lives: Special Education in Today's Schools*. 2nd Ed. New Jersey: Prentice☐Hall.Inc
- Udvari-Solner, A. & Kluth, P. (2008). *Joyful Learning: Active and collaborative learning in inclusive classrooms*. Thousand Oaks, CA: Corwin Press.

DSE Paper – IV

DISSERTATION/ RESEARCH PROJECT
(College can give this choice only for students with above 60% aggregate marks)

The students will select a research project on any Educational issue or problem or topic and prepare a report. The project will be prepared based on proposal already developed in Semester-III, Core-6.

Distribution of Marks will be as follows:

Item	Total
Report	75
Viva-voce	25
Total	**100**

The assessment of students' performance will be made jointly by the external and internal examiners.

<div align="center">

Generic Elective Paper I

EDUCATIONAL PHILOSOPHY

</div>

Learning Objectives

On completion of this course, the learners shall be able to:

- State and analyse the meaning of education and form own concept on education

- Explain philosophy as the foundation of education
- Analyse aims of education
- Describe the essence of different formal philosophies and draw educational implications
- Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

(i) Etymological meaning of education

(ii) Narrower and broader meaning of education, Lifelong Education

(iii)Aims of Education- Individual and Social Aims of Education

(iv)Meaning and nature of philosophy

(v) Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications

(vi)Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

(i) Idealism, Naturalism, Pragmatism with reference to:

(ii) Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

(i) Common Characteristics of Indian Philosophy

(ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

(iii)Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

UNIT 4: Educational Thought of Western and Indian Thinkers

(i) Plato

(ii) Dewey

(iii)Gopabandhu Das

(iv)Gandhi

(v) Tagore

(vi)Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both the internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education.* New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).

- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education.* Delhi: PHI Learning Pvt. Ltd.

- Nayak, B.K . (ND). *Text Book of Foundation of Education.* Cuttack, Odisha: Kitab Mhal.

Reference Books

- Aggrawal, J.C. (2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al.* (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul. Radhakrishnan, S. Indian philosophy Vol. I and Vol. II
- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt. Limited.

Generic Elective Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives

On completion of this course, the students will:

- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics of growth and development during childhood and adolescence.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii) Application of educational psychology in understanding learner
(iv) Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas:
(vi) Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education
(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.
(iii) Measurement of intelligence- individual and group test, verbal, non-verbal test
(iv) Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning
(ii) Theories of learning with experiment and educational implications-
(iii) Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning
(iv) Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality
(ii) Theories- type theory(Jung), trait theory(Allport)

(iii) Assessment of personality- subjective, objective and projective techniques
(iv) Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.
(v) Adjustment mechanism: Concept and Types

PRACTICAL

- Case study of an exceptional child and reporting

N.B: It will be evaluated by both the Internal and External examiners**.**

Text Books

- Chauhan, S.S. (1978). *Advanced educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.

- Mangal, S.K. (2002). *Advanced educational psychology*. New Delhi: Prentice Hall of India.

- Woolfolk, A. (2015). *Educational psychology (9ᵗʰ Ed.)*. New Delhi: Pearson Publication

Reference Books

- Aggarwal, J.C. (2014). Essentials of Educational Psychology. New Delhi: Vikas Publishing House Pvt. Ltd.

- Attri, A.K. (2015). *Psychology of development and learning*. New Delhi: APH Publishing Corporation.
- Bernard, P.H. (1970). *Mental Health in the class room*. New York: McGraw Hill.
- Biehier, R.F. & Snowman, J., (1997). *Psychology applied to teaching*. New York: Houghton MIflin.
- Bigge, M.L., *Psychological foundations of education*, Harper and Row, New York, 1985.
- Chandraiah,K.(2011). *Emotional intelligence*. New Delhi: APH Publishing Corporation.
- Dececco, J.P. & Crawford, W.R. (1997). *Psychology of learning and institution*. New Delhi: Prentice Half of India.
- Good T., (1990). *Educational psychology*. Longman, New York, 1990.
- Lindgren, H.C. (1980). *Educational psychology in the classroom*. New York: Oxford University Press.
- Mouly, G.J. (1982). *Psychology for teaching*. Allyn & Bacon, Boston.
- Rothstein, P.R. (1990). *Educational psychology*. New York: McGraw Hill..
- Salvin, R, (1990). *Educational psychology: theory into practice,* N.J.: Prentice hall, Englewood Cliffs,
- Snowman and Biehler **(---).** *Psychology applied to teaching*………..
- Sprint hall, RC. & Sprint hall, NA, (1990). *Educational psychology, development approach*, New York: McGraw Hill.

Generic Elective Paper III

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will
- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues for ensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues for ensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues for ensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1: Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalization of Elementary Education: efforts to achieve UEE, SSA
(iii) Problems and issues in implementing Right to Education Act 2009.
(iv) Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii) Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv) Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi) Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii) Higher education through open and distance learning mode
(iv) Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online examination)

(ii) Choice Based Credits System (CBCS):Concept, Learning Objectives, importance, problems and issues.

(iii)Human Rights Education: Concept, Learning Objectives, importance, problems and issues.

(iv)Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.

(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of Perception of Stakeholder's of Education on any of the current issues and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books

- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21st century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**
  Saxena, V. (2011). Contemporary trends in education: A handbook for educators. New Delhi: Pearson.

Reference Books

- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009.* New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.

- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.
- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

Generic Elective Paper IV

EDUCATIONAL ASSESSMENT AND EVALUATION

Learning Objectives

On completion of this course, the students will.

- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics.

UNIT 4: Characteristics of a good Test
(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability
(iii) Objectivity- concept and methods of estimating objectivity
(iv) Usability- concept and factors ensuring usability

PRACTICAL

- Construction of Unit test on a school subject based on Blueprint and Reporting.

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books
- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES*. Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and assessment. an introduction to the tests and measurement*. California: Mayfield Publishing Co.
- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize*

student learning. Thousand Oaks, California: Corwin Press

- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation.* Boston: Allyn and Bacon.
- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching.* London: Merrill Prentice Hall.
- Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction.* Boston: Allyn and Bacon
- Mohan, R. (2016). *Measurement evaluation and assessment in education.* Delhi: PHI Learning Pvt. Ltd.
- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms.* New Delhi: NCERT
- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement.* Boston: Houghton Miffin.

Course structure of UG Education Pass

Semester	Course	Course Name	Credits	Total marks

I	DSC-I	Educational philosophy	04	75
	DSC-I Practical		02	25
II	DSC-II	Educational psychology	04	75
	DSC-II Practical		02	25
III	DSC-III	Educational sociology	04	75
	DSC-III Practical		02	25
IV	DSC-IV	Changing pedagogical perspective	04	75
	DSC-IV Practical		02	25
V	DSE-I	Contemporary trends and issues in Indian education	04	75
	DSE-I Practical		02	25
VI	DSE-II	Educational assessment and evaluation	04	75
	DSE-II Practical		02	25
			30	**600**

Education Papers for PASS students

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper – 40 hours + 20 hours practical

Discipline Specific Core Paper I

EDUCATIONAL PHILOSOPHY

Learning Objectives

On completion of this course, the learners shall be able to:

- State and analyse the meaning of education and form own concept on education
- Explain philosophy as the foundation of education
- Analyse aims of education
- Describe the essence of different formal philosophies and draw educational implications
- Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

(i) Etymological meaning of education

(ii) Narrower and broader meaning of education, Lifelong Education

(iii)Aims of Education- Individual and Social Aims of Education

(iv)Meaning and nature of philosophy

(v) Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications

(vi)Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

(i) Idealism, Naturalism, Pragmatism with reference to:

(ii) Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

(i) Common Characteristics of Indian Philosophy

(ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

(iii)Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

UNIT 4: Educational Thought of Western and Indian Thinkers

(i) Plato

(ii) Dewey

(iii)Gopabandhu Das

(iv)Gandhi

(v) Tagore

(vi)Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education*. New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).

- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.

- Nayak, B.K (2012). *Text Book of Foundation of Education*. Cuttack, Odisha: Kitab Mhal.

Reference Books

- Aggrawal, J.C. (2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al*. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th

Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul. Radhakrishnan, S. Indian philosophy Vol. I and Vol. II
- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt.Limited.

Discipline Specific Core Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives

On completion of this course, the students will:
- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Describe the theoretical perspectives of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics of growth and development during childhood and adolescence.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii)Application of educational psychology in understanding learner
(iv)Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas:
(vi)Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education
(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.
(iii)Measurement of intelligence- individual and group test, verbal, non-verbal test
(iv)Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning
(ii) Theories of learning with experiment and educational implications-
(iii)Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning
(iv)Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality
(ii) Theories: type theory and trait theory
(iii)Assessment of personality- subjective, objective and projective techniques
(iv)Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.
(v) Adjustment Mechanism: Concept and Types

PRACTICAL

- Administration and interpretation of any psychological test relating to Intelligence OR Personality

N.B: It will be evaluated by both the Internal and External examiners.

Text Books
- Chauhan, S.S. (1978). *Advanced educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.

- Mangal, S.K. (2002). *Advanced educational psychology*. New Delhi: Prentice Hall of India.

- Aggarwal, J.C. (2014). *Essentials of educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.

Reference Books
- Woolfolk, A. (2015). Educational psychology (9th Ed.). New Delhi: Pearson Publication
- Attri, A.K. (2015). Psychology of development and learning. New Delhi: APH Publishing Corporation.
- Bernard, P.H. (1970). Mental Health in the class room. New York: McGraw Hill.
- Biehier, R.F. & Snowman, J., (1997). Psychology applied to teaching. New York:

Houghton Mifflin.

- Bigge, M.L., Psychological foundations of education, Harper and Row, New York, 1985.
- Chandraiah,K.(2011). Emotional intelligence. New Delhi: APH Publishing Corporation.
- Dececco, J.P. & Crawford, W.R. (1997). Psychology of learning and institution. New Delhi: Prentice Half of India.
- Good T., (1990). Educational psychology. Longman, New York, 1990.
- Lindgren, H.C. (1980). Educational psychology in the classroom. New York: Oxford University Press.
- Mouly, G.J. (1982). Psychology for teaching. Allyn & Bacon, Boston.
- Salvin, R, (1990). Educational psychology: theory into practice, N.J.: Prentice hall, Englewood Cliffs,
- Sprint hall, RC. & Sprint hall, NA, (1990). Educational psychology, development approach, New York: McGraw Hill

Discipline Specific Core Paper III

EDUCATIONAL SOCIOLOGY

Learning Objectives
On completion of this course, the students will:
- State the relationship between education and society.
- Understand the meaning of Educational Sociology and function of education as a social system.
- State different agencies of education and their functions.
- Justify the importance of education for social change.
- Describe the role of education in modernization and globalization.
- Describe the function of education to ensure equality and equity.

UNIT 1: Education and Society
(i) Relationship between education and society, school as a miniature society
(ii) Educational Sociology- Concept, nature, scope and importance;
(iii)Relationship between education and sociology.
(iv)Education as a process of Socialization.
(v) Education and Politics, Education and Economic Development

UNIT 2: Agencies of Education
(i) Family- Importance, functions and role for education and socialization of the children
(ii) School - Importance, functions and role for education and socialization of the children
(iii)Society- Importance, functions and role for education and socialization of the children
(iv)Mass Media- Importance, functions and role for education and socialization of the children

UNIT 3: Education, Social change and Modernization

   (i) Concept of social change and factors affecting Social Change
   (ii) Education as an instrument of social change and social control
   (iii)Concept and Attributes of modernization
   (iv)Education for accelerating the process of modernization
   (v) Impact of Globalization, Liberalization, and Privatization on Education

UNIT 4: Equalization of Educational opportunities for ensuring equity and Inclusion

   (i) Concept of equality, equity and inclusion: its educational implication
   (ii) Ensuring equality in the Education of SC and ST
   (iii)Education for Women Empowerment
   (iv)Inclusive Education with reference to children with special needs (CWSN)

PRACTICAL

- Field Visit: Study of a social unit (Home/School/Village/slum) and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books
- Aggrawal, J.C.(2013). *Theory and principle of education*. New Delhi: Vikash Publishing House Pvt Ltd.
- NCERT (2014). Basics in Education. New Delhi: Author.
- Pathak, R. P. (2012). *Philosophical and sociological principles of education*. Delhi: Pearson. Pathak

Reference Books
- Anand, C.L. et.al. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
  Ravi, Samuel.S.(2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
  Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Safaya, R.N. & Shaida, B.D. (2010), Modern theory and principles of education. New Delhi: Dhanpati Publising Company Pvt. Ltd.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.

Saraswati, T.S. (Ed.) (1999).   Culture, socialization and human development. Theory, research and applications in India. New Delhi: Sage Publication.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.

Discipline Specific Core Paper IV

CHANGING PEDAGOGICAL PERSPECTIVE

Learning Objectives
- On completion of this course, the students will:
- Explain the concept of pedagogy
- Differentiate pedagogy from other allied concepts
- Explain different teaching task with example
- Establish relationship between teaching and learning
- List out different approaches and methods of teaching
- Prepare a lesson plan following different designs

UNIT 1: Concept of Teaching and Learning

(i) Meaning and definition of teaching and learning
(ii) Relationship between teaching and learning
(iii) Variables involved in teaching task: independent, dependent and intervening
(iv) Phases of teaching: Pre- active, inter- active and post- active
(v) Levels of teaching: memory, understanding and reflective
(vi) Lesson plan design- The Herbartian steps, 5 E and ICON design model

UNIT 2: Theories of Teaching

(i) Meaning and nature of teaching theory
(ii) Types of teaching theories:
(iii) Formal theories of teaching- communication theory of teaching
(iv) Descriptive theories of teaching– Gagne's hierarchical theory of instruction and Bruner's cognitive theory of instruction
(v) Normative theories of teaching - Mitra's psychological theory of teaching and Clarke's general theory of teaching

UNIT 3: Principles and maxims of teaching

(i) General principles of teaching
(ii) Psychological principles of teaching
(iii)Maxims of teaching
(iv)Core teaching skills: Introducing the lesson, explaining, illustrating with examples, stimulus variation, and reinforcement, questioning, and probing questions, closure.

UNIT 4: Approaches and methods of Teaching

(i) Concept of approach, method, strategy and techniques
(ii) Methods of teaching: inductive-deductive, analytic- synthetic, problem solving and project
(iii) Shift in focus from teaching to learning- constructivist approach to learning

PRACTICAL

- Preparation of Rating Scale/ Observation Schedule and evaluate a classroom teaching and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books

- Mangal, S.K. and Mangal, U.(2010). Essentials of Educational Technology. New Delhi, PHI Learning Pvt. Limited.
- Walia, J.S. (2013). *Educational Technology*. Jalandhar, Punjab: Ahim Publications.
- Sharma, R.A.(1986). *Technology of Teaching*. International Publishing House, Meerut.

Reference Books

- Aggarwal, J.C.(1995). Essentials of Educational Technology, Vikash Publishing House, New Delhi
- Chauhan, S.S.(1995). Innovations of teaching learning process, Vikash Publishing House, New Delhi
- Kochar, S.K.(2011) Methods and Techniques of teaching, Sterling Publisher Pvt. Ltd., New Delhi
- Mangal, S.K.(1988) Foundations of Educational Technology, Ludhiana, Tandan Publications
- Nageswar Rao, S., Sreedhar, P. & Rao, B.(2007). Methods and techniques of teaching, Sonali Publications, New Delhi
- Oliver,R.A. (1963) Effective teaching, JM Dent & Sons
- Pathak, R.P. & Chaudhary, J. (2012) Educational Technology, Pearson, New Delhi
- Ryburn, W.M.(1955) Principles of Teaching, Geoffrey Cembridge, OUP
- Sampath,K, Pannir Salvam,A.,& Santhanam, S.(1981) introduction to Educational Technology, Sterling Publisher, New Delhi

Discipline Specific Elective Paper I

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will

- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues for ensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues for ensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues for ensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1:Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalization of Elementary Education: efforts to achieve UEE, SSA
(iii)Problems and issues in implementing Right to Education Act 2009.
(iv)Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii)Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv)Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi)Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii)Higher education through open and distance learning mode
(iv)Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online

examination)

(ii) Choice Based Credits System(CBCS):Concept, Learning Objectives, importance, problems and issues.

(iii)Human Rights Education: Concept, Learning Objectives, importance, problems and issues.

(iv)Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.

(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of perception of Stakeholder's of Education on any of the current issues based

  on Pass DSE-1 and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books

- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21ˢᵗ century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**
- Saxena, V. (2011). *Contemporary trends in education: A handbook for educators*. New Delhi: Pearson.

Reference Books

- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009.* New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.
- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.

- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

<div align="center">

Discipline Specific Elective Paper II

EDUCATIONAL ASSESSMENT AND EVALUATION

</div>

Learning Objectives

On completion of this course, the students will.
- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of Instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based, objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics.

UNIT 4: Characteristics of a Good Test

(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability
(iii) Objectivity- concept and methods of estimating objectivity
(iv) Usability- concept and factors ensuring usability

PRACTICAL
- Construction of Unit test on a school subject based on blueprint and reporting.

NB: It will be evaluated by both Internal and External examiners.

Text Books
- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
- Goswami, M. (2011). *Measurement and evaluation in psychology and education*. Hyderabad: Neelkamal Publishers
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books
- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES*. Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and*

BA Education (Honours, Elective & Pass) Syllabus 2019-2020

assessment. an introduction to the tests and measurement. California: Mayfield Publishing Co.

- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize student learning*. Thousand Oaks, California: Corwin Press

- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation.* Boston: Allyn and Bacon.

- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching.* London: Merrill Prentice Hall.

- Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction.* Boston: Allyn and Bacon

- Mohan, R. (2016). *Measurement evaluation and assessment in education.* Delhi: PHI Learning Pvt. Ltd.

- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms.* New Delhi: NCERT

- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement.* Boston: Houghton Miffin.

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN MATHEMATICS
(Bachelor of Science Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Preamble

Mathematics is an indispensable tool for much of science and engineering. It provides the basic language for understanding the world and lends precision to scientific thought. The mathematics program at Universities of Odisha aims to provide a foundation for pursuing research in Mathematics as well as to provide essential quantitative skills to those interested in related fields. With the maturing of the Indian industry, there is a large demand for people with strong analytical skills and broad-based background in the mathematical sciences.

COURSE STRUCTURE FOR MATHEMATICS HONORS

Semester	Course	Course Name	Credits
I	AECC-I	AECC-I	04
	C-I	Calculus	04
	C-I	Practical	02
	C-II	Discrete Mathematics	05
	C-II	Tutorial	01
	GE-I	GE-I	05
	GE-I	Tutorial	01
			22
II	AECC-II	AECC-II	04
	C-III	Real Analysis	05
	C-III	Tutorial	01
	C-IV	Differential equations	04
	C-IV	Practical	02
	GE-II	GE-II	05
	GE-II	Tutorial	01
			22
III	C-V	Theory of Real functions	05
	C-V	Tutorial	01
	C-VI	Group Theory-I	05
	C-VI	Tutorial	01
	C-VII	Partial differential equations and system of ODEs	04

		Practical	02
	C-VII		
	GE-III	GE-III	05
	GE-III	Tutorial	01
	SECC-I	SECC-I	04
			28
IV	C-VIII	Numerical Methods and Scientific Computing	04
	C-VIII	Practical	02
	C-IX	Topology of Metric spaces	05
	C-IX	Tutorial	01
	C-X	Ring Theory	05
	C-X	Tutorial	01
	GE-IV	GE-IV (Theory)	05
	GE-IV	Tutorial	01
	SECC-II	SECC-II	04
			28
Semester	Course	Course Name	Credits
V	C-XI	Multivariable Calculus	05
	C-XI	Tutorial	01
	C-XII	Linear Algebra	05
	C-XII	Tutorial	01
	DSE-I	Linear Programming	05
	DSE-I	Tutorial	01
	DSE-II	Probability and Statistics	05
	DSE-II	Tutorial	01

			24
VI	C-XIII	Complex analysis	05
	C-XIII	Tutorial	01
	C-XIV	Group Theory-II	05
	C-XIV	Tutorial	01
	DSE-III	Differential Geometry	05
	DSE-III	Tutorial	01
	DSE-IV	Number Theory/Project	06
			24
		TOTAL	**148**

B.A./B.SC.(HONOURS)-MATHEMATICS

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 5 papers suggested)

Generic Elective for non Mathematics students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper –

For practical paper: Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

For non practical paper: Mid term : 20 marks, End term : 80 marks

 Total – 100 marks   Credit per paper – 6

Teaching hours per paper –

Practical paper-40 hour theory classes + 20 hours Practical classes

Non Practical paper-50 hour theory classes + 10 hours tutorial

CORE PAPER-1
CALCULUS

Objective: The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. More precisely, main target of this course is to explore the different tools for higher order derivatives, to plot the various curves and to solve the problems associated with differentiation and integration of vector functions.

Excepted Outcomes: After completing the course, students are expected to be able to use Leibnitz's rule to evaluate derivatives of higher order, able to study the geometry of various types of functions, evaluate the area, volume using the techniques of integrations, able to identify the difference between scalar and vector, acquired knowledge on some the basic properties of vector functions.

UNIT-I

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of the type $e^{ax+b} sinx, e^{ax+b} cosx, (ax+b)^n sinx, (ax+b)^n cosx$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L' Hospitals rule, Application in business ,economics and life sciences.

UNIT-II

Riemann integration as a limit of sum, integration by parts, Reduction formulae, derivations and illustrations of reduction formulae of the type $\int sin^n xdx, \int cos^n xdx, \int tan^n xdx, \int sec^n xdx, \int (logx)^n dx, \int sin^n xcos^n xdx,$

definite integral, integration by substitution.

UNIT-III

Volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution, techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

UNIT-IV

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

LIST OF PRACTICALS

(To be performed using Computer with aid of MATLAB or such software)

1. Plottingthe graphsofthe functions$e^{ax+b}, \log(ax+b), 1/ax+b, \sin(ax+b), \cos(ax+b)$ and $|ax+b|$to illustrate the effect of a and b on the graph.

2. Plotting the graphs of the polynomial of degree 4 and5.

3. Sketching parametric curves (E.g. Trochoid, cycloid, hypocycloid).

4. Obtaining surface of revolution of curves.

5. Tracing of conics in Cartesian coordinates/polar coordinates.

6. Sketching ellipsoid, hyperboloid of one and two sheets (using Cartesian co-ordinates).

BOOKS RECOMMENDED:

1. H.Anton, I.Bivensand S.Davis, *Calculus*,10thEd., JohnWileyand Sons(Asia) P.Ltd., Singapore, 2002.

2. Shanti Narayan, P. K. Mittal, Differential Calculus, S. Chand, 2014.

3. Shanti Narayan, P. K. Mittal, Integral Calculus, S. Chand, 2014.

BOOKS FOR REFERNCE:

1. James Stewart, Single Variable Calculus, Early Transcendentals, Cengage Learning, 2016.

2. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi,2005.

CORE PAPER-II

DISCRETE MATHEMATICS

Objective: This is a preliminary course for the basic courses in mathematics and all its applications. The objective is to acquaint students with basic counting principles, set theory and logic, matrix theory and graph theory.

Expected Outcomes: The acquired knowledge will help students in simple mathematical modeling. They can study advance courses in mathematical modeling, computer science, statistics, physics, chemistry etc.

UNIT-I

Sets, relations, Equivalence relations, partial ordering, well ordering, axiom of choice, Zorn's lemma, Functions, cardinals and ordinals, countable and uncountable sets, statements, compound statements, proofs in Mathematics, Truth tables, Algebra of propositions, logical arguments, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, modular arithmetic, Chinese remainder theorem, Fermat's little theorem.

UNIT-II

Principles of Mathematical Induction, pigeonhole principle, principle of inclusion and exclusion Fundamental Theorem of Arithmetic, permutation combination circular permutations binomial and multinomial theorem, Recurrence relations, generating functions, generating function from recurrence relations.

UNIT-III

Matrices, algebra of matrices, determinants, fundamental properties, minors and cofactors, product of determinant, adjoint and inverse of a matrix,   Rank and nullity of a matrix, Systems of linear equations, row reduction and echelon forms, solution sets of linear systems, applications of linear systems, Eigen values, Eigen vectors of a matrix.

UNIT-IV

Graph terminology, types of graphs, subgraphs, isomorphic graphs, Adjacency and incidence matrices, Paths, Cycles and connectivity, Eulerian and Hamiltonian paths, Planar graphs.

BOOKS RECOMMENDED:
1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.

2. Kenneth Rosen Discrete mathematics and its applications Mc Graw Hill Education 7th edition.

3. V Krishna Murthy, V. P. Mainra, J. L. Arora, An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd.

<u>**BOOKS FOR REFERENCE:**</u>

1. J. L. Mott, A. Kendel and T.P. Baker: Discrete mathematics for Computer Scientists and Mathematicians, Prentice Hall of India Pvt Ltd, 2008.

CORE PAPER-III

REAL ANALYSIS

Objective: The objective of the course isto have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weierstrass Theorem , sequences and convergence of sequences, series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.

Expected Outcome: On successful completion of this course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

<u>UNIT-I</u>

Review of Algebraic and Order Properties of *R*, ε-neighborhood of a point in *R*, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of *R*, The Archimedean Property, Density of Rational (and Irrational) numbers in *R*., Intervals, Interior point, , Open Sets, Closed sets, , Limit points of a set , Illustrations of Bolzano-Weierstrass theorem for sets, closure, interior and boundary of a set.

<u>UNIT-II</u>

Sequences and Subsequences, Bounded sequence, Convergent sequence, Limit of a sequence.

Limit Theorems, Monotone Sequences,. Divergence Criteria, Bolzano Weierstrass Theorem for Sequences, Cauchy sequence, Cauchy's Convergence Criterion. Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

UNIT-III

Limitsof functions (epsilon-deltaapproach),sequential criterionforlimits, divergence criteria. Limit theorems, onesidedlimits, Infinitelimitsandlimits at infinity, Continuous functions, sequential criterion forcontinuity &discontinuity. Algebra ofcontinuousfunctions, Continuousfunctions onaninterval, Boundedness Theorem, Maximum Minimum Theorem, Bolzano's Intermediatevaluetheorem, location of rootstheorem, preservation of intervalstheorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem, Monotone and Inverse Functions.

UNIT-IV

Differentiabilityofafunction ata point&inaninterval, Caratheodory'stheorem, chain Rule,algebra of differentiable functions, Mean value theorem, interior extremum theorem. Rolle'stheorem, intermediate value property ofderivatives,Darboux'stheorem. Applications of mean value theorem toinequalities.

BOOKS RECOMMENDED:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore,2002.
2. G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co.

BOOKS FOR REFERENCE:

1. S.C. Mallik and S. Arora-Mathematical Analysis, New Age InternationalPublications.
2. A.Kumar, S. Kumaresan, *A basic course in Real Analysis*, CRC Press, 2014.
3. BrianS.*Thomson*,Andrew.M.*Bruckner*,andJudithB.*Bruckner*,*ElementaryReal Analysis,* Prentice Hall,2001.
4. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, *An Introductionto Analysis,*Jones & Bartlett, Second Edition, 2010.

CORE PAPER-IV

DIFFERENTIAL EQUATIONS

Objective: Differential Equations introduced by Leibnitz in 1676 models almost all Physical, Biological, Chemical systems in nature. The objective of this course is to familiarize the students with various methods of solving differential equations and to have a qualitative applications through models. The students have to solve problems to understand the methods.

Expected Outcomes: A student completing the course is able to solve differential equations and is able to model problems in nature using Ordinary Differential Equations. This is also prerequisite for studying the course in Partial Differential Equations and models dealing with Partial Differential Equations.

UNIT-I

Differential equations and mathematical models, General, Particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equations and Bernoulli's equation, special integrating factors and transformations.

UNIT-II

Introduction to compartmental models, Exponential decay radioactivity (case study of detecting art forgeries), lake pollution model (with case study of Lake Burley Griffin), drug assimilation into the blood (case study of dull, dizzy and dead), exponential growth of population, Density dependent growth, Limited growth with harvesting.

UNIT-III

General solution of homogeneous equation of second order, principle of superposition, Wronskian, its properties and applications, method of undetermined coefficients, Method of variation of parameters, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation.

Equilibrium points, Interpretation of the phase plane, predatory-pray model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

Practical / Lab work to be performed on a computer:

Modeling of the following problems using *Matlab / Mathematica / Maple* etc.

1. Plotting of second & third order solution family of differentialequations.
2. Growth & Decay model (exponential caseonly).
3. (a) Lake pollution model (with constant/seasonal flow and pollution concentration)/

    (b) Case of single cold pill and a course of cold pills.

    (c) Limited growth of population (with and without harvesting).

4. (a) Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).

    (b) Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).

    (c) Battle model (basic battle model, jungle warfare, long range weapons).
5. Plotting of recursivesequences.

BOOKS RECOMMENDED:

1. J. Sinha Roy and S Padhy: A course of Ordinary and Partial differential equation Kalyani Publishers,New Delhi.
2. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies,A DifferentialEquationApproachusingMapleandMatlab,*2ndEd.,TaylorandFrancisgroup, London and New York,2009.

BOOKS FOR REFERENCE:

1. Simmons G F, Differential equation, Tata Mc GrawHill, 1991.

2. Martin Braun, Differential Equations and their Applications, Springer International, Student

Ed.

3. S. L. Ross, Differential Equations, 3rd Edition, John Wiley and Sons, India.

4. C.Y. Lin, Theory and Examples of Ordinary Differential Equations, World Scientific, 2011.

CORE PAPER-V
THEORY OF REAL FUNCTIONS

Objective: The objective of the course is to have knowledge on limit theorems on functions, limits of functions, continuity of functions and its properties, uniform continuity, differentiability of functions, algebra of functions and Taylor's theorem and, its applications. The student how to deal with real functions and understands uniform continuity, mean value theorems also.

Expected Outcome: On the completion of the course, students will have working knowledge on the concepts and theorems of the elementary calculus of functions of one real variable. They will work out problems involving derivatives of function and their applications. They can use derivatives to analyze and sketch the graph of a function of one variable, can also obtain absolute value and relative extrema of functions. This knowledge is basic and students can take all other analysis courses after learning this course.

UNIT-I

L' Hospital's Rules, other Intermediate forms, Cauchy's meanvalue theorem, Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, Relative extrema,Taylor's series andMaclaurin's series, expansions of exponential andtrigonometric functions.

UNIT-II

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions; Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

UNIT-III

Improper integrals: Convergence of Beta and Gamma functions. Pointwise and uniform convergence of sequence of functions, uniform convergence, Theorems on continuity, derivability and integrability of the limit function of a sequence of functions.

UNIT-IV

 Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test Limit superior and Limit inferior, Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

BOOKS RECOMMENDED:

1. R.G. Bartle & D. R. Sherbert, Introduction to Real Analysis, John Wiley &Sons.
2. G. Das and S. Pattanayak, *Fundamentals of mathematics analysis*, TMH Publishing Co.
3. S. C. Mallik and S. Arora, *Mathematical analysis*, New Age International Ltd., New Delhi.

BOOK FOR REFERENCES:

1. A. Kumar, S. Kumaresan, *A basic course in Real Analysis*, CRC Press, 2014
2. K. A. Ross, *Elementary analysis: the theory of calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004A.Mattuck, Introduction toAnalysis, Prentice Hall
3. Charles G. Denlinger, *Elements of real analysis*, Jones and Bartlett (Student Edition), 2011.

CORE PAPER-VI

GROUP THEORY-I

Objective: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of group theory and examples of groups and their properties. This course will lead to future basic courses in advanced mathematics, such as Group theory-II and ring theory.

Expected Outcomes: A student learning this course gets idea on concept and examples of groups and their properties . He understands cyclic groups, permutation groups, normal subgroups and related results. After this course he can opt for courses in ring theory, field theory, commutative algebras, linear classical groups etc. and can be apply this knowledge to problems in physics, computer science, economics and engineering.

UNIT-I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups, Subgroups and examples of subgroups, centralizer, normalizer, center of a group,

UNIT-II

Product of two subgroups, Properties of cyclic groups, classification of subgroups of cyclic groups,Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group,

UNIT-III

Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, external direct product of a finite number of groups, normal subgroups, factor groups.

UNIT-IV

Cauchy's theorem for finite abelian groups, group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, first, second and third isomorphism theorems.

BOOKS RECOMMENDED:

1. Joseph A. Gallian, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi
2. John B. Fraleigh, *A First Course in Abstract Algebra,* 7th Ed., Pearson, 2002.

BOOK FOR REFERENCES:

1. M. *Artin, Abstract Algebra,* 2nd Ed., Pearson, 2011.
2. Joseph 1. Rotman, *An Introduction to the Theory of Groups,* 4th Ed., Springer Verlag, 1995.
3. I. N. Herstein, *Topics in Algebra,* Wiley Eastern Limited, India, 1975.

CORE PAPER-VII
PARTIAL DIFFERENTIAL EQUATIONS AND SYSTEM OF ODEs

Objective: The objective of this course is to understand basic methods for solving Partial Differential Equations of first order and second order. In the process, students will be exposed to Charpit's Method, Jacobi Method and solve wave equation, heat equation, Laplace Equation etc. They will also learn classification of Partial Differential Equations and system of ordinary differential equations.

Expected Outcomes: After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linear evolution equations etc. All these courses are important in engineering and industrial applications for solving boundary value problem.

UNIT-I

Partial Differential Equations - Basic concepts and Definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

UNIT-II

Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

UNIT-III

The Cauchy problem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end. Equations with non-homogeneous boundary conditions, Non- Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction problem

UNIT-IV

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations.

LIST OF PRACTICALS (USING ANY SOFTWARE)

(i)   Solution of Cauchy problem for first order PDE.

(ii)   Finding the characteristics for the first order PDE.

(iii)   Plot the integral surfaces of a given first order PDE with initial data.

(iv)   Solution of wave equation $\dfrac{\partial^2 u}{\partial t^2} - c\dfrac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

   (a) $u(x, 0) = \phi(x)$, $u_t\{ (x, 0) = \psi(x)$, $x \in R,\ t>0$

   (b) $u(x,0)=\phi(X)$, $u_t\{ (x, 0) = \psi(x)$, $u(0,t)=0$, $x \in (0,\infty),\ t>0$

   (c) $u(x, 0)=\phi(x)$, $u_t \{ (x, 0) = \psi(x)$, $u_x (0,t) = 0$, $x \in (O,\infty),\ t>0$

   (d) $u(x, 0) = \phi(x)$, $ut (x, 0) = \psi(x)$, $u(0,t) = 0$, $u(l,t) = 0$, $0<x<l,\ t>0$

(v)   Solution of wave equation $\dfrac{\partial u}{\partial t} - \kappa\dfrac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

   (a) $u(x, 0) = \phi(x)$, $u(0,t) = a$, $u(l, t) = b$, $0 <x <l,\ t >0$

   (b) $u(x, 0) = \phi(x)$, $x \in R$, $0 <t <T$

   (c) $u(x,0)=\phi(x)$, $u(0,t)=a$, $x \in (0,\infty),\ t \ge 0$

BOOKS RECOMMENDED :

1.   Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers,* 4th edition, Birkhauser, Indian reprint, 2014.

2.   S.L. Ross, *Differential equations,* 3rd Ed., John Wiley and Sons, India,

BOOK FOR REFERENCES:

1. J Sinha Roy and S Padhy:A course of Ordinary and Partial differential equation Kalyani Publishers,New Delhi,

2. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA,* 3rd Ed., Elsevier Academic Press, 2004.

3. Robert C. McOwen: Partial Differential Equations, Pearson Education Inc.

4. T Amarnath: An Elementary Course in Partial Differential Equations, Narosa Publications.

CORE PAPER-VIII
NUMERICAL METHODS AND SCIENTIFIC COMPUTING

Use of Scientific Calculator is allowed.

Objective: Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of systems of linear equations and differential equations, interpolation, differentiation, evaluating integration.

Expected Outcome: Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

UNIT-I

Rate of convergence, Algorithms, Errors: Relative, Absolute, Round off, Truncation. Approximations in Scientific computing, Error propagation and amplification, conditioning, stability and accuracy, computer arithmetic mathematical software and libraries, visualisation, Numerical solution of non-linear equations: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method, Fixed-point Iteration method.

UNIT-II

Rate of convergence of the above methods. System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. Computing eigen-values and eigenvectors

UNIT-III

Polynomial interpolation: Existence uniqueness of interpolating polynomials.Lagrange and Newtons divided difference interpolation, Error in interpolation, Central difference & averaging operators, Gauss-forward and backward difference interpolation. Hermite and Spline interpolation, piecewise polynomial interpolation.

UNIT-IV

Numerical Integration: Some simple quadrature rules, Newton-Cotes rules, Trapezoidal rule, Simpsons rule, Simpsons *3/8th* rule, Numerical differentiation and integration, Chebyshev differentiation and FFT, Richard-son extrapolation.

PRACTICAL/LAB WORK TO BE PERFORMED ON A COMPUTER:

Use of computer aided software (CAS), for example *Matlab / Mathematica / Maple / Maxima* etc., for developing the following Numerical programs:

(i)   Calculate the sum *1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/N.*
(ii)   To find the absolute value of an integer.
(iii) Enter- 100 integers into an array and sort them in an ascending' order.

(iv)   Any two of the following
    (a)   Bisection Method
    (b)   Newton Raphson Method
    (c)   Secant Method
    (d)   Regular Falsi Method
    (v)   Gauss-Jacobi Method
    (vi)   SOR Method or Gauss-Siedel Method
    (vii) Lagrange Interpolation or Newton Interpolation

(viii) Simpson's rule.

Note: For any of the CAS *Matlab / Mathematica / Maple / Maxima* etc., Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expression, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

BOOKS RECOMMENDED:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation,* New age International Publisher, India,

2. Michael Heath: Scientific Computing : An introductory Survey.

BOOK FOR REFERENCES:

1. B. Bradie, *A Friendly Introduction to Numerical Analysis,* Pearson Education, India, 2007.

2. Kendall E. Atkinson: An Introduction to Numerical Analysis

3. C. F. Gerald and P. O. Wheatley, *App.ied Numerical Analysis,* Pearson Education, India, 7th Edition, 2008

4. S. D. Conte & S. de Boor: Elementary Numerical Analysis: An Algorithmic Approach.

CORE PAPER-IX
TOPOLOGY OF METRIC SPACES

Objective: This is an introductory course in topology of metric spaces. The objective of this course is to impart knowledge on open sets, closed sets, continuous functions, connectedness and compactness in metric spaces.

Expected Outcomes: On successful completion of the course students will learn to work with abstract topological spaces. This is a foundation course for all analysis courses in future.

UNIT-I

Metric spaces, sequences in metric spaces, Cauchy sequences, complete metric spaces, open and closed balls, neighborhood, open set, interior of a set, limit point of a set, closed set, diameter of a set, Cantor's theorem,

UNIT-II

Subspaces, Countability Axioms and Separability, Baire's Category theorem

UNIT-III

Continuity: Continuous mappings, Extension theorems, Real and Complex valued Continuous functions, Uniform continuity, Homeomorphism, Equivalent metrics and isometry, uniform convergence of sequences of functions.

UNIT-IV

Contraction mappings and applications, connectedness, Local connectedness, Bounded sets and compactness, other characterization of compactness, continuous functions on compact spaces,

BOOKS RECOMMENDED:

1. Satish Shirali & Harikishan L. Vasudeva, *Metric Spaces*, Springer Verlag London (2006) (First Indian Reprint 2009)

BOOK FOR REFERENCES:

1. S. Kumaresan, *Topology of Metric Spaces*, Narosa Publishing House, Second Edition 2011.

CORE PAPER-X
RING THEORY

Objective: This is a second course in modern algebra which deals with ring theory. Some basics of ring theory like rings, subrings, ideals, ring homomorphisms and their properties and. This course is an integral part of any course on Modern algebra the ohers being Group theory and Field Theory.

Expected Outcomes: After completing this course, this will help students to continue more courses in advanced Ring theory modules, Galois groups.

UNIT-I

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring, Ideals, ideal generated by a subset of a ring, factor rings, operations on ideals.

UNIT-II

Prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

UNIT-III

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, Unique factorization in Z[x].

UNIT-IV

Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

BOOKS RECOMMENDED:

1. Joseph A. Gallian, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi.
2. John B. Fraleigh, *A First Course in Abstract Algebra,* 7th Ed., Pearson, 2002.

BOOK FOR REFERENCES:

1. M. *Artin, Abstract Algebra,* 2nd Ed., Pearson, 2011.
2. Joseph 1. Rotman, *An Introduction to the Theory of Groups,* 4th Ed., Springer Verlag, 1995.
3. I. N. Herstein, *Topics in Algebra,* Wiley Eastern Limited, India, 1975.

CORE PAPER - XI
MULTIVARIATE CALCULUS

Objective: The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus. The course will introduce partial derivatives and several of its consequences and will introduce double and triple integrals along with line integrals which are fundamental to all streams where calculus can be used.

Expected Outcomes: After reading this course a student will be able to calculate partial derivatives,directional derivatives,extremum values and can calculate double, triple and line integrals. He will have idea of basic vector calculus including green's theorem, divergence

theorem.and stokes theorem. He can take courses in calculus on manifolds, Differential geometry and can help in numerical computations involving several variables.

UNIT-I

Functions of several variables, limit and continuity of functions of two variables. Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT-II

Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems.

Definition of vector field, divergence and curl, Double integration over rectangular region, double integration over nonrectangular region. Double integrals in polar co-ordinates,

UNIT-III

Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co- ordinates. Change of variables in double integrals and triple integrals.

UNIT-IV

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservativevector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stokes' theorem, The Divergence theorem.

BOOKS RECOMMENDED:

1. M. J,.Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. S C Mallik and S Arora: Mathematical Analysis, New Age International Publications

BOOK FOR REFERENCES:

1. G.B. Thomas and R.L. Finney, *Calculus,* 9th Ed., Pearson Education, Delhi, 2005.
2. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus,*Springer(SIE). Indian reprint, 2005.

3. James Stewart, *Multivariable Calculus, Concepts and Contexts,*2nd Ed., Brooks/*Cole,* Thomson Learning, USA, 2001.

4. S Ghorpade, B V Limaye, Multivariable calculus, Springer international edition

CORE PAPER –XII
LINEAR ALGEBRA

Objective: Linear algebra is a basic course in almost all branches of science. A full course in undergraduate program will help students in finding real life applications later.. The objective of this course is to introduce a student the basics of linear algebra and some of its application

Expected Outcomes: The student will use this knowledge wherever he/She goes after undergraduate program. It has applications in computer science, finance mathematics, industrial mathematics, bio mathematics and what not.

UNIT-I

Vector spaces, subspaces, examples, algebra of subs paces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Linear transformations, null space, range, rank and nullity of a linear transformation.

UNIT-II

Matrix representation of a linear transformation, Algebra of linear transformations, Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix, Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Basics of Fields.

UNIT-III

Eigenspaces of a linear operator, diagonalizability. Invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, Inner product spaces and norms, Gram-Schmidt orthogonalization process,

UNIT-IV

Orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint

operators, Orthogonal projections and Spectral theorem.

BOOKS RECOMMENDED:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra* (4th Edition), Pearson, 2018.

BOOKS FOR REFERENCE:

1. Rao A R and Bhim Sankaram Linear Algebra Hindustan Publishing house.
2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

CORE PAPER-XIII
COMPLEX ANALYSIS

Objectives: The objective of the courseis aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity and complex integration are presented. The Cauchy's theoremand its applications, the calculus of residues and its applications are discussed in detail.

Expected Outcomes: Students will be able to handle certain integrals not evaluated earlier and will know a technique for counting the zeros of polynomials. This course is prerequisite to many other advance analysis courses.

UNIT-I

Complex Numbers and Complex plane: Basic properties, convergence, Sets in the Complex plane, Functions on the Complex plane: Continuous functions, holomorphic functions, power series, Integration along curves.

UNIT-II

Cauchy's Theoremand Its Applications: Goursat's theorem, Local existence of primitives and Cauchy's theorem in a disc, Evaluation of some integrals, Cauchy's integral formulas.

UNIT-III

Morera's theorem, Sequences of holomorphic functions, Holomorphic functions defined in terms of integrals, Schwarz reflection principle, Zeros and poles.

UNIT-IV

Meromorphic Functions and the Logarithm: The residue formula, Examples, Singularities and meromorphic functions, The argument principle and applications, The complex logarithm.

BOOKS RECOMMENDED:

1. Elias M. Stein & Rami Shakarchi, Complex Analysis, Princeton University press, Princeton and Oxford, 2003.

BOOKS FOR REFERENCE:

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications* (Eighth Edition), McGraw - Hill International Edition, 2009.
2. G. F. Simmons, *Introduction to Topology and Modern Analysis*, Mcgraw-Hill, Edition 2004.
3. Joseph Bak and Donald 1. Newman, *Complex analysis* (2ndEdition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

CORE PAPER-XIV
GROUP-THEORY-II

Objective: The objective of this course **i**s to be exposed to moreadvanced results in group theory after completing a basic course. The course introduces results on automorphism, commutator subgroup,group action Sylow theorems etc.

Expected Outcomes: The knowledge of automorphism helps to study more on field theory. Students learn on direct products, group actions , class equations and their applications with proof of all results . This course helps to opt for more advanced courses in algebra and linear classical groups.

UNIT-I

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups,applications of factor groups to automorphism groups. Characteristic

subgroups.

UNIT-II

Commutator subgroup and its properties, Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

UNIT-III

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Application of group actions: Generalized Cayley's theorem, Index theorem.

UNIT-IV

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, p - groups,Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

BOOKS RECOMMENDED:

1. John B. Fraleigh, *A First Course in Abstract Algebra,* Narosa Publishing House, New Delhi.

2. Joseph A. Gallian *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi.

BOOK FOR REFERENCES:

1. M. Artin, *Abstract Algebra,* 2nd Ed., Pearson, 2011.
2. David S. Dummit and Richard M. Foote, *Abstract Algebra,* 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
3. J.R. Durbin, *Modern Algebra,* John Wiley & Sons, New York Inc., 2000.

Discipline Specific Elective Paper-1
LINEAR PROGRAMMING

Objective: The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.

Expected Outcomes: More knowledge on this topic in higher studies will help students to deal industrial models. This is also prerequisite for studying advanced courses in Nonlinear Programming Problems, Inventory Control Problem and Queuing Theory etc.

UNIT-I
Introduction to linear Programming problem, Theory of simplex method, optimality and unboundedness, the simplex alorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

UNIT-II
Duality, formulation of the dual problem, primal-dual relationships, Fundamental Theorem of Duality, economic interpretation of the dual.

UNIT-III

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem. Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

UNIT-IV
Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

BOOKS RECOMMENDED:

1. Kanti Swarup, Operations Research, Sultan Chand & Sons, New Delhi. Books.

BOOKS FOR REFERENCE:
1. S. Hillier and G.J. Lieberman, *Introduction to Operations Research- Concepts and Cases* (9th Edition), TataMcGraw Hill, 2010.

2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *LinearProgramming and Network Flows* (2nd edition), John Wiley and Sons, India, 2004.

3. G. Hadley, *Linear Programming,* Narosa Publishing House, New Delhi, 2002.
4. Hamdy A. Taha, *Operations Research: An Introduction* (10th edition), Pearson, 2017.

<div align="center">

Discipline Specific Elective Paper-II

Probability and Statistics

</div>

Objective: The objective of the course is to expertise the student to the extensive role of statistics in everyday life and computation, which has made this course a core course in all branches of mathematical and engineering sciences.

Expected Outcome: The students shall learn probability and statistics for various random variables, multivariate distributions, correlations and relations. He shall learn law of large numbers and shall be able to do basic numerical calculations.

UNIT-I

Probablity: Introduction, Sample spaces, Events, probability of events, rules of probability, conditional probability, independent events, Bayes's theorem,

Probability distributions and probability densities: random variables, probability distributions, continuous random variables, probability density functions, Multivariate distributions, joint distribution function, joint probability density function, marginal distributions, conditional distributions, conditional density, The theory in practice, data analysis, frequency distribution, class limits, class frequencies, class boundary, class interval, class mark, skewed data, multimodality, graphical representation of the data, measures of location and variability. Population, sample, parameters

UNIT-II

Mathematical Expectation:Introduction, expected value of random variable, moments, Chebyshev's theorem, moment generating functions, product moments, moments of linear combinations of random variables, conditional expectations, the theory in practice, measures of location, dispersion

UNIT-III

Special probability distributions: Discrete Uniform distribution, binomial distribution, Negative binomial, geometric, hypergeometric, poisson, multinomial distribution, multinomial. Special probability densities; Uniform distribution, gamma, exponential, gamma, chi-square, beta distribution, normal, normal approximation to binomial, bivariate normal, Functions of random variables, distribution function technique, transformation technique-one variable, several variables, moment generating function technique,

UNIT-IV

Sampling distributions: population distribution, random sample, sampling distribution of mean, Central Limit theorem, Sampling distribution of the mean: finite populations, chi-square, t, F distributions, regression and correlation: Bivariate regression, regression equation, Linear regression, method of least squares.

BOOKS RECOMMENDED:
1. Irwin Miller and Marylees Miller, *John E. Freund's Mathematical Statistics with Applications* (8th Edition), Pearson, Asia, 2014.

BOOK FOR REFERENCES:
l.   Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics,* Pearson Education, Asia, 2007.

2.Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory of Statistics,* (3rd Edition), Tata McGraw- Hill, Reprint 2007.

3. Sheldon Ross, *Introduction to Probability Models* (9th Edition), Academic Press, Indian Reprint, 2007.

Discipline Specific Elective Paper-III

DIFFERENTIAL GEOMETRY

Objective: After learning methods on curve tracing andAnalytic Geometry, the objective of this course is to teach Differential geometry of curves and surfaces which trains a student using tools in calculus to derive intrinsic properties of plain curves and space curves.

Expected Outcome: After completing this course a student will learn on serret-Frenet formulae, relation between tangent, normal and binormals, first and second fundamental forms and ideas on various curvatures. He has scope to take more advanced courses in surface theory and geometry.

UNIT-I
Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves.

UNIT-II

Evolutes and involutes of curves. Theory of Surfaces: Parametric curves on surfaces, surfaces of revolution, helicoids, Direction coefficients. First and second Fundamental forms.

UNIT-III

Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula,

Conjugate and Asymptotic lines. Developables: Developable associated with space curves and curves on surfaces, Minimal surfaces.

UNIT-IV

Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature.

BOOKS RECOMMENDED:
1. T.J. Willmore, *An Introduction to Differential Geometry,* Dover Publications, 2012.

BOOK FOR REFERENCES:
1. A. Pressley, Elementary Differential Geometry, Springer Internationl Edition, 2014.
2. O'Neill, *Elementary Differential Geometry,* 2nd Ed., Academic Press, 2006.
3. C.E. Weatherburn, *Differential Geometry of Three Dimensions,* Cambridge University Press 2003.
4. D.J. Struik, *Lectures on Classical Differential Geometry,* Dover Publications, 1988.

<div align="center">

Discipline Specific Elective Paper-IV
NUMBER THEORY

</div>

Objective: The main objective of this course is to build up the basic theory of the integers, prime numbers and their primitive roots, the theory of congruence, quadratic reciprocity law and number theoretic functions, Fermat's last theorem, to acquire knowledge in cryptography specially in RSA encryption and decryption.

Expected Outcomes: Upon successful completion of this course students will able to know the basic definitions and theorems in number theory, to identify order of an integer, primitive roots, Euler's criterion,the Legendre symbol, Jacobi symboland theirproperties, to understand modular arithmetic number-theoretic functions and apply them to cryptography.

UNIT- I
Linear Diophantine equation,primecounting function, statement ofprime number theorem,Goldbach conjecture, linearcongruences, complete set of residues, Chinese remainder theorem,Fermat's littletheorem, Wilson's theorem.

UNIT-II

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties ofthe Dirichlet product, the Mobius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced setofresidues, someproperties ofEuler's phi-function.

UNIT-III

Order of an integer modulo n, primitive roots for primes, composite numbers havingprimitive roots, Euler's criterion, the Legendre symbol, Jacobi symboland their properties, quadratic reciprocity, quadratic congruences with composite moduli.

UNIT-IV
Affine ciphers, Hill ciphers, publickey cryptography, RSA encryption anddecryption, theequation $x^2 + y^2 = z^2$, Fermat's Last Theorem.

BOOKS RECOMMENDED:

1. David M.Burton, *Elementary Number Theory* (6thEdition), TataMcGraw-Hill Edition, Indian reprint, 2007.

BOOK FOR REFERENCES:
1. Thomas Koshy, *ElementaryNumber Theory with Applications (*2nd Edition), Academic Press, 2007.
2. Neville Robinns, *Beginning Number Theory* (2ndEdition), Narosa Publishing House Pvt.Limited, Delhi,2007.

<div align="center">

OR

</div>

Discipline Specific Elective Paper-IV
PROJECT

Guidelines for +3(CBCS) Under Graduate(B.A./B.Sc.) Mathematics(Honours) Project

1. Any student registering for doing project is required to inform the HOD, Mathematics the name of his/her project supervisor(s) at the time of pre-registration.

2. By the last date of add and drop, the student must submit the "Project Registration Form'', appended as Annexure-I to this document, to the HOD, Mathematics. This form requires a project title, the signature of the student, signature(s) of the supervisor(s) and the signature of the HOD, Mathematics of the college/university.

3. The project supervisor(s) should normally be a faculty member(s) of the Department of Mathematics and the topic of the project should be relevant to Mathematical Sciences. If a student desires to have a Project Supervisor from another department of the institute, the prior approval for the same should be sought from the HOD, Mathematics.

4. A student may have at the most two Project Supervisors. If a student desires to have two supervisors, at least one of these should be from the Department of Mathematics.

5. The student(s) will be required to submit one progress report and a final report of the Project to the HOD, Mathematics. The progress report is to be submitted in the sixth week of the semester in which the project is undertaken. The hard copy and an electronic version of the final report of the project should be submitted two weeks before the end semester examination of the sixth semester. In addition the student will be required to make an oral presentation in front of a committee **(**Under Graduate (B.A./B.Sc.) Mathematics (Honours) Project committee of the college in which supervisor is one of the members) constituted for this purpose by the Department of Mathematics of the college.

6. The student is expected to devote about 100 hours. The project will be evaluated by a committee of faculty members at the end of the sixth semester. The committee will be constituted by the Under Graduate (B.A./B.Sc.) Mathematics(Honours) Project committee of the college keeping in mind the areas of project they will cover.

7. In each semester the grade of a student will be awarded by the committee in consultation with his/her project supervisor(s). The project is evaluated on the basis of the following components: First Progress Reports: 20%; second/Final Report: 30%; Presentation: 30%; Viva:20%.

8. Project progress reports should normally be no longer than 250 words and final report should not be longer than 40 A4 size pages in double spacing. Each final project report need to contain the following: (i) Abstract (ii) Table of contents (iii)Review of literature (iv) Main text(v) List of references. It may be desirable to arrange the main text as an introduction, the main body and conclusions.

GUIDELINES FOR STRUCTURING CONTENTS

Sequence of Contents:

The following sequence for the thesis organization should be followed:

(i) Preliminaries   Title Page

Certificate

Abstract/Synopsis

Acknowledgement and/ or Dedication

Table of Contents

List of Figures, Tables, Illustrations,

Symbols, etc (wherever applicable)

(ii) Text of Thesis   Introduction

The body of the thesis, summary and conclusions

(iii) Reference Material   List of References, Bibliography

(iv) Appendices

NOTE:

1. *Synopsis/Abstract* should be self-complete and contain no citations for which the thesis has to be referred.

2. The Text of the Thesis

(a) Introduction:

Introduction may be the first chapter or its first major division. In either case, it should contain a brief statement of the problem investigated. It should outline the scope, aim, general character of the research and the reasons for the student's interest in the problem.

(b) *The body of Thesis*

This is the substance of the dissertation inclusive of all divisions, subdivisions, tables, figures, etc.

(c) *Summary and conclusions*

If required, these are given as the last major division (chapter) of the text. A further and final subdivision titled "*Scope* for Further Work" may follow.

(d) *Reference material*

The list of references should appear as a consolidated list with references listed either alphabetically or sequentially as they appear in the text of the thesis.

For referencing an article in a scientific journal the suggested format should contain the following information: authors, title, name of journal, volume number, page numbers and year. For referencing an article published in a book, the suggested format should contain, authors, the title of the book, editors, publisher, year, page number of the article in the book being referred to. For referencing a thesis the suggested format should contain, author, the title of thesis, where thesis was submitted or awarded, year.

ANNEXURE-I

Department of Mathematics

Project Registration Form

Name of the college/university:

Name of the student:

Roll No. :

e-mail :

Name of the supervisor(s):

Department(s):

e-mail(s):

Title of the Project:

Signature of the Student:

Signature of supervisor(s): (i)

(ii)

Signature of HOD, Mathematics:

GENERIC ELECTIVES (TWO PAPER CHOICE)

Generic Elective Paper I

CALCULUS AND DIFFERENTIAL EQUATIONS

Objective: Calculus invented by Newton and Leibnitz is a powerful analytical tool to solve mathematical problems which arise in all branches of science and engineering. The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of a mathematical nature as well as practical problems using calculus and differential equation. The aim should be to expose the students to basic ideas quickly without much theoretical emphasis with importance on applications.

Excepted Outcomes: After completing the course, students are expected to be able to apply knowledge of calculus and differential equations in the areas of their own interest.

UNIT-I

Curvature, Asymptotes, Tracing of Curves (Catenary, Cycloid, Folium of Descartes), Rectification, Quadrature, Elementary ideas about Sphere, Cones, Cylinders and Conicoids.

UNIT-II

Reviewoflimits,continuityanddifferentiabilityoffunctionsofonevariable and their properties, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's theorem and Cauchy's form of remainder, Taylor's series, Maclaurin's series of $sinx, cosx, e^x, \log(1+x), (1+x)^m$, L' Hospital's Rule, other Intermediate forms.

UNIT-III

Limitand Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions, Change of variables, Mean value theorem,Taylors theorem and Maclaurin's theorem for functions of two variables (statements &applications), Maxima and Minima of functions of two and three variables, Implicit functions, Lagrange's multipliers (Formulae & its applications), Concepts of Multiple integrals & its applications.

Ordinary Differential Equations of order one and degree one (variables separable, homogeneous, exact and linear). Equations of order one but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

BOOKS RECOMMENDED:

1. Shanti Narayan, P. K. Mittal, Differential Calculus, S. Chand, 2014.

2. Shanti Narayan, P. K. Mittal, Integral Calculus, S. Chand, 2014.

3. S.C. Mallik and S. Arora-Mathematical Analysis, New Age InternationalPublications.

4. J. Sinharoy and S. Padhy: A Course of Ordinary and Partial Differential Equations, Kalyani Publishers.

BOOK FOR REFERENCES:

1. H.Anton,I.Bivensand S.Davis,*Calculus*,10thEd.,JohnWileyand Sons(Asia)P.Ltd.,Singapore, 2002.

2. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.

3. Martin Braun-Differential Equations and their Applications-Martin Braun, Springer International.

4. B. P.AcharyaandD. C.Sahu:AnalyticalGeometryofQuadraticSurfaces,KalyaniPublishers.

Generic Elective Paper II

ALGEBRA

Objective: This is a preliminary course for the basic courses in mathematics like, abstract algebra and linear algebra. The objective is to acquaint students with the properties of natural numbers i.e. Euclidean algorithm, congruence relation, fundamental theorem of arithmetic, etc. The basics of linear algebra i.e. vector spaces, matrices are introduced here.

Expected Outcomes: Theacquired knowledge will help students to study further courses in mathematics like, group theory, ring theory and field theory and linear algebra. It has applications not only in higher mathematics but also in other science subjects like computer science, statistics, physics, chemistry etc.

UNIT-I

Sets, relations,Equivalence relations, partial ordering, well ordering, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, statements, compound statements, proofs in Mathematics,Truth tables, Algebra of propositions, logical arguments

UNIT-I

Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

UNIT-III

Matrices, algebra of matrices, determinants, fundamental properties, minors and cofactors, product of determinant, adjoint and inverse of a matrix, Rank and nullity of a matrix, Systems of linear equations, row reduction and echelon forms, solution sets of linear systems, applications of linear systems,.

UNIT-IV

Vector spaces and subspaces, examples, linear independence, linear dependence, basis, dimension, examples, Introduction to linear transformations, matrix representation of a linear transformation, Eigen values, Eigen vectors of amatrix.

BOOKS RECOMMENDED:

1.Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory,

3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.

2.V Krishna Murthy, V P Mainra, J L Arora, An Introduction to Linear Algebra , Affiliated East-West Press Pvt. Ltd

BOOKS FOR REFERENCE:

1**.**   DavidC.Lay,LinearAlgebraanditsApplications,3rdEd.,PearsonEducationAsia,Indian Reprint,2007.

2. B S Vatsa and Suchi Vatsa Theory of Matrices New age International third edition 2010.

3. Ward Cheney, David kincaid. Linear algebra theory and applications, Jones and Bartlett ,2010.

OR

GENERIC ELECTIVES (FOR FOUR PAPERS CHOICE)

Generic Elective Paper III

REAL ANALYSIS

Objective: The objective of the course is to have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weiersstrass Theorem, sequences and convergence of sequences, series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.

Expected Outcome: On successful completion of this course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

UNIT-I

Review of Algebraic and Order Properties of R, ε-neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R.

UNIT-II

Intervals, Interior point, Open Sets, Closed sets, Limit points of a set , Illustrations of Bolzano-Weierstrass theorem for sets, closure, interior and boundary of a set. Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems ,Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only). Bolzano Weierstrass Theorem for Sequences, Cauchy sequence, Cauchy's Convergence Criterion.

UNIT-III

Infinite series, convergence and divergence of infinite series, Cauchy Criterion,Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

UNIT-IV

Sequence and Series of functions, point-wise and uniform convergences, M_n test, M test,

statement of results about uniform convergence, differentiability and integrability of function, power series and radius of convergence.

BOOKS RECOMMENDED:

1. S.C. Mallik and S. Arora-Mathematical Analysis, New Age InternationalPublications.
2. G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co.

BOOKS FOR REFERENCE:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia)   Pvt. Ltd., Singapore,2002.

2. A.Kumar, S. Kumaresan, *A basic course in Real Analysis*, CRC Press, 2014.

3. BrianS.*Thomson*,Andrew.M.*Bruckner*,andJudithB.*Bruckner,ElementaryReal Analysis,* Prentice Hall,2001.

4. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, *An Introductionto Analysis,* Jones & Bartlett, Second Edition, 2010.

Generic Elective Paper IV

NUMERICAL METHODS

Objective: Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of nonlinear equations, systems of linear equations, differential equations, Interpolation, differentiation, evaluating integration.

Expected Outcome: Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

UNIT-I

Algorithms,   Convergence,   Bisection   method,   False   position   method,   Fixed

pointiterationmethod, Newton's method, Secant method.

Gauss Elimination and Gauss Jordan methods, LU decomposition, Gauss-Jacobi, Gauss-Siedel.

UNIT-II

Lagrange and Newton interpolation: linear and higher order, finite differenceoperators.

UNIT-III

Numerical differentiation: forward difference, backward difference and centralDifference.

UNIT-IV

Integration: trapezoidal rule, Simpson's rule, Euler'smethod, Runge-Kutta methods of orders two and four.

BOOKS RECOMMENDED:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific andEngineering Computation*, 5th Ed., New age International Publisher, India,2007.

BOOKS FOR REFERENCE:

1. S. S. Sastry, Introductory method for Numerical Analysis, PHI New Delhi,2012.
2. S. D. Conte and Carl De Boor, Elementary Numerical Analysis, Mc Graw Hill, 1980.

STRUCTURE OF THE +3 UNDER GRADUATE (B.A / B.Sc)

MATHEMATICS (PASS) SYLLABUS

BASED ON CHOICE BASED CREDIT SYSTEM (CBCS)

Semester	Course Number	Title of the Course	Number of credits assigned to the course		Total Credits
			Theory	Practical(P)/ Tutorial((T)	
DSC 4 PAPERS					
	MATH- DSC-1	Calculus and Differential equations	5	1	6
	MATH-DSC2	Algebra	5	1	6
	MATH-DSC-3	Real Analysis	5	1	6
	MATH-DSC-4	Numerical Methods	5	1	6

	DSE 2 PAPERS				
	MATH- DSE-1	Group Theory	5	1	6
	MATH-DSE-2	Linear Programming	5	1	6
				TOTAL	36

B.A./B.SC.(PASS)-MATHEMATICS

MATHEMATICS PAPERS FOR PASS STUDENTS

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

 Marks per paper – Mid term : 20 marks, End term : 80 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper – 50 hours Theory classes + 10 hours tutorial

Discipline Specific Core Paper I

CALCULUS AND DIFFERENTIAL EQUATIONS

Objective: Calculus invented by Newton and Leibnitz is powerful analytical tool to solve mathematical problems which arise in all branches of science and engineering. The main emphasis of this course is to equip the student with necessary analytic and technical skills to

handle problems of a mathematical nature as well as practical problems using calculus and differential equation. The aim should be to expose the students to basic ideas quickly without much theoretical emphasis with importance on applications.

Excepted Outcomes: After completing the course, students are expected to be able to apply knowledge of calculus and differential equations in the areas of their own interest.

UNIT-I

Curvature, Asymptotes, Tracing of Curves (Catenary, Cycloid, Folium of Descartes), Rectification, Quadrature, Elementary ideas about Sphere, Cones, Cylinders and Conicoids.

UNIT-II

Reviewoflimits,continuityanddifferentiabilityoffunctionsofonevariable andtheirproperties, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's theorem and Cauchy's form of remainder, Taylor's series, Maclaurin's series of $sinx, cosx, e^x, \log(1 + x), (1 + x)^m$, L' Hospital's Rule, other Intermediate forms.

UNIT-III

Limitand Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions,Change of variables,Mean value theorem,TaylorstheoremandMaclaurinstheorem for functions of two variables(statements &applications), Maxima and Minima of functions of two and three variables, Implicit functions, Lagranges multipliers (Formulae & its applications), Concepts of Multiple integrals & its applications.

UNIT-IV

OrdinaryDifferentialEquationsoforderoneanddegreeone(variablesseparable,homogeneous,exactand linear).Equationsoforderonebuthigherdegree.Secondorderlinearequationswithconstantcoefficients, homogeneousforms,Secondorderequationswithvariablecoefficients,Variationofparameters.

BOOKS RECOMMENDED:

1. Shanti Narayan, P. K. Mittal, Differential Calculus, S. Chand, 2014.

2. Shanti Narayan, P. K. Mittal, Integral Calculus, S. Chand, 2014.

3. S.C. Mallik and S. Arora-Mathematical Analysis, New Age InternationalPublications.

4. J. Sinharoy and S. Padhy: A Course of Ordinary and Partial Differential Equations,
   Kalyani Publishers.

BOOKS FOR REFERENCE:

1. H.Anton,I.Bivensand S.Davis,*Calculus*,10thEd.,JohnWileyand Sons(Asia)P.Ltd.,Singapore, 2002.

2. Shanti Narayan and P.K. Mittal-Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.

3. Martin Braun-Differential Equations and their Applications-Martin Braun, Springer International.

4. B. P.AcharyaandD. C.Sahu:AnalyticalGeometryofQuadraticSurfaces,KalyaniPublisher

<div align="center">

Discipline Specific Core Paper II

ALGEBRA

</div>

Objective: This is a preliminary course for the basic courses in mathematics like, abstract algebra and linear algebra. The objective is to acquaint students with the properties of natural numbers i.e. Euclidean algorithm, congruence relation, fundamental theorem of arithmetic, etc. The basics of linear algebra i.e. vector spaces, matrices are introduced here.

Expected Outcomes: Theacquired knowledge will help students to study further courses in mathematics like, group theory, ring theory and field theory and linear algebra. It has applications not only in higher mathematics but also in other science subjects like computer science, statistics, physics, chemistry etc.

UNIT-I

Sets,relations,Equivalence relations,partial ordering,well ordering, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, statements, compound statements,proofs in Mathematics,Truth tables, Algebra of propositions,logical arguments

UNIT-II

Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

UNIT-III

Matrices, algebra of matrices , determinants, fundamental properties, minors and cofactors, product of determinant, adjoint and inverse of a matrix, Rank and nullity of a matrix, Systems of linear equations, row reduction and echelon forms, solution sets of linear systems, applications of linear systems,.

UNIT-IV

Vector spaces and subspaces, examples, linear independence, linear dependence, basis, dimension, examples, Introduction to linear transformations, ,matrix representation of a linear transformation,Eigen values, Eigen vectors of amatrix.

BOOKS RECOMMENDED:

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
2. V Krishna Murthy, V P Mainra, J L Arora, An Introduction to Linear Algebra , Affiliated East-West Press Pvt. Ltd

BOOKS FOR REFERENCE:

1. DavidC.Lay,LinearAlgebraanditsApplications,3rdEd.,PearsonEducationAsia,Indian Reprint, 2007.

2. B S Vatsa and Suchi Vatsa Theory of Matrices New age International third edition, 2010.

3. Ward Cheney, David Kincaid. Linear algebra theory and applications ,Jones and Bartlett, 2010.

REAL ANALYSIS

Objective: The objective of the course isto have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weiersstrass Theorem , sequences and convergence of sequences, series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.

Expected Outcome: On successful completion of this course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

UNIT-I

Review of Algebraic and Order Properties of R, ε-neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R, Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R.

UNIT-II

Intervals, Interior point, Open Sets, Closed sets, Limit points of a set , Illustrations of Bolzano-Weierstrass theorem for sets, closure, interior and boundary of a set. Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems ,Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only). Bolzano Weierstrass Theorem for Sequences, Cauchy sequence, Cauchy's Convergence Criterion.

UNIT-III

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

UNIT-IV

Sequence and Series of functions, pointwise and uniform convergences, M_n test, M test, statement of results about uniform convergence, differentiability and integrability of function, power series and radius of convergence.

BOOKS RECOMMENDED:

1. S.C. Mallik and S. Arora-Mathematical Analysis, New Age InternationalPublications.
2. G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co.

BOOKS FOR REFERENCE:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore,2002.

2. A.Kumar, S. Kumaresan, *A basic course in Real Analysis*, CRC Press, 2014.

3. BrianS.*Thomson*,Andrew.M.*Bruckner*,andJudithB.*Bruckner*,*ElementaryReal Analysis*, Prentice Hall,2001.

4. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, *An Introductionto Analysis,*Jones & Bartlett, Second Edition, 2010.

Discipline Specific Core Paper IV
NUMERICAL METHODS

Objective: Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of nonlinear equations, systems of linear equations, differential equations, Interpolation, differentiation, evaluating integration.

Expected Outcome: Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

UNIT-I

Algorithms, Convergence, Bisection method, False position method, Fixed pointiterationmethod, Newton's method, Secant method.

Gauss Elimination and Gauss Jordan methods, LU decomposition, Gauss-Jacobi, Gauss-Siedel.

UNIT-II

Lagrange and Newton interpolation: linear and higher order, finite differenceoperators.

UNIT-III

Numerical differentiation: forward difference, backward difference and centralDifference.

UNIT-IV

Integration: trapezoidal rule, Simpson's rule, Euler'smethod, Runge-Kutta methods of orders two and four.

BOOKS RECOMMENDED:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific andEngineering Computation*, 5th Ed., New age International Publisher, India,2007.

BOOKS FOR REFERENCE:

1. S. S. Sastry, Introductory method for Numerical Analysis, PHI New Delhi,2012.
2. S. D. Conte and Carl De Boor, Elementary Numerical Analysis, Mc Graw Hill, 1980.

Discipline Specific Elective Paper –I

GROUP THEORY

Objective: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of group theory and examples of groups and their properties. This course will lead to future basic courses in advanced mathematics, such as Group theory-II and ring theory.

Expected Outcomes: A student learning this course gets idea on concept and examples of groups and their properties . He understands cyclic groups, permutation groups, normal subgroups and related results. After this course he can opt for courses in ring theory, field theory, commutative algebras, linear classical groups etc. and can be apply this knowledge to problems in physics, computer science, economics and engineering.

UNIT-I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties

of groups, Subgroups and examples of subgroups, centralizer, normalizer, center of a group,

UNIT-II

Product of two subgroups, Properties of cyclic groups, classification of subgroups of cyclic groups,Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group,

UNIT-III

Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, external direct product of a finite number of groups, normal subgroups, factor groups.

UNIT-IV

Cauchy's theorem for finite abelian groups, group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, first, second and third isomorphism theorems.

BOOKS RECOMMENDED:

1. Joseph A. Gallian, *Contemporary Abstract Algebra* (4th Edition), Narosa Publishing House, New Delhi,
2. John B. Fraleigh, *A First Course in Abstract Algebra,* 7th Ed., Pearson, 2002.

BOOK FOR REFERENCES:

1. M. Artin*, Abstract Algebra,* 2nd Ed., Pearson, 2011.
2. Joseph 1. Rotman, *An Introduction to the Theory of Groups,* 4th Ed., Springer Verlag, 1995.
3. I. N. Herstein, *Topics in Algebra,* Wiley Eastern Limited, India, 1975.

Discipline Specific Elective Paper –II
LINEAR PROGRAMMING

Objective: The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.

Expected Outcomes: More knowledge on this topic in higher studies will help students to deal industrial models. This is also prerequisite for studying advanced courses in Nonlinear Programming Problems, Inventory Control Problem and Queuing Theory etc.

UNIT-I

Introduction to linear Programming problem, Theory of simplex method, optimality and unboundedness, the simplex alorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

UNIT-II

Duality, formulation of the dual problem, primal-dual relationships, Fundamental Theorem of Duality, economic interpretation of the dual.

UNIT-III

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem. Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

UNIT-IV

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

BOOKS RECOMMENDED:

1. Kanti Swarup, Operations Research, Sultan Chand & Sons, New Delhi. Books.

BOOKS FOR REFERENCE:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *LinearProgramming and Network Flows* (2nd edition), John Wiley and Sons, India, 2004.

2. Hillier and G.J. Lieberman, *Introduction to Operations Research- Concepts and Cases* (9th

Edition), TataMcGraw Hill, 2010.

3. G. Hadley, *Linear Programming,* Narosa Publishing House, New Delhi, 2002.

4. Hamdy A. Taha, *Operations Research: An Introduction* (10th edition), Pearson, 2017

SKILL ENHANCEMENT COMPULSORY COURSES (SECC)

Optional for SECC II paper

Skill Enhancement Compulsory Courses (Option1)

COMPUTER GRAPHICS

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices. Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti aliasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

Books Recommended:

1. D. Hearn and M.P. Baker-Computer Graphics, 2nd Ed., PrenticeHall of India, 2004.

2. J. D. Foley, A van Dam, S.K. Feiner and J.F. Hughes-Computer Graphics: Principals and Practices, 2nd Ed., Addison-Wesley, MA, 1990.

3. D. F. Rogers-Procedural Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 2001.

4. D. F. Rogers and A. J. Admas-Mathematical Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 1990.

<div align="center">

SKILL ENHANCEMENT COURSES (Option2)-

INFORMATION SECURITY

</div>

Overview of Security: Protection versus security; aspects of security data integrity, data availability, privacy; security problems, user authentication, Orange Book. Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. C. Pfleeger and S. L. Pfleeger-Security in Computing, 3rd Ed., Prentice-Hall of India, 2007.
2. D. Gollmann-Computer Security, John Wiley and Sons, NY, 2002.
3. J. Piwprzyk, T. Hardjono and J. Seberry-Fundamentals of Computer Security, Springer-Verlag Berlin, 2003. 335
4. J.M. Kizza-Computer Network Security, Springer, 2007.

5. M. Merkow and J. Breithaupt-Information Security: Principles and Practices, Pearson Education, 2006.

<u>**Training Programmes to be Imparted**</u>

1.   There should be training programs in MATLAB/ PYTHON/R/ MATHEMATICA software for all college teachers to acquaint the teachers on state of the art. Experts from Indian Statistical Institute Kolkata and nearby IIT's should be invited for the programs to ensure quality.

2. The faculty members in colleges/universities should be trained in the following courses at University or any Institute of Higher Learning.

a) Advanced Group Theory
b) Advanced Ring Theory
c) Differential Equations & Mathematical Modeling
d) Mathematical Finance
e) Object Oriented Programming in C++

f) Computer Graphics

g) Information Security

3. Emphasis may be given for implementation of the programs as listed in the courses with Practical.

4. College/ Universities should be provided with the recommended set of books in adequate numbers.

5. There should be frequent visits to colleges/ Universities offering crash courses to initiate some of the new courses.

Required Equipment/Technical Experts

The following equipment /software are to be provided to colleges / universities for smooth running of practical/ project:

1. There should be funding to Computer Lab with minimum of 15 computer systems for 30 students with licensed MATLAB/ PYTHON/R/MATHEMATICA software.

2. At least one computer programmer must be assigned in computer labs during practical sessions.

Model Syllabus of Courses

Ability/Skill Enhancement

STATE MODEL SYLLABUS FOR UNDER GRADUATE

COURSE IN

ABILITY/SKILL ENHANCEMENT

(+3 Arts, Science &Commerce Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

ENVIRONMENTAL STUDIES (AECC I)

SEMESTER – I

FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE – 2019-20

FULL MARKS: 100

TIME: 3 HOURS   END SEMESTER: 80
TIME: 1 HOUR   MID SEMESTER: 20

Unit – I

The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle), Environment Pollution: Air Pollution, Water Pollution, Soil Pollution, Radiation Pollution.

Unit – II
Population Ecology: Individuals, Species, Pollution, Community, Control Methods of Population, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases.

Unit- III
Environmental Movements in India: Grass root Environmental movements in India, Role of women, Environmental Movements in Odisha, State Pollution Control Board, Central Pollution Control Board.

Unit –IV

Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Natural Disasters and their Management.

Books Recommended
1. Dash MC and Mishrs PC, Man and Environment, McMillan, London.
2. Mishra PC and Das MC, Environment and Society, McMillan, London.
3. Odeem EP, Fundamentals of Ecology, Natraj Publication.
 4. Mishra DD, Fundamental Concept in Environmental Studies, S.Chand, New Delhi.
5. Asthana DK and Asthana Meera, A Testbook of Environmental Studies, S. Chand, New Delhi.

6. Bharucah Erach, Textbook for Environmental Studies, Universities Press India Pvt. Ltd., Hyderabad.

Ability Enhancement Compulsory Course (AECC II)
MIL / Alternative English **

** The Detailed course is available in the respective language courses. For Example, MIL Odia is available in the Model Syllabus for Odia

As per the CBCS regulation, the student registered under Honours course in any subject has to opt for two SEC courses and a student registered under Pass stream has to opt for four SEC courses. In this context, Some options are provided here. Syllabus of individual subjects also have listed additional skill based papers at the end. In addition, the combined board and Project OHEPEE has also formulated two skill papers in great detail keeping requirements of spoken English and quantitative as well as logical thinking abilities in mind. These two Special SEC papers are available as separate Model Syllabi.

Optional for SEC paper

Total Marks- 100

Skill Enhancement Courses (SEC Option-I)

ENGLISH COMMUNICATION

Introduction: This paper intends to build up the four primary skills in students in the academic as well as in the wider domains of use like public offices. The books recommended only provide guidelines for what to teach, and the list is in no way exhaustive. Teachers must be free and resourceful enough to collect teaching materials on their own, and even use newspaper clippings as teaching materials.

This is an activity-based, goal-oriented, functional course in English Communication, which aims to make the students able and efficient communicators by helping them to be self-reflexive about English. This course has a pre-defined context of being supportive and complementary to the core courses in various disciplines. Therefore, unlike most other courses in English Communication on offer, it does not seek to build facile fluency that passes off as communicative competence. Rather, it intends to equip the students with the relevant skills of presentation and expression needed in the academic as well as in the professional domains of communicative use. While reading skills exercises are meant to promote the acquisition of analytical and comprehension skills, writing skills exercises are centered on sentence construction, paragraph development and précis writing. Teachers must be free and flexible enough in relation to teaching materials, using newspaper clippings, non-conventional and multi-media resources in the classroom. There is ample scope to build the speaking and listening skills of students in the way the course is planned with an emphasis on interactive learning and articulation.

UNIT 1: Introduction
   (i) What is communication?
   (ii) Types of communication (Horizontal, Vertical, Interpersonal, Grapevine),
   (iii)   Uses of Communication, Inter-cultural communication, Communication today:
   (iv) Distinct features of Indianisation, alternative texts of language learning, global English and English in the print and electronic media in India.

UNIT 2: The Four Skills and Prospect of new material in language learning
   (i) Listening-Passive and active, Speaking effective, intelligibility and clarity
   (ii) Methods and techniques of reading such as skimming, scanning and searching for information; Reading to understand the literal, metaphorical and suggested meaning of a passage,
   (iii)   Identifying the tone (admiring, accusatory, ironical, sympathetic, evasive, indecisive, ambiguous, neutral etc.) of the writer and view-points.
   (iv) Cohesive and Coherent writing

UNIT 3: Grammatical and Composition Skills

   (i) Doing exercises like filling in the blanks, correcting errors, choosing correct forms out of alternative choices, joining clauses, rewriting sentences as directed, and replacing indicated sections with single words / opposites / synonyms, choosing to use correct punctuation marks, getting to understand and use formal and informal styles, learning to understand the usages of officialese, sexism, racism, jargon.
   (ii) Learning to understand information structure of the sentence such as topic-focus relationship; strategies of thematization, postponement, emphasis, structural compression (deletion of redundant parts, nominalization, cleft and pseudo-cleft sentences, elliptical structures etc.), Logical Connectors between sentences, Methods of developing a paragraph, structure of an essay and methods of developing an essay

UNIT 4: Exercises in Written Communication
   (i) Précis writing
   (ii) Note-taking skills
   (iii)   Writing reports
   (iv) Guidelines and essentials of official correspondence for making enquiries, complaints and replies
   (v) Making representations; writing letters of application for jobs; writing CV, writing letters to the editor and social appeals in the form of letters/pamphlets.

Reference Books:
   - *Ways of Reading: Advanced reading Skills for Students of English Literature*. Martin Montgomery et al. London: Routledge, 2007.

- *Applying Communication Theory for Professional Life: A Practical Introduction*. Dainton and Zelley, http://tsime.uz.ac.zw/claroline/backends/download.php?url=L0ludHJvX3RvX2NvbW11bmljYRpb25fVGhlb3J5LnBkZg%3D%3D&cidReset=true&cidReq=MBA563
- *Literature and the art of Communication*, Cambridge University Press.
- *Vistas and Visions*. Orient Black Swan (writing and grammar exercises at the end of lessons are recommended) From *Remapping An Anthology for Degree Classes*, ('Writing Skills'), Orient Black Swan.
- *Indian English through Newspapers (*Chapter 4,5 and 6), Concept, New Delhi,2008.
- *Contemporary Communicative English,* S Chand
- Technical Communication: A Reader Centred Approach. P.V. Anderson. Wadsworth, Cengage.

SEC Option II
MODERN OFFICE MANAGEMENT

Full marks – 100
Mid Term-20
End Term-80

Unit- I: Office

What is a Business Enterprise? What is an Office? Who are Office Staff? What are the most Common Forms of Business Organization? What are the Advantages of Office Work? What are the Categories of Office Career and Job Classifications under Each Category? What are the Specific Skill Requirements for Office Jobs? Duties and Responsibilities of Office Staff

Unit-II: Records Management

Objectives of Record Keeping; What is Filing? What are the Different Kinds of Filing System? Steps in Filing; Indexing; Selecting the Appropriate Filing System; How to handle Incoming & Outgoing Mails

Unit –III: Document/Report Writing

Key points to write a document: The 5w-h plan for writing; Steps in writing workplace documents; Important things to remember when editing seven layout mistakes to avoid; Quick tips for report Writing; Basics of Meetings

Unit-IV: Supervisory Skills

What are the Skills of the Supervisor and How to Acquire Them? Functions of Supervisor

Communication

Meaning; Process; Communicating Tools; Types, Barriers

Leadership & Motivation

Meaning and Concept; Importance of Leadership; Qualities of a Leader; Relationship & Differences Leadership and Motivation; Organizational Leadership; Leadership Ethics - Traits of an Ethical Leader; Leadership Styles - Important Leadership Styles- Situational Leadership – Emotional Intelligence of Leader; Which Leadership Style to Follow? Influence of Situational Leadership Styles on Subordinate Development;

References:–

1. Office Management
   By Ankita Bhatia
   Dr. R. K. Chopra
2. Office Management
   By Dr. P. Rizwan Ahmed
3. Office Management
   By R S N Pillai

SEC OPTION III

Leadership and Personality Development

Full Mark:-100   (Mid Sem:-20   End Sem.:80) Credit Point-04 Credit Hour-40

Unit I: Leadership: Definition and meaning, Importance, Leadership and Management, Leader vs Manager, Essential qualities of an effective leader

Unit II: Theories of Leadership: Trait theory, Behavioral theories, Contingency theory

Unit III: Types of Leaders, Leadership styles: Traditional, Transactional, Transformational, Inspirational and servant leadership and Emerging issues in leadership: Emotional Intelligence and leadership, Trust as a factor, Gender and Leadership

Unit IV: Personality: Concept and Definition, Determinants of personality, Personality traits, Personality characteristics in organizations: Self evaluation, Locus of control, Self-efficacy, Self-esteem, Self-monitoring: Positive and negative Impact. Organizational Context of Leadership and Personality, Contemporary Business Leaders.

Book Reference:

1. Organisational Behaviour , M.Parikh and R.Gupta , TataMcGraw Hill Education Private Limited
2. Organisational Behavior, D. Nelson, J.C Quick and P. Khandelwal, Cengage Publication.

SEC OPTION IV

FINANCIAL LITERACY AND BANKING

Full Marks – 100
(Mid Sem-20 + End Sem-80)
Credit Points - 4

Objectives- To make the students aware of the benefits of financial planning

Unit: I – Basics of Savings and Investment: Why are investing and savings important? Savings Vs Investment, Power of Compounding, What should be the investment objectives? Risk and Return, Inflation effects on Investment, Investor's Age and Assets Allocation. **Tax saving Schemes**-Government Schemes-National Saving Certificates, Public Provident Fund, Post Office Schemes, Equity Linked Savings Schemes, Retirement Benefits Schemes- NPS (New Pension System)

Unit:-II- Banking Activities: Deposits and Types of Deposits-Saving Bank Accounts, Fixed Deposit Accounts, Recurring Deposit Account, Special Term Deposit Schemes, Loans and Types of loan advanced by Banks and Other secondary functions of Bank. Banking structure in India and Role of Reserve Bank of India

Unit: III- Financial Markets: Capital Market Vs Money Market, Securities and its types, i.e., Equity, Debentures or Bonds, IPOs and FPOs, Mutual Funds, Types of Mutual Funds, Brokers, sub-brokers, Process for becoming a capital market investor

Unit:IV- Protection Related products: Insurance Policies, Life Insurance, Term Life Insurance, Endowment Policies, Pension Policies, ULIP, Health Insurance and its Plans, Understanding of Ponzi Schemes

Output: It will make a more responsible individual with a disciplined approach to money and helps people from overspending and inculcates a habit of savings and investments.

Books for References:

1. Investment Planning by SEBI
2. Indian financial System, by T. R. Jain and R. L .Sharma, VK Global Publisher
3. Money and Banking by T. R. Jain and R. K. Kaundal, VK Global Publisher

SEC OPTION V

DATA ANALYSIS AND COMPUTER APPLICATION

Course Description: The purpose of this course is to introduce basic computer skills to students at UG level in non technical subjects. After completion of this course, the students are expected to acquire some basic knowledge about computers and to develop some basic skills in using computers for data storage, compilation, analysis and presentation.

Module I:

Introduction to computer and Basic data types Introduction to computer- Characteristics and Basic Applications of Computer, Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Memory, concepts of Hardware and Software, Classifications of computers; Representation of data/Information concepts of data processing, Basic data types, Storage of data/Information as files, operating system and The User Interface (windows, Linux), Windows Setting- Control Panels, Accessories (windows)

Module II:

Basic Word Processing Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats. Basic Presentations Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides

Module III:

Spreadsheets and Basic Data Analysis Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread

sheets for Small accountings maintaining invoices/budgets, basic practical data analysis works (Maintaining daily and monthly sales reports)

Module IV:

Basic Computer Communication and Internet Basic of Computer networks- LAN and WAN, Internet, Service on Internet; WWW and Web Browsers, Web Browsing software, Surfing the Internet, Chatting on Internet, Email-Basic of electronic mail, Using Emails, Document handling in Email.

Reading List:

1. C.S. French "Data Processing and Information Technology", BPB Publications 1998

2. P.K Sinha, Computer Fundamentals, BPB Publications, 1992

3. Guy Hart-Davis "The ABCs of Microsoft Office 97 Professional edition", BPB Publications, 1998 4. Karl Schwartz, "Microsoft Windows 98 Training Guide", 1998

STATE MODEL SYLLABUS FOR UNDERGRADUATE COURSE IN ODIA

+3, Arts, Science & Commerce

(Under Choice Based Credit System)

ପସଦ ଓ ଆସ୍ଥାଭିତ୍ତିକ ପାଠ୍ୟଖସଡ଼ା : ସ୍ନାତକ (ଓଡ଼ିଆ ସମ୍ମାନ) ୨୦୧୯-୨୦

CBCS : BA (Hons.) 2019-20

Core Course – ପ୍ରଧାନ ପାଠ୍ୟାଂଶ

ମୋଟ୍ ପତ୍ର ସଂଖ୍ୟା – ୧୪

ପ୍ରତ୍ୟେକ ପତ୍ର – ୧୦୦ ମୂଲ୍ୟାଙ୍କ ବିଶିଷ୍ଟ (୨୦ ନମ୍ବର ମହାବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ଅନ୍ତଃ ପର୍ଯ୍ୟାୟ ପରୀକ୍ଷା + ୮୦ ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ମାନକ ଅନ୍ତିମ ପରୀକ୍ଷା)

ସମ୍ମାନ : ଜଣେ ସ୍ନାତକ – ସମ୍ମାନର (ଅନର୍ସ) ବିଦ୍ୟାର୍ଥୀ – ମୋଟ୍ ୧୪୦୦ ନମ୍ବରର ପରୀକ୍ଷା ଦେବେ ।

କ) ଅତି କମ୍‌ରେ (ମୋଟ୍) ୫୫ଟି କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ (ପିରିୟଡ୍)ରେ ଗୋଟିଏ ପତ୍ରର ପାଠଦାନ ଶେଷ ହେବ । ଗୋଟିଏ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ ବା ପିରିୟଡ୍-୪୫ ମିନିଟ)

ଖ) ପ୍ରତ୍ୟେକ ପତ୍ର ୪ ଗୋଟି ୟୁନିଟ୍ / ଏକକ / ଉପାଂଶରେ ବିଭକ୍ତ ହୋଇଛି ।

ଗ) ପ୍ରତ୍ୟେକ ପତ୍ର ୬ ଆସ୍ଥାଭିତ୍ତିକ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ (୪ + ୨ କ୍ରେଡିଟ୍) ପାଇବେ । ଗୋଟିଏ ଆସ୍ଥାଭିତ୍ତିକ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟର ମହତ୍ତ୍ୱ ହେଉଛି – ୧୦ ପିରିୟଡ୍ ସହିତ ସମାନ ।

ମୋଟ୍ ୧୪ ଗୋଟି ସମ୍ମାନ ପତ୍ରର ଆସ୍ଥାମୂଲ୍ୟାଙ୍କ (କ୍ରେଡିଟ୍) ହେଉଛି – ୧୪ x ୬ (୪ + ୨) = ୮୪ ।

ଏଥିମଧ୍ୟରୁ ୧୪ x ୪ = ୫୬ ତାତ୍ତ୍ୱିକ ପାଠ (Theory) ରହିବ ।

ଘ) ପରୀକ୍ଷା ପର୍ଯ୍ୟାୟକ୍ରମ (Semester) ଓ ପ୍ରସ୍ତାବିତ ପାଠ ଯୋଜନା :

ପ୍ରଥମ ଶିକ୍ଷାବର୍ଷ

୧ମ ପର୍ଯ୍ୟାୟ

    ଦୁଇଟି ପତ୍ର ୧ମ ଓ ୨ୟ ପତ୍ର -   ୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

    (୧ମ ଓ ୨ୟ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

୨ୟ ପର୍ଯ୍ୟାୟ

    ଦୁଇଟି ପତ୍ର ୩ୟ / ୪ର୍ଥ ପତ୍ର   ୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

    (୩ୟ ଓ ୪ର୍ଥ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

ଦ୍ୱିତୀୟ ଶିକ୍ଷାବର୍ଷ

୩ୟ ପର୍ଯ୍ୟାୟ

    ତିନୋଟି ପତ୍ର ୫ମ, ୬ଷ୍ଠ ଓ ୭ମ ପତ୍ର (୫ମ, ୬ଷ୍ଠ, ୭ମ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

    ୧୦୦+୧୦୦+୧୦୦= ୩୦୦ ନମ୍ବର

୪ର୍ଥ ପର୍ଯ୍ୟାୟ

ତିନୋଟି ପତ୍ର ୮ମ, ୯ମ ଓ ୧୦ମ ପତ୍ର- (୮ମ,୯ମ, ୧୦ମ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

୧୦୦+୧୦୦+୧୦୦= ୩୦୦ ନମ୍ବର

ତୃତୀୟ ଶିକ୍ଷାବର୍ଷ

୫ମ ପର୍ଯ୍ୟାୟ

ଦୁଇଟି ପତ୍ର ୧୧ଶ ଓ ୧୨ଶ ପତ୍ର (୧୧ଶ, ୧୨ଶ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

୬ଷ୍ଠ ପର୍ଯ୍ୟାୟ

ଦୁଇଟି ପତ୍ର ୧୩ଶ ଓ ୧୪ଶ ପତ୍ର (୧୩ଶ, ୧୪ଶ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ)

୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

ଶିକ୍ଷା ଅବଧ   ୬ଟି ପରୀକ୍ଷା   ୧୪ଗୋଟି ମୋଟ = ୧୪୦୦ ନମ୍ବର

୩ ବର୍ଷ   ୬ଟି ପର୍ଯ୍ୟାୟ ପତ୍ର

3 years   Total   Total paper   Total number 1400   Total credits
Course   Semester-6   14   14 × 6 (4+2) = 84

ବିଦ୍ୟାର୍ଥୀମାନଙ୍କ ମୁକ୍ତ ମେଧାବୃଭି ପରୀକ୍ଷା ପାଇଁ ସେମାନଙ୍କ ପସନ୍ଦ ଓ ବୋଧଜ୍ଞାନମୂଳକ ଦୀର୍ଘ ଓ ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପରୀକ୍ଷା ନିମନ୍ତେ ଉପସ୍ଥାପନା କରାଯିବ ।

ନମ୍ବର / ମୂଲ୍ୟାଙ୍କ ବିଭାଜନ ପଦ୍ଧତି :

୧.   ପ୍ରତ୍ୟେକ ପ୍ରଧାନ ପାଠ୍ୟାଂଶ ବା ପ୍ରତ୍ୟେକ ପତ୍ର   – ୧୦୦ ନମ୍ବର ବିଶିଷ୍ଟ

୨.   ମହାବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ଅନ୍ତଃପରୀକ୍ଷା   – ୨୦ ନମ୍ବର

ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ମୁଖ୍ୟ ପରୀକ୍ଷା   – ୮୦ ନମ୍ବର

୩.   ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ମୁଖ୍ୟ ପରୀକ୍ଷା ନିମନ୍ତେ ନିମ୍ନମତେ ପ୍ରଶ୍ନ ହେବ :

କ)   ପ୍ରତ୍ୟେକ ପତ୍ର ପ୍ରତ୍ୟେକ ଏକକରୁ ୨ଟି କରି ୮ଟି ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀ ସେଥରୁ ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । ପ୍ରତ୍ୟେକଏକକରୁ ଗୋଟିଏ ଲେଖାଏଁ ପ୍ରଶ୍ନର ଉତ୍ତରଦେବା ବାଧ୍ୟତାମୂଳକ । (୪ X ୧୫ = ୬୦ ନମ୍ବର)

ଖ)   ପ୍ରତ୍ୟେକ ପତ୍ର ପ୍ରତି ଏକକରୁ ୧୫ଟି ୨ ନମ୍ବର ବିଶିଷ୍ଟ ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ ; ବିଦ୍ୟାର୍ଥୀ ସେଥରୁ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । (୨ X ୧୦ = ୨୦)

ବିଶେଷ ଦ୍ରଷ୍ଟବ୍ୟ –

ଓଡ଼ିଆ ସମ୍ମାନ ୧୧ଶ ପତ୍ର, ୧୨ଶ ପତ୍ର, ୧୩ଶ ପତ୍ର ଓ ୧୪ଶ ପତ୍ର ଥିବା ପ୍ରତ୍ୟେକ ପତ୍ରର ପଞ୍ଚମ ଏକକର ପ୍ରକଳ୍ପ ପାଇଁ ୨୦ ନମ୍ବର ଓ ଅନ୍ତଃ ପରୀକ୍ଷା ପାଇଁ ୧୦ ନମ୍ବର ରହିବ ।

 କ) ମୋଟ୍ ନମ୍ବର - ୧୦୦

ଖ) ଅନ୍ତଃ ପରୀକ୍ଷା - ୨୦ ଓ ମୁଖ୍ୟ ପରୀକ୍ଷା – ୭୦

ଗ) ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି – ୨୦

ଘ) ମୁଖ୍ୟ ପରୀକ୍ଷାରେ ପ୍ରତ୍ୟେକ ପତ୍ରର ପ୍ରଥମ ଚାରୋଟି ଏକକରୁ ଦୁଇଟି ଲେଖାଁୟଁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୮ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡ଼ିବ ; ସେଥିରୁ ପ୍ରତ୍ୟେକ ଏକକରୁ ଗୋଟିଏ ଲେଖାଁୟଁ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବା ବାଧ୍ୟତାମୂଳକ । (୧୫ X ୪ = ୭୦)

ଙ) ପ୍ରଥମ ୪ଟି ଏକକରୁ ୨ନମ୍ବର ବିଶିଷ୍ଟ ୧୫ଟି ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ସେଥିରୁ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୧୦ X ୨ = ୨୦)

ପ୍ରକଳ୍ପଗୁଡ଼ିକ ସାହିତ୍ୟଭିତ୍ତିକ ହେବା ଆବଶ୍ୟକ । ବିଭାଗମୁଖ୍ୟଙ୍କ ଅନୁମୋଦନକ୍ରମେ ବିଭାଗର ସମସ୍ତ ଅଧ୍ୟାପକ ଓ ଅଧ୍ୟାପିକାଙ୍କ ମଧ୍ୟରେ ଦିଗ୍‌ଦର୍ଶନ ନିମନ୍ତେ ସମାନ ଭାବରେ ବାଣ୍ଟିଦିଆଯିବ ।

ଭୂମିକା।

       ସ୍ନାତକ ଶ୍ରେଣୀରେ ଓଡ଼ିଆ ଭାଷା ଓ ସାହିତ୍ୟ ସମ୍ବନ୍ଧୀୟ ପାଠଦାନ ନିମନ୍ତେ ଏହି ପାଠ୍ୟଖସଡ଼ାଟି ପ୍ରସ୍ତୁତ ହୋଇଛି । ଏହାର ପ୍ରସ୍ତୁତି କ୍ଷେତ୍ରରେ ବିଶ୍ୱବିଦ୍ୟାଳୟ ଆୟୋଗଙ୍କ ପ୍ରାୟୋଜିତ "ପସନ୍ଦ ଓ ଆସ୍ଥାଭିତ୍ତିକ ନୂତନ ପାଠ୍ୟବିନ୍ୟାସ ପଦ୍ଧତି"କୁ ଗ୍ରହଣ କରାଯାଇଛି । ଏହି ପାଠ୍ୟଖସଡ଼ାଟି ସଦ୍ୟତମ ଭାଷା-ସାହିତ୍ୟ ସମ୍ବନ୍ଧୀୟ ଜ୍ଞାନ ବ୍ୟବସ୍ଥା ଓ ଚଳନ୍ତି ସମୟର ଉପଯୋଗିତାକୁ ଲକ୍ଷ୍ୟ କରି ପ୍ରସ୍ତୁତ ହୋଇଛି । ଏହା ଓଡ଼ିଆ ଭାଷା ଓ ସାହିତ୍ୟର ଉନ୍ମେଷ, ବିକାଶ ସହିତ ଏହାର ସାମ୍ପ୍ରତିକ ସ୍ଥିତି, ବ୍ୟାକରଣ ଓ ଭାଷାତାତ୍ତ୍ୱିକ ବୈଶିଷ୍ଟ୍ୟ ସଂପର୍କରେ ସବିଶେଷ ଧାରଣା ପ୍ରଦାନ କରିବ । ଓଡ଼ିଆ ସାହିତ୍ୟର ବ୍ୟାବହାରିକ ଦିଗ ଓ ମହତ୍ତ୍ୱ ପ୍ରତି ଏଥିରେ ଧ୍ୟାନ ଦିଆଯାଇଛି । ଓଡ଼ିଆ ସାହିତ୍ୟର ବିବିଧ ରୂପ, ସାହିତ୍ୟ-ଧାରା ଓ ବିଶିଷ୍ଟ ସାହିତ୍ୟ-ଲେଖକଙ୍କ ବହି ସହିତ ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ଅବଗତ କରିବାରେ ପାଠ୍ୟଖସଡ଼ାଟି ସହାୟକ । ଓଡ଼ିଆ ଭାଷା ଓ ସାହିତ୍ୟକୁ ସର୍ବଭାରତୀୟ ଭାଷା ଓ ସାହିତ୍ୟ ତଥା ଅନ୍ତର୍ଜାତୀୟ ସାହିତ୍ୟ ବିଦ୍ୟା ସହିତ ବିଦ୍ୟାର୍ଥୀମାନଙ୍କୁ ପରିଚିତ କରାଇବାରେ ଏହା ବିଦ୍ୟାର୍ଥୀଙ୍କ ଉପଯୋଗୀ ହୋଇପାରିବ ।

ପାଠ୍ୟକ୍ରମର ସାରାଂଶ – ସଂରଚନା
Structure of B.A. (Honours) Odia Under CBCS

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ (Core Course) : 14

ପ୍ରତ୍ୟେକ ପତ୍ରର କ୍ରେଡ଼ିଟସ୍ / ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬ (୬୦ ପିରିଅଡ଼ସ୍)

ପ୍ରଥମ ପର୍ଯ୍ୟାୟ:

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୧ (Core Course – 1) ପ୍ରାଚୀନ ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ :

(ଚର୍ଯ୍ୟାପଦଠାରୁ ପଞ୍ଚସଖା ପର୍ଯ୍ୟନ୍ତ)

୧ମ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬ (୬୦ ପିରିଅଡ଼ସ୍)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୨ (Core Course – 2) ମଧ୍ୟଯୁଗୀୟ ଓଡ଼ିଆ ସାହିତ୍ୟ :

(ପ୍ରାକୃତି, ରୀତି ଓ ଗୀତି ସାହିତ୍ୟ)

୨ୟ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ:

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୩ (Core Course – 3)   ଆଧୁନିକ ଓଡ଼ିଆ ସାହିତ୍ୟ (ସ୍ୱାଧୀନତା ପୂର୍ବବର୍ତ୍ତୀ)

୩ୟ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୪ (Core Course – 4)   ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ସାହିତ୍ୟ

୪ର୍ଥ ପତ୍ର - ମୂଲ୍ୟାଙ୍କ = ୪ + ୨ = ୬

ତୃତୀୟ ପର୍ଯ୍ୟାୟ :

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୫ (Core Course – 5)   ଭାଷାର ସଂଜ୍ଞା ଓ ସ୍ୱରୂପ

୫ମ ପତ୍ର- ସମୟ ନିର୍ଘଣ୍ଟ ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୬ (Core Course – 6)   ଓଡ଼ିଆ ଭାଷାର ବୈଶିଷ୍ଟ୍ୟ ଓ ବିବିଧତା

ଷଷ୍ଠ ପତ୍ର- ସମୟ ନିର୍ଘଣ୍ଟ ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୭ (Core Course – 7)   ଓଡ଼ିଆ ବ୍ୟାବହାରିକ ବ୍ୟାକରଣ

ସପ୍ତମ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ଚତୁର୍ଥ ପର୍ଯ୍ୟାୟ :

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୮ (Core Course – 8)   ଓଡ଼ିଆ ଲୋକ ସଂସ୍କୃତି ଓ ଲୋକସାହିତ୍ୟ

�....ମ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୯ (Core Course – 9)   ପ୍ରାଚ୍ୟ ଓ ପାଶ୍ଚାତ୍ୟ ସାହିତ୍ୟ ତତ୍ତ୍ୱ

ତ୍ତ ୯ମ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୧୦ (Core Course-10)   ଓଡ଼ିଆ ପଦ୍ୟ ସାହିତ୍ୟ (ପ୍ରାଚୀନରୁ ସ୍ୱାଧୀନତା ପର୍ଯ୍ୟନ୍ତ)

୧୦ମ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପଞ୍ଚମ ପର୍ଯ୍ୟାୟ :

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ- ୧୧ (Core Course - 11)   ଓଡ଼ିଆ ନାଟକ ଓ ଏକାଙ୍କିକା

୧୧ଶ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ- ୧୨ (Core Course -12)   ଓଡ଼ିଆ କଥା ସାହିତ୍ୟ (ଗଳ୍ପ ଓ ଉପନ୍ୟାସ)

୧୨ଶ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ଷଷ୍ଠ ପର୍ଯ୍ୟାୟ :

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ- ୧୩ (Core Course -13)   ଓଡ଼ିଆ ଗଦ୍ୟ ସାହିତ୍ୟ (ପ୍ରବନ୍ଧ, ଆତ୍ମଜୀବନୀ, ଭ୍ରମଣକାହାଣୀ)

୧୩ଶ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ- ୧୪ (Core Course- 14)   ଓଡ଼ିଆ ଭାଷାର ବ୍ୟାବହାରିକ ପ୍ରୟୋଗ

୧୪ଶ ପତ୍ର - ସମୟ ନିର୍ଘଣ୍ଟ = ୪ + ୨ = ୬

ସବିଶେଷ ପାଠ୍ୟକ୍ରମ (Detail Syllabus)
ପ୍ରଥମ ପର୍ଯ୍ୟାୟ (Semester – 1)

ମୂଳ ପାଠ : ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ- ୧ (Core Course - 1) : ପ୍ରାଚୀନ ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ

ପ୍ରଥମ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ପ୍ରାକ୍-ସାରଳା ସାହିତ୍ୟ (ଚର୍ଯ୍ୟାଗୀତିକା ଓ ନାଥ ସାହିତ୍ୟ)

ସାମାଜିକ, ଧାର୍ମିକ, ସାହିତ୍ୟିକ ଓ ଭାଷାତାତ୍ତ୍ୱିକ ମୂଲ୍ୟାୟନ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ସାରଳା ସାହିତ୍ୟର ସାମାଜିକ, ସାଂସ୍କୃତିକ ଓ ସାହିତ୍ୟିକ ମୂଲ୍ୟ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ବଳରାମ ଦାସ ଓ ଜଗନ୍ନାଥ ଦାସ (ବିଶେଷ ଅଧ୍ୟୟନ)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଅନନ୍ତ ଦାସ, ଯଶୋବନ୍ତ ଦାସ ଓ ଅଚ୍ୟୁତାନନ୍ଦ ଦାସ (ବିଶେଷ ଅଧ୍ୟୟନ)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ – ସୂର୍ଯ୍ୟନାରାୟଣ ଦାଶ (୧ମ ଓ ୨ୟ ଭାଗ) – ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୨. ଓଡ଼ିଆ ସାହିତ୍ୟର ଆଦିପର୍ବ – ସୁରେନ୍ଦ୍ର ମହାନ୍ତି – କଟକ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର୍, କଟକ

୩. ଚର୍ଯ୍ୟା ଗୀତିକା- ଖଗେଶ୍ୱର ମହାପାତ୍ର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୪. ଓଡ଼ିଶାର ନାଥ ସାହିତ୍ୟ - ବଂଶୀଧର ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୫. ଓଡ଼ିଆ ସାହିତ୍ୟର ସଂକ୍ଷିପ୍ତ ପରିଚୟ - ବୃନ୍ଦାବନ ଚନ୍ଦ୍ର ଆଚାର୍ଯ୍ୟ,ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୬. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ, ପ୍ରଥମ ଭାଗ, ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୭. ଓଡ଼ିଆ ସାହିତ୍ୟର ମଧ୍ୟପର୍ବ – ସୁରେନ୍ଦ୍ର ମହାନ୍ତି – କଟକ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର୍, କଟକ

୮. ପଞ୍ଚସଖା ଓଡ଼ିଆ ସାହିତ୍ୟ - ଦେବେନ୍ଦ୍ର ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୯. ଓଡ଼ିଆ ସାହିତ୍ୟର ଉନ୍ମେଷ ଓ ଉତ୍ତରଣ - ଦେବେନ୍ଦ୍ର ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୧୦. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ, ବଂଶୀଧର ମହାନ୍ତି (୧ମ ଓ ୨ୟ ଭାଗ), ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୨ (Core Course - 2) : ମଧ୍ୟଯୁଗୀୟ ଓଡ଼ିଆ ସାହିତ୍ୟ

ଦ୍ୱିତୀୟ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ମଧ୍ୟଯୁଗୀୟ ଓଡ଼ିଆ ସାହିତ୍ୟର ପୃଷ୍ଠଭୂମି (ସାମାଜିକ, ସାଂସ୍କୃତିକ, ରାଜନୀତିକ ଓ
ଧର୍ମୀୟ ପୃଷ୍ଠଭୂମି)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ :   ମଧ୍ୟଯୁଗୀୟ କାବ୍ୟର ଆଙ୍ଗିକ ବୈଚିତ୍ର୍ୟ

(ବିଷୟ ବିନ୍ୟାସ, ଭାଷା, ଛନ୍ଦ ବୈଚିତ୍ର୍ୟ, ବର୍ଣ୍ଣନା ବୈଚିତ୍ର୍ୟ ଓ ଆଲଙ୍କାରିକତା)

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ :   ମଧ୍ୟଯୁଗୀୟ କାବ୍ୟର ଆନ୍ତରିକ ବିଭବ

(ରସ, ସୌନ୍ଦର୍ଯ୍ୟଚେତନା ଓ ଭାବାଦର୍ଶ)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ମଧ୍ୟଯୁଗୀୟ ଓଡ଼ିଆ ଗୀତି ପରମ୍ପରା (ଚମ୍ପୂ, ଚଉପଦୀ, ଚଉତିଶା, ଭଜନ ଓ ଜଣାଣ)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ – ସୂର୍ଯ୍ୟନାରାୟଣ ଦାଶ (୪ର୍ଥ ଭାଗ) – ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୨. ଭଞ୍ଜୀୟ କାବ୍ୟ ଭାବନା – ବେଣୀ ମାଧବ ପାଢ଼ୀ, ବ୍ରହ୍ମପୁର

୩. ଉପେନ୍ଦ୍ର ଭଞ୍ଜ ସାହିତ୍ୟ ଏକ ଅଧ୍ୟୟନ - ଜୟକୃଷ୍ଣ ମିଶ୍ର, ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟ ପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ
ସଂସ୍ଥା, ଭବନେଶ୍ୱର

୪. ମଧ୍ୟକାଳୀନ ଓଡ଼ିଆ ସାହିତ୍ୟ – କୃଷ୍ଣ ଚରଣ ସାହୁ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୫. ଭଞ୍ଜ ସାହିତ୍ୟର ବିଭା ଓ ବିଭବ - ସଚ୍ଚିଦାନନ୍ଦ ମିଶ୍ର, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର

୬. ଓଡ଼ିଆ ଗୀତିକାବ୍ୟ- ଜାନକୀବଲ୍ଲଭ ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ ପବ୍ଲିଶର୍ସ, କଟକ

୭. କାବ୍ୟକୌଶଳ- ସୁଦର୍ଶନ ଆଚାର୍ଯ୍ୟ, ଫ୍ରେଣ୍ଡସ ପବ୍ଲିଶର୍ସ, କଟକ

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ (Semester – II)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୩ (Core Course - 3) : ଆଧୁନିକ ଓଡ଼ିଆ ସାହିତ୍ୟ
ତୃତୀୟ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଆଧୁନିକ ଓଡ଼ିଆ ସାହିତ୍ୟର ପୃଷ୍ଠଭୂମି ଓ ନବଜାଗରଣ

(ଇଂରାଜୀ ଶିକ୍ଷା ବିସ୍ତାର, ପତ୍ରପତ୍ରିକା ପ୍ରକାଶନ, ମୁଦ୍ରଣଯନ୍ତ୍ର ପ୍ରତିଷ୍ଠା ଓ ଭାଷା ସୁରକ୍ଷା ଆନ୍ଦୋଳନ)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଆଧୁନିକ ଓଡ଼ିଆ ସାହିତ୍ୟର ପ୍ରମୁଖ ସ୍ରଷ୍ଟା

(ରାଧାନାଥଙ୍କ କାବ୍ୟ, ଗଙ୍ଗାଧରଙ୍କ କାବ୍ୟ, ମଧୁସୂଦନ ରାଓଙ୍କ କବିତା ଓ ଫକୀରମୋହନଙ୍କ ଉପନ୍ୟାସ ଓ ଗଳ୍ପ)

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଓଡ଼ିଆ ସାହିତ୍ୟରେ ସତ୍ୟବାଦୀଧାରା

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ସାହିତ୍ୟରେ ସବୁଜଧାରା ଓ ପ୍ରଗତିବାଦୀ ଧାରା

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ (୧୮୦୩-୧୯୨୦) ନଟବର ସାମନ୍ତରାୟ, ବାଣୀ ଭବନ, ଭୁବନେଶ୍ୱର

୨. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ – ପ୍ରେମାନନ୍ଦ ମହାପାତ୍ର, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୩. ମେହେର ସାହିତ୍ୟରେ ମାନବୀୟ ମହନୀୟତା- ମଣୀନ୍ଦ୍ର କୁମାର ମେହେର, ଗ୍ରନ୍ଥମନ୍ଦିର, କଟକ

୪. କାବ୍ୟଶିଳ୍ପୀ ଗଙ୍ଗାଧର - ଗୋବିନ୍ଦଚନ୍ଦ୍ର ଉଦ୍‌ଗାତା

୫. ଓଡ଼ିଆ ସାହିତ୍ୟରେ ରାଧାନାଥ ଓ ସତ୍ୟବାଦୀ ଯୁଗ, ପ୍ର. ବିଷ୍ଣୁ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ ପବ୍ଲିଶର୍ସ, କଟକ

୬. ସବୁଜରୁ ସ୍ୱାପ୍ନିକ - ନିତ୍ୟାନନ୍ଦ ଶତପଥୀ, ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୭. ଓଡ଼ିଆ ସାହିତ୍ୟର ପ୍ରଗତିବାଦୀ ଧାରା – ବିଜୟ କୁମାର ଶତପଥୀ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୪ (Core Course - 4) : ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ସାହିତ୍ୟ
ଚତୁର୍ଥ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ କବିତା

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ କଥା ସାହିତ୍ୟ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ନାଟକ ଓ ଏକାଙ୍କିକା

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ଗଦ୍ୟ ସାହିତ୍ୟ (ପ୍ରବନ୍ଧ, ଜୀବନୀ, ଆତ୍ମ ଜୀବନୀ ଓ ସମାଲୋଚନା।

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ସବୁଜରୁ ସାଂପ୍ରତିକ – ନିତ୍ୟାନନ୍ଦ ଶତପଥୀ, ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୨. ସତୁରୀରୁ ସହସ୍ରାବ୍ଦୀ – ନିତ୍ୟାନନ୍ଦ ଶତପଥୀ

୩. ଶହେ ବର୍ଷର ଓଡ଼ିଆ କ୍ଷୁଦ୍ରଗଳ୍ପ ଏକ ତାତ୍ତ୍ୱିକ ବିଶ୍ଳେଷଣ – କବିତା ବାରିକ, ବିଦ୍ୟାପୁରୀ, କଟକ

୪. ଉପନ୍ୟାସ ସାହିତ୍ୟର ପରିଚୟ – ସଂକଳନ – ପଠାଣି ପଟ୍ଟନାୟକ ଓ ଭୋଲାନାଥ ରାଉତ (୧ମ ଓ ୨ୟ ଭାଗ) ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

୫. ଓଡ଼ିଆ କ୍ଷୁଦ୍ର ଗଳ୍ପର ଇତିବୃତ୍ତ – ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ବୁକ୍ସ ଆଣ୍ଡ ବୁକ୍ସ, କଟକ

୬. ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ସାହିତ୍ୟର ଭୂମି ଓ ଭୂମିକା – ସଂ. ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଓଡ଼ିଶା ବୁକ୍ସ୍ଟୋର, କଟକ

୭. ଓଡ଼ିଆ ନାଟକର ଉତ୍ତର ଆଧୁନିକ ପର୍ବ – ହେମନ୍ତ କୁମାର ଦାସ, ବିଦ୍ୟାପୁରୀ, କଟକ

୮. ସ୍ୱାଧୀନତୋତ୍ତର ଓଡ଼ିଆ ନାଟକ– ନାରାୟଣ ସାହୁ, ଓ. ରା. ପା. ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୯. ଓଡ଼ିଆ ନାଟ୍ୟସାହିତ୍ୟ – ସର୍ବେଶ୍ୱର ଦାସ, ଓ. ରା. ପା. ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୧୦. ଓଡ଼ିଆ ନାଟକର ଉଦ୍ଭବ ଓ ବିକାଶ – ରତ୍ନାକର ଚଇନି,

୧୧. ଓଡ଼ିଆ ଐତିହାସିକ ନାଟକର ମୂଳସୂତ୍ର – ନୀଳାଦ୍ରିଭୂଷଣ ହରିଚନ୍ଦନ

୧୨. ନାଟକର ବ୍ୟାପ୍ତି ଓ ଦାପ୍ତି – ସଂଘମିତ୍ରା ମିଶ୍ର, ଅଗ୍ରଦୂତ, କଟକ

୧୩. ନାଟ୍ୟସୃଷ୍ଟି ଓ ନାଟ୍ୟଦୃଷ୍ଟି – ବିଷ୍ଣୁପ୍ରିୟା ଓତା, ଶିଶୁକଲମ, ଭୁବନେଶ୍ୱର

୧୪. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ – ବାଉରୀ ବନ୍ଧୁ କର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୧୫. ଓଡ଼ିଆ ଚରିତ ସାହିତ୍ୟ – ଲାବଣ୍ୟ ନାୟକ

୧୬. ଓଡ଼ିଆ ସମାଲୋଚନା ସାହିତ୍ୟ – ଅସିତ କବି

ତୃତୀୟ ପର୍ଯ୍ୟାୟ (Semester – III)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୫ (Core Course - 5) : ଓଡ଼ିଆ ଭାଷା ଓ ଲିପିର ଐତିହାସିକ ବିକାଶକ୍ରମ

ପଞ୍ଚମ ପତ୍ର :

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଓଡ଼ିଆ ଭାଷାର ଉଦ୍ଭବ ଓ ବିକାଶକ୍ରମ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଓଡ଼ିଆ ଲିପିର ଐତିହାସିକ ବିବର୍ତ୍ତନ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଓଡ଼ିଆ ଅଭିଲେଖର ଭାଷା (ଶିଳାଲେଖ, ତାମ୍ରଲେଖ ଓ ପ୍ରାଚୀନ ସନନ୍ଦ)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଚର୍ଯ୍ୟାପଦ ଓ ସାରଳା ସାହିତ୍ୟର ଭାଷା

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ଭାଷାର ଉନ୍ମେଷ ଓ ବିକାଶ – ବାସୁଦେବ ସାହୁ, ଫ୍ରେଣ୍ଡ୍‌ସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୨. ଓଡ଼ିଆ ଧ୍ୱନିତତ୍ତ୍ୱ ଓ ଶବ୍ଦ ସଂଭାର - ଧନେଶ୍ୱର ମହାପାତ୍ର, ଫ୍ରେଣ୍ଡ୍‌ସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୩. ଓଡ଼ିଆ ଭାଷା ଓ ଲିପିର କ୍ରମବିକାଶ – କୁଞ୍ଜ ବିହାରୀ ତ୍ରିପାଠୀ, ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୪. ଓଡ଼ିଆ ଭାଷାତ   ୍‌ର ରୂପଚିତ୍ର, ନଟବର ଶତପଥୀ, ବିଜୟିନୀ ପବ୍ଲିକେଶନ, କଟକ

୫. ଧ୍ୱନିବିଜ୍ଞାନ, ଗୋଲୋକ ବିହାରୀ ଧଳ, ଓ. ରା. ପା. ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୬ (Core Course - 6) : ଭାଷାର ସଂଜ୍ଞା ସ୍ୱରୂପ, ଓଡ଼ିଆ ଭାଷାର ବୈଶିଷ୍ଟ୍ୟ ଓ ବିବିଧତା

ଷଷ୍ଠ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଭାଷାର ସଂଜ୍ଞା, ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଭାଷା ଉତ୍ପତ୍ତି ସମ୍ପର୍କୀୟ ବିଭିନ୍ନ ସିଦ୍ଧାନ୍ତ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଓଡ଼ିଆ ଭାଷାର ଆଞ୍ଚଳିକ ରୂପ

୪ର୍ଥ ଏକକ/ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ଭାଷା ଉପରେ ବିଭିନ୍ନ ଭାଷାର ପ୍ରଭାବ (ଦ୍ରାବିଡ଼, ଅଷ୍ଟ୍ରିକ୍‌ ଯାବନିକ ଓ ଇଂରାଜୀ)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଭାଷାବିଜ୍ଞାନର ରୂପରେଖ – ବାସୁଦେବ ସାହୁ, ଫ୍ରେଣ୍ଡ୍‌ସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୨. ଭାଷାଶାସ୍ତ୍ର ପରିଚୟ – ଗୋଲୋକ ବିହାରୀ ଧଳ, ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୩. ଓଡ଼ିଆ ଭାଷାର ସୃଷ୍ଟି ଓ ବିକାଶ – ଉପେନ୍ଦ୍ର ପ୍ରସାଦ ଦଳାଇ, ଏ.କେ.ମିଶ୍ର ପବ୍ଲିଶର୍ସ, କଟକ

୪. ଓଡ଼ିଆ ଭାଷାର ଉନ୍ମେଷ ଓ ବିକାଶ – ବାସୁଦେବ ସାହୁ, ଫ୍ରେଣ୍ଡ୍‌ସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୫. ଭାଷା ଭାବନା, ସଂ. ବିଜୟଲକ୍ଷ୍ମୀ ମହାନ୍ତି, ବିଦ୍ୟାପ୍ରକାଶନୀ, ଭୁବନେଶ୍ୱର

୬. ଓଡ଼ିଆ ଭାଷା ଓ ଭାଷା ବିଜ୍ଞାନ - ଦେବୀ ପ୍ରସନ୍ନ ପଟ୍ଟନାୟକ, ଗ୍ରନ୍ଥମନ୍ଦିର, କଟକ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୭ (Core Course - 7) : ଓଡ଼ିଆ ବ୍ୟାବହାରିକ ବ୍ୟାକରଣ

୭ମ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଓଡ଼ିଆ ବର୍ଣ୍ଣ ବିଚାର, ବାକ୍ୟର ଗଠନ ରୀତି ଓ ପ୍ରକାରଭେଦ ।

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : କାରକ, ବିଭକ୍ତି, କୃଦନ୍ତ ଓ ତଦ୍ଧିତ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଉପସର୍ଗ, ସନ୍ଧି ଓ ସମାସ

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ଶବ୍ଦସମ୍ଭାର

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ସର୍ବସାର ବ୍ୟାକରଣ - ନାରାୟଣ ମହାପାତ୍ର ଓ ଶ୍ରୀଧର ଦାସ, ନିୟୁ ଷ୍ଟୁଡେଣ୍ଟ ଷ୍ଟୋର୍, କଟକ

୨. ଆଧୁନିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ - ଧନେଶ୍ୱର ମହାପାତ୍ର, କିତାବ ମହଲ, କଟକ

୩. ବ୍ୟାବହାରିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ, ବିଜୟ ପ୍ରସାଦ ମହାପାତ୍ର, ବିଦ୍ୟାପୁରୀ, କଟକ

୪. ଓଡ଼ିଆ ଭାଷା ଚର୍ଚ୍ଚାର ପରମ୍ପରା, ପ୍ରଫେସର ଗଗନେନ୍ଦ୍ର ନାଥ ଦାସ, ଓଡ଼ିଆ ଗବେଷଣା ପରିଷଦ, କଟକ

ଚତୁର୍ଥ ପର୍ଯ୍ୟାୟ (Semester – IV)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୮ (Core Course - 8) : (ଓଡ଼ିଆ ଲୋକସଂସ୍କୃତି ଓ ଲୋକସାହିତ୍ୟ)

ଅଷ୍ଟମ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଲୋକ ସଂସ୍କୃତି ଓ ଲୋକସାହିତ୍ୟର ସଂଜ୍ଞା, ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଓଡ଼ିଆ ଲୋକଗୀତର ସ୍ୱରୂପ, ପ୍ରକାରଭେଦ ଓ ବିଭିନ୍ନ ଦିଗ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଓଡ଼ିଆ ଲୋକକାହାଣୀର ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ

୪ର୍ଥ ଏକକ/ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ଲୋକନାଟକର ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ (ପାଲା, ଦାସକାଠିଆ, ଦଣ୍ଡନାଚ,

ଛଉନାଚ, ଲୀଳା, ଦଧି, ଡାଲଖାଇ ଓ କରମା)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଲୋକଧାରା, ଲୋକସଂସ୍କୃତି ଓ ଲୋକସାହିତ୍ୟ – କୁମୁଦ ରଞ୍ଜନ ପାଣିଗ୍ରାହୀ, ସୁଖଦୁଖ୍ ପବ୍ଲିକେଶନ, ସମ୍ବଲପୁର

୨. ଲୋକସଂସ୍କୃତି ଓ ଲୋକ ସାହିତ୍ୟ – କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ବିଦ୍ୟାପୁରୀ, କଟକ

୩. ଲୋକସାହିତ୍ୟ ତତ୍ତ୍ୱ- ଶ୍ୟାମ ସୁନ୍ଦର ମହାପାତ୍ର, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର୍, କଟକ

୪. ଓଡ଼ିଆ ଲୋକଗୀତି ସଂଚୟନ - କୁଞ୍ଜବିହାରୀ ଦାଶ, ବିଶ୍ୱ ଭାରତୀ ପ୍ରକାଶନ

୫. ପଲ୍ଲୀଗୀତି ସଞ୍ଚୟନ - କୁଞ୍ଜବିହାରୀ ଦାଶ, (୧ମ- ୨ୟ ଓ ୩ୟ ଭାଗ)

୬. ଲୋକସଂସ୍କୃତି-ଲୋକସାହିତ୍ୟ - ନାରାୟଣ ସାହୁ, ଚିନ୍ମୟ ପ୍ରକାଶନ, କଟକ

୭. ଓଡ଼ିଶାର ଦଣ୍ଡ ନାଟ - ସନ୍ତୋଷ କୁମାର ଶତପଥୀ, କେଦାର ପ୍ରିଣ୍ଟିଙ୍ଗ୍ ପ୍ରେସ୍, ଭୁବନେଶ୍ୱର

୮. ଓଡ଼ିଆ ଲୋକନାଟ୍ୟ - କଲଚରାଲ ଏକାଡ଼େମୀ, ରାଉରକେଲା

୯. ପଶ୍ଚିମ ଓଡ଼ିଶାର ଲୋକସଂସ୍କୃତି, ଡ. ସୁଶୀଲ କୁମାର ବାଗ୍

୧୦. ପଶ୍ଚିମ ଓଡ଼ିଶାର ଲୋକଗୀତ, ଦ୍ୱାରିକାନାଥ ନାୟକ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର୍, କଟକ

୧୧.	ଲୋକବିଶ୍ୱାସ ଓ ଲୋକାଚାର, ଡ. ସଦାନନ୍ଦ ନାୟକ, ବିଜୟ ବୁକ୍ ଷ୍ଟୋର୍, ବ୍ରହ୍ମପୁର

୧୨.	ଉତ୍କଳ ଗାଉଁଲି ଗୀତ, ଚକ୍ରଧର ମହାପାତ୍ର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୧୩.	ଉତ୍କଳ ଗ୍ରାମ୍ୟ ଗୀତି – ଚକ୍ରଧର ମହାପାତ୍ର, ଓଡ଼ିଆ ସାହିତ୍ୟ ଏକାଡେମୀ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୯ (Core Course - 9) : ସାହିତ୍ୟ ତତ୍ତ୍ୱ (ପ୍ରାଚ୍ୟ ଓ ପାଶ୍ଚାତ୍ୟ)

୯ମ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ରସ ଓ ଧ୍ୱନି

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ରୀତି, ବକ୍ରୋକ୍ତି ଓ ଅଳଙ୍କାର

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : କ୍ଲାସିସିଜିମ୍, ରୋମାଣ୍ଟିସିଜିମ୍

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ପ୍ରତୀକବାଦ, ଚିତ୍ରକଳ୍ପ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଅଳଙ୍କାର ପ୍ରସଙ୍ଗ – ଗୋବିନ୍ଦ ଚନ୍ଦ୍ର ଉଦ୍‍ଗାତା, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୨. ଭାରତୀୟ ସାହିତ୍ୟ ତତ୍ତ୍ୱ– ବନମାଳୀ ରଥ,ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୩. ଓଡ଼ିଆ କାବ୍ୟ କୌଶଳ – ସୁଦର୍ଶନ ଆଚାର୍ଯ୍ୟ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୪. ପାଶ୍ଚାତ୍ୟ ସାହିତ୍ୟ ଓ ସମୀକ୍ଷା ତତ୍ତ୍ୱ – କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ପ୍ରାଚୀ ସାହିତ୍ୟ ପ୍ରତିଷ୍ଠାନ, କଟକ

୫. ସାହିତ୍ୟର ସୂତ୍ରୀପତ୍ର, ବିଭୂତି ପଟ୍ଟନାୟକ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ– ୧୦ (Core Course - 10) : ଓଡ଼ିଆ କବିତା ପ୍ରାଚୀନରୁ ଆଧୁନିକ

୧୦ମ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ସାରଳା ମହାଭାରତ (ଦୁର୍ଯ୍ୟୋଧନଙ୍କ ରକ୍ତନଦୀ ସନ୍ତରଣ)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଭାଗବତ (୨୪ ଗୁରୁ ପ୍ରସଙ୍ଗ) - ଜଗନ୍ନାଥ ଦାସ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଦୀନକୃଷ୍ଣ ଦାସଙ୍କ ରସକଲ୍ଲୋଲ(୧ମ ଛାନ୍ଦ) ଓ ଉପେନ୍ଦ୍ରଭଞ୍ଜଙ୍କ କୋଟିବ୍ରହ୍ମାଣ୍ଡ ସୁନ୍ଦରୀ
	(୧ମ ଛାନ୍ଦ)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଆଧୁନିକ କବିତା

ମହାଯାତ୍ରା (ସପ୍ତମ ସର୍ଗ)- ଅମର୍ଷିଙ୍କ ଉଦ୍‍ବୋଧନ (ରାଧାନାଥ ରାୟ)

ମଙ୍ଗଳେ ଅଇଲା ଉଷା – ଗଙ୍ଗାଧର ମେହେର

ବନ୍ଦୀର ସାଧ୍ୟ ଅନୁଚିନ୍ତା - ଗୋପବନ୍ଧୁ ଦାସ

ପ୍ରତିମା ନାୟକ - ସଚ୍ଚିଦାନନ୍ଦ ରାଉତରାୟ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ସାରଳା ମହାଭାରତ (ଗଦା ପର୍ବ-ସାରଳା ଦାସ)

୨. ଅବଧୂତ ଓ ଯଦୁରାଜା ସୟାଦ, ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ ପବ୍ଲିଶର୍ସ, କଟକ

୩. କହେ କୃଷ୍ଣଦାସ କବି – କୃଷ୍ଣଚରଣ ସାହୁ, ବିଦ୍ୟାପୁରୀ, କଟକ

୪. ରସକଲ୍ଲୋଳ, ସଂପାଦନା – ଦେବେନ୍ଦ୍ର ମହାନ୍ତି

୫. ଦୁର୍ଲଭ ଦୀନକୃଷ୍ଣ - ଡ. ଜ୍ୟୋତିରଞ୍ଜନ ସାମଲ, ବିଜୟିନୀ ପବ୍ଲିକେସନ, କଟକ

୬. ତପସ୍ୱିନୀ ଓ ମେହେର ସାହିତ୍ୟ – ଗୌରୀ କୁମାର ବ୍ରହ୍ମା

ପଞ୍ଚମ ପର୍ଯ୍ୟାୟ (Semester – V)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୧୧ (Core Course - 11) : ଓଡ଼ିଆ ନାଟକ ଓ ଏକାଙ୍କିକା

୧୧ଶ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ରକ୍ତମାଟି - କାଳୀଚରଣ ପଟ୍ଟନାୟକ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ନନ୍ଦିକା କେଶରୀ - ମନୋରଞ୍ଜନ ଦାସ କିୟା। ତଟନିରଞ୍ଜନା – ବିଜୟ ମିଶ୍ର

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : କୋକୁଆ – ବିଜୟ କୁମାର ଶତପଥୀ, ଅଗ୍ରଦୂତ, କଟକ କିୟା। ଭୁଖା- ମଙ୍ଗଳୁଚରଣ ବିଶ୍ୱାଲ

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଏକାଙ୍କିକା- ସ୍ତୁତି ବିଭ୍ରାଟ - ପ୍ରାଣବନ୍ଧୁ କର ଓ ଛଦ୍ମବେଶୀ - ବିଶ୍ୱଜିତ୍ ଦାସ

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ରକ୍ତମାଟି - କାଳୀଚରଣ ପଟ୍ଟନାୟକ

୨. ନନ୍ଦିକା କେଶରୀ-ମନୋରଞ୍ଜନ ଦାସ କିୟା। ତଟନିରଞ୍ଜନା – ବିଜୟ ମିଶ୍ର

୩. କୋକୁଆ – ବିଜୟ କୁମାର ଶତପଥୀ, ଅଗ୍ରଦୂତ, କଟକ କିୟା। ଭୁଖା- ମଙ୍ଗଳୁଚରଣ ବିଶ୍ୱାଲ

୪. ଅଶୁ ନୁହେଁ ଅନଲ, ହେମନ୍ତ କୁମାର ଦାସ

୫. ସ୍ୱାଧୀନୋତ୍ତୋର ଓଡିଆ ନାଟକର ମନସ୍ତାତ୍ତ୍ୱିକ ବିଶ୍ଳେଷଣ, ରଶ୍ମିତା ରାଉତରାୟ, ବିଜୟିନୀ ପବ୍ଲିକେସନ, କଟକ

୬. ସାହିତ୍ୟ ସାଧକ ମଙ୍ଗଳୁଚରଣ ବିଶ୍ୱାଲ – ଗୌରିଦାସ ପ୍ରଧାନ

(ଚତୁର୍ଥ ପତ୍ର ନିମନ୍ତେ ପ୍ରଦତ୍ତ ସହାୟକ ପୁସ୍ତକଗୁଡିକ ଅନୁସରଣୀୟ ।)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୧୨ (Core Course - 12) : (ଓଡ଼ିଆ କଥା ସାହିତ୍ୟ)

୧୨ଶ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଓଡ଼ିଆ କଥାସାହିତ୍ୟର ବିକାଶକ୍ରମ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଛ'ମାଣ ଆଠଗୁଣ୍ଠ - ଫକୀର ମୋହନ ସେନାପତି

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଦାନାପାଣି - ଗୋପୀନାଥ ମହାନ୍ତି କିୟା ନୟନତାରା - ଦୟାନିଧି ମିଶ୍ର

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଗଳ୍ପ ସାହିତ୍ୟ

ପାଠ୍ୟ ଗଳ୍ପ : ଦେବତାର ବିଧାତା – ଗୋଦାବରୀଶ ମହାପାତ୍ର

ମାଂସର ବିଳାପ - କାଳିନ୍ଦୀ ଚରଣ ପାଣିଗ୍ରାହୀ

ମଧୁବନର ମେୟର - ମନୋଜ ଦାସ

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ଉପନ୍ୟାସ ସାହିତ୍ୟର ପରିଚୟ, ସଂ ପଠାଣି ପଞ୍ଚନାୟକ ଓ ଭୋଲାନାଥ ରାଉତ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

୨. ଓଡ଼ିଆ କ୍ଷୁଦ୍ରଗଳ୍ପର ଉନ୍ମେଷ ଓ ଉତ୍ତରଣ – ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୩. ଛ'ମାଣ ଆଠଗୁଣ୍ଠ - ଫକୀର ମୋହନ ସେନାପତି

୪. ଛ'ମାଣ ଆଠଗୁଣ୍ଠ ଭିନ୍ନ ଦୃଷ୍ଟି ଭିନ୍ନ ବ୍ୟାଖ୍ୟା, ପଞ୍ଚାନନ ମିଶ୍ର, ବିଜୟିନୀ ପବ୍ଲିକେସନ, କଟକ

୧. ଦାନାପାଣି - ଗୋପୀନାଥ ମହାନ୍ତି କିୟା ନୟନତାରା - ଦୟାନିଧି ମିଶ୍ର

୨. କଥାଶିଳ୍ପୀ ମନୋଜ ଦାସ - ଶତଘ୍ନ ପାଣ୍ଡବ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୩. ମନସ୍ୱୀ ମନୋଜ - ମଣୀନ୍ଦ୍ର କୁମାର ମେହେର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୪. ଓଡ଼ିଆ ଉପନ୍ୟାସର ସମାଜତାତ୍ତ୍ୱିକ ଆଲୋଚନା - କଇଳାଶ ପଞ୍ଚନାୟକ, ବିଦ୍ୟାପୁରୀ, କଟକ

ଷଷ୍ଠ ପର୍ଯ୍ୟାୟ (Semester – VI)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୧୩ (Core Course - 13) : ଓଡ଼ିଆ ଗଦ୍ୟ ସାହିତ୍ୟ

୧୩ଶ ପତ୍ର

୧ମ ଏକକ/ୟୁନିଟ୍ – ୧ : ଆତ୍ମ ଜୀବନୀ, ଭ୍ରମଣ କାହାଣୀ ଓ ସମାଲୋଚନା ତତ୍ତ୍ୱ (ସଂଜ୍ଞା, ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ମୋ ଫୁଟ୍ସ ଡଙ୍ଗାର କାହାଣୀ - ଫତୁରାନନ୍ଦ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ପଶ୍ଚିମ ଆଫ୍ରିକାରେ ଓଡ଼ିଆ ଢେଙ୍କି - ଭୁବନେଶ୍ୱର ବେହେରା

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ପ୍ରବନ୍ଧ - ଭାଷା ଓ ଜାତୀୟତା - ଗୋପବନ୍ଧୁ ଦାସ

ମୁଁ ସତ୍ୟଧର୍ମା କହୁଛି – ଚନ୍ଦ୍ରଶେଖର ରଥ

ବିବେକାନନ୍ଦ : ଏକ ଗୁହାମୁକ୍ତିର ପ୍ରୟାସ - ଚିତ୍ତରଞ୍ଜନ ଦାସ

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ମୋ ଫୁଟା ଡଙ୍ଗାର କାହାଣୀ - ଫତୁରାନନ୍ଦ

୨. ପଶ୍ଚିମ ଆଫ୍ରିକାରେ ଓଡ଼ିଆ ଢେଙ୍କି - ଭୁବନେଶ୍ୱର ବେହେରା

୩. ଜୀବନୀ ସାହିତ୍ୟ ଏକ ଅଧ୍ୟୟନ - ପଠାଣି ପଟନାୟକ, ଓଡ଼ିଶା ପା.ପୁ.ପ୍ର.ଓ.ପ୍ର.ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୪. ସମାଲୋଚନାର ଦିଗଦିଗନ୍ତ - ଖଗେଶ୍ୱର ମହାପାତ୍ର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୫. ସାହିତ୍ୟ ଓ ସମାଲୋଚନା - କୁଞ୍ଜବିହାରୀ ଦାଶ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର୍, କଟକ

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୧୪ (Core Course - 14) : ଓଡ଼ିଆ ଭାଷାର ବ୍ୟାବହାରିକ ପ୍ରୟୋଗ

୧୪ଶ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଭାଷଣ କଳା, ଦଲଗତ ଆଲୋଚନା ଓ ସାକ୍ଷାତକାର

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ସମ୍ବାଦ ପ୍ରସ୍ତୁତି, ଫିଚର ରଚନା ଓ ବିଜ୍ଞାପନ ପ୍ରସ୍ତୁତି

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : କାର୍ଯ୍ୟାଳୟରେ ଓଡ଼ିଆ ଲିଖନ ବିଧି

ନଥି ପ୍ରସ୍ତୁତି, ଅନୁବିଧି, ଟିପ୍ପଣୀ, ପ୍ରସ୍ତାବ, ଅନୁମୋଦନ, ଚିଠା ପ୍ରସ୍ତୁତି, ଅଧିସୂଚନା, ବିଜ୍ଞପ୍ତି, ଘୋଷଣା ଲିଖନ, ପତ୍ରଲିଖନ (ବ୍ୟକ୍ତିଗତ, ବ୍ୟାବସାୟିକ ଓ ସମ୍ପାଦକଙ୍କୁ ପତ୍ର)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ଭାଷାର କମ୍ପ୍ୟୁଟ୍‌ରୀକରଣ, ସଫ୍ଟ୍‌ଓ୍ୱେୟାର୍ ଏବଂ ହାର୍ଡ୍‌ଓ୍ୱେୟାର୍, ଓଡ଼ିଆ ଫଣ୍ଟ୍‌ସ,‌କୀ-ବୋର୍ଡ, ୱାଡ ପ୍ରୋସେସିଂ, ବନାନ ଓ ବ୍ୟାକରଣୟାଞ୍ଜିକ ପ୍ରକ୍ରିୟା, ଓଡ଼ିଆରେ ଇଣ୍ଟରନେଟ୍‌ର ବ୍ୟବହାର, ଓଡ଼ିଆ ସାମାଜିକ ୱେବ୍‌ସାଇଟ୍

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଯୋଗାଯୋଗମୂଳକ ମାତୃଭାଷା – ବିରଞ୍ଚି ନାରାୟଣ ସାମଲ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୨. ଭାଷଣ କଳା ଓ ଅନ୍ୟାନ୍ୟ ପ୍ରସଙ୍ଗ - କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୩. ସମ୍ବାଦପତ୍ର ଓ ଗଣମାଧ୍ୟମ - ମୃଣାଳ ଚାଟାର୍ଜୀ, ଶେଫାଳୀ କମ୍ୟୁନିକେଶନ, ସଞ୍ଜୀରମାର୍ଗ, ଢେଙ୍କାନାଳ

୪. ପ୍ରାୟୋଗିକ ଭାଷା ଓ ବିଜ୍ଞାପନର ଦିଗବିଦିଗ - କେ.ବି. ପଟନାୟକ, ଓ.ରା.ପା.ପ୍ର.ଓ.ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୫. ସଂଯୋଗ ଅନୁବିଧ-ସନ୍ତୋଷ କୁମାର ତ୍ରିପାଠୀ, ନାଳନ୍ଦା, କଟକ

୬. କାର୍ଯ୍ୟାଳୟ ନଥି - ଓଡ଼ିଆ ଭାଷା ପ୍ରତିଷ୍ଠାନ, ଭୁବନେଶ୍ୱର

---

୭. ଓଡ଼ିଆରେ କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା – ରୁଦ୍ରନାରାୟଣ ମହାପାତ୍ର, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର୍, କଟକ

୮. ଓଡ଼ିଆ ଭାଷାରେ କମ୍ପ୍ୟୁଟରର ପ୍ରୟୋଗ - ସୁଧୀର ଚନ୍ଦ୍ର ମହାନ୍ତି, ଏ.କେ. ମିଶ୍ର ପବ୍ଲିକେଶନ, ଭୁବନେଶ୍ୱର

୯. କମ୍ପ୍ୟୁଟରରେ ଓଡ଼ିଆ ଭାଷାର ବ୍ୟବହାର ଓ ପ୍ରୟୋଗ, ରୁଦ୍ରପ୍ରସାଦ ମିଶ୍ର, ଆଜିଅନ୍ତା ପବ୍ଲିଶର୍ସ, ଜଗତସିଂହପୁର

ଶୃଙ୍ଖଳାକୈନ୍ଦ୍ରିକ ଇଚ୍ଛାଧୀନ ପାଠ – ଓଡ଼ିଆ

Discipline Specific Elective – Odia DSE
ସାଧାରଣ (Pass) ଶ୍ରେଣୀ ପାଇଁ ଉଦ୍ଦିଷ୍ଟ

୫ମ ଓ *୬ଷ୍ଠ ପର୍ଯ୍ୟାୟ* (Semester – V, VI)

୫ମ ପର୍ଯ୍ୟାୟ (Semester – V) : ପ୍ରଥମ ଓ ଦ୍ୱିତୀୟ ପତ୍ର

୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

୬ଷ୍ଠ ପର୍ଯ୍ୟାୟ (Semester – VI) : ତୃତୀୟ ପତ୍ର ଓ ଚତୁର୍ଥ ପତ୍ର

୧୦୦ + ୧୦୦ = ୨୦୦ ନମ୍ବର

(୨୦ ନମ୍ବର ଅନ୍ତଃ ପରୀକ୍ଷା ଓ ୮୦ ନମ୍ବର ମୁଖ୍ୟ ପରୀକ୍ଷା = ୧୦୦ ନମ୍ବର)

ଚତୁର୍ଥ ପତ୍ର - ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି ୧୦୦ ନମ୍ବର

(ଅନୁବାଦ ବା ସଂପାଦନା ବା ଓଡ଼ିଆ ସଂସ୍କୃତି ଉପରେ ଅନ୍ୟୂନ ୫୦ ପୃଷ୍ଠା ମଧ୍ୟରେ ନିବନ୍ଧଟି ଲେଖିବାକୁ ହେବ ।)

(୮୦ ନମ୍ବର ପ୍ରକଳ୍ପ ଲେଖା + ୨୦ ନମ୍ବର ସାକ୍ଷାତକାର ପରୀକ୍ଷା= ୧୦୦ ନମ୍ବର)

ମୋଟ୍ - ୪୦୦ ନମ୍ବର

ମୂଲ୍ୟାଙ୍କନ ବିଭାଜନ ପଦ୍ଧତି

(କ) ପ୍ରତ୍ୟେକ ପାଠ୍ୟର ସବୁ ଏକକ (ୟୁନିଟ୍) ରୁ ୧୫ଟି ୨ ନମ୍ବର ବିଶିଷ୍ଟ ଅତି ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ସେଥିରୁ ଯେକୌଣସି ୧୦ ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୨x୧୦=୨୦)

(ଖ) ପ୍ରତ୍ୟେକ ପାଠ୍ୟର ସବୁ ଏକକ (ୟୁନିଟ୍)ରୁ ଅନ୍ତତଃ ୨ଟି ଲେଖାଏଁ ମୋଟ ୮ଟି ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ସେଥିରୁ ଯେକୌଣସି ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ପଡ଼ିବ । (୧୫ x ୪=୬୦)

(ଗ) ମହାବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ଅନ୍ତଃ ପର୍ଯ୍ୟାୟ ପରୀକ୍ଷା – (୨୦ ନମ୍ବର)

ମୋଟ୍ ମୂଲ୍ୟାଙ୍କ – ୧୦୦ ନମ୍ବର

ଭୂମିକା।

ଏହି ପାଠ୍ୟକ୍ରମଟି ବିଦ୍ୟାର୍ଥୀମାନଙ୍କୁ ଓଡ଼ିଶାର ସାମାଜିକ, ସାଂସ୍କୃତିକ ଓ ଐତିହାସିକ ବିବର୍ତ୍ତନ ବିଷୟରେ ଜ୍ଞାନ ଆହରଣ ପାଇଁ ସୁଯୋଗ ସୃଷ୍ଟିକରିବ । ଓଡ଼ିଆ ସାହିତ୍ୟରେ ସମାଜ ଓ ସଂସ୍କୃତିର ପ୍ରତିଫଳନ, ସାହିତ୍ୟର ବିବିଧତା ଏବଂ କମ୍ପ୍ୟୁଟରଭିତ୍ତିକ ବିଦ୍ୟା ଶିକ୍ଷଣ ଦିଗକୁ ଧ୍ୟାନ ଦିଆଯାଇ ଏହା ପ୍ରସ୍ତୁତ ହୋଇଛି ।

ଏହି ପାଠ୍ୟକ୍ରମରେ ମୋଟ ୪ ଗୋଟି ପାଠ୍ୟ ବାଧ୍ୟତାମୂଳକ । ସମ୍ମାନ (Hons) ଶ୍ରେଣୀର ଛାତ୍ରଛାତ୍ରୀମାନେ ଏହି ଚାରୋଟିଯାକ ପାଠ୍ୟ ପଢ଼ିବେ । ଏଥିମଧ୍ୟରୁ ଗୋଟିଏ ପାଠ୍ୟକୁ ଆଧାର କରି ତା' ସହିତ ଅନ୍ୟ ବିଦ୍ୟାକୁ ସଂଯୋଗ କରି ଷଷ୍ଠ ପର୍ଯ୍ୟାୟ (ସେମିଷ୍ଟର-୬) ପରୀକ୍ଷା ବେଳକୁ ପ୍ରକଳ୍ପ (୫୦ ପୃଷ୍ଠା ମଧ୍ୟରେ) ପ୍ରସ୍ତୁତ କରିବେ । ପ୍ରକଳ୍ପଟି ୪ର୍ଥ ପତ୍ର ଭାବରେ ବିବେଚିତ ହେବ ।

ଭିଶେଷ୍ୟ ଦ୍ରଷ୍ଟବ୍ୟ : ସାଧାରଣ (Pass) ଶ୍ରେଣୀର ଛାତ୍ରଛାତ୍ରୀମାନେ ପାଠ୍ୟ-୧ କୁ ୫ ପର୍ଯ୍ୟାୟରେ DSE-IA କିମ୍ବା DSE-IIA ଭାବେ ଏବଂ ପାଠ୍ୟ-୨କୁ ଷଷ୍ଠ ପର୍ଯ୍ୟାୟରେ DSE-IB କିମ୍ବା DSE-IIB ଭାବେ ପଢ଼ିବେ ।

ସବିଶେଷ ପାଠ୍ୟକ୍ରମ

ମୋଟ ୪ ଗୋଟି ପାଠ୍ୟ

ପତ୍ର ସଂଖ୍ୟା - ୪

ପ୍ରତ୍ୟେକ ପତ୍ର - ୧୦୦ ନମ୍ବର (୨୦ ନମ୍ବର ଅନ୍ତଃପରୀକ୍ଷା + ୮୦ ନମ୍ବର ମୁଖ୍ୟ ପରୀକ୍ଷା)

ସମୟ ନିର୍ଘଣ୍ଟ = ୬ x ୪ = ୨୪

ପ୍ରତ୍ୟେକ ପତ୍ର ପାଇଁ ୪୦ଟି ପିରିୟଡ୍, ପ୍ରତି ପିରିୟଡ୍ – ୪୫ ମିନିଟ

୫ମ ଓ ୬ଷ ପର୍ଯ୍ୟାୟ (ସେମିଷ୍ଟର – ୦୫ ଓ ୦୬)

ପାଠ୍ୟ-୧ / Course-1 : ଓଡ଼ିଶାର ସାଂସ୍କୃତିକ ଇତିହାସ ଓ ଓଡ଼ିଆ ସାହିତ୍ୟ (Pass)

(ସମୟ ନିର୍ଘଣ୍ଟ ୪+୨=୬)

୧ମ ଏକକ : ଓଡ଼ିଶାର ସଂକ୍ଷିପ୍ତ ଇତିହାସ ।

୨ୟ ଏକକ : ଓଡ଼ିଶାରେ ବୌଦ୍ଧ ସଂସ୍କୃତି, ଶୈବ ସଂସ୍କୃତି ଓ ବୈଷ୍ଣବ ସଂସ୍କୃତି ।

୩ୟ ଏକକ : ଶ୍ରୀଜଗନ୍ନାଥ ସଂସ୍କୃତି ଓ ଆଦିବାସୀ ସଂସ୍କୃତି ।

୪ର୍ଥ ଏକକ : ଓଡ଼ିଆ ଓଷା ବ୍ରତ ଓ ପର୍ବପର୍ବାଣି ।

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧. ଓଡ଼ିଶାର ସାଂସ୍କୃତିକ ଇତିହାସ - ସଂସ୍କୃତି ବିଭାଗ, ଓଡ଼ିଶା

୨. ଓଡ଼ିଶାର ସାଂସ୍କୃତିକ ଇତିହାସ - ପ୍ରବୋଧ କୁମାର ମିଶ୍ର, ବିଦ୍ୟାପୁରୀ, କଟକ

୩. ଓଡ଼ିଆ ସାହିତ୍ୟର ସାମାଜିକ ଓ ସାଂସ୍କୃତିକ ଇତିହାସ - ଚିତ୍ତରଞ୍ଜନ ଦାସ, ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୪. ଓଡ଼ିଶାର ଧର୍ମଧାରା - କାହ୍ନୁଚରଣ ମିଶ୍ର, ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୫. ବୈଷ୍ଣବ ସାହିତ୍ୟ ତତ୍ତ୍ୱ - ଆଶୁତୋଷ ପଟ୍ଟନାୟକ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୬. ଓଡ଼ିଆ ସାହିତ୍ୟରେ ଶୈବଧର୍ମ - କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୭. ଓଡ଼ିଆ ସାହିତ୍ୟରେ ଶ୍ରୀଜଗନ୍ନାଥ - ବାସୁଦେବ ସାହୁ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୮. ଲୀଳାମୟ ନୀଳାଦ୍ରୀଶ - ସଂପାଦନା, ଭୁବନେଶ୍ୱର ଭଞ୍ଜ ଭାରତୀ (୧ମ ଭାଗ ଓ ୨ୟ ଭାଗ)

୯. ଓଡ଼ିଆ ବ୍ରତ ସାହିତ୍ୟ - ଅରବିନ୍ଦ ପଟ୍ଟନାୟକ, ଓଡ଼ିଶା ସାହିତ୍ୟ ଏକାଡେମୀ

१०.   ଓଡ଼ିଶାର ଧର୍ମଧାରା, ଡ. ପ୍ରଦୀପ୍ତ କୁମାର ପଣ୍ଡା

११.   ଲୋକଧର୍ମ ଓ ଲୋକସାହିତ୍ୟ, ଡ. ସଦାନନ୍ଦ ନାୟକ, ବିଜୟ ବୁକ୍ ଷ୍ଟୋର, ବ୍ରହ୍ମପୁର

ପାଠ୍ୟ-୨ / **Course – 2** : ଓଡ଼ିଆ ଶିଶୁ ସାହିତ୍ୟ ଓ ବିଜ୍ଞାନଭିତ୍ତିକ ସାହିତ୍ୟ **(Pass)**

୧ମ ଏକକ :   ଓଡ଼ିଆ ଶିଶୁ ସାହିତ୍ୟର ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ

୨ୟ ଏକକ :   ଓଡ଼ିଆ ବିଜ୍ଞାନଭିତ୍ତିକ ସାହିତ୍ୟର ସ୍ୱରୂପ ଓ ବିକାଶଧାରା

୩ୟ ଏକକ :   ପୃଥିବୀ ବାହାରେ ମଣିଷ - ଗୋକୁଳାନନ୍ଦ ମହାପାତ୍ର

୪ର୍ଥ ଏକକ :   ବିଚିତ୍ର ବିଶ୍ୱ – ଦେବକାନ୍ତ ମିଶ୍ର

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧.ଓଡ଼ିଆ ଶିଶୁ ସାହିତ୍ୟର ଇତିବୃତ୍ତ - ମନୀନ୍ଦ୍ର ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୨.ପୃଥିବୀ ବାହାରେ ମଣିଷ - ଗୋକୁଳାନନ୍ଦ ମହାପାତ୍ର

୩.ବିଚିତ୍ର ବିଶ୍ୱ – ଦେବକାନ୍ତ ମିଶ୍ର

୪.ଓଡ଼ିଆ ସାହିତ୍ୟ, ମହେଶ୍ୱର ମହାନ୍ତି

୫.ଆଧୁନିକ ଶିଶୁ ଓଡ଼ିଆ ସାହିତ୍ୟ –ଜାନକୀ ବଲ୍ଲଭ ମହାନ୍ତି, ଗ୍ରନ୍ଥମନ୍ଦିର, କଟକ

ପାଠ୍ୟ-୩ / **Course – 3** : ଓଡ଼ିଆ ପଦ୍ୟ ସାହିତ୍ୟ **(Pass)**

୧ମ ଏକକ :   ଜଗନ୍ନାଥ ଜଣାଣ - କବିସୂର୍ଯ୍ୟ ବଳଦେବ ରଥ

ଆକାଶ ପ୍ରତି - ମଧୁସୂଦନ ରାଓ

ଯାତ୍ରା ସଂଗୀତ - ବୈକୁଣ୍ଠନାଥ ପଟ୍ଟନାୟକ

ମୌସୁମୀ - ରାଧାମୋହନ ଗଡ଼ନାୟକ

୨ୟ ଏକକ :   କ୍ଷୁଦ୍ରଗଳ୍ପ

ଡିମିରି ଫୁଲ – ଅଖିଳ ମୋହନ ପଟ୍ଟନାୟକ

ଭଙ୍ଗା ଖେଳନା - କିଶୋରୀ ଚରଣ ଦାଶ

ଅନ୍ଧ ରାତିର ସୂର୍ଯ୍ୟ - ମହାପାତ୍ର ନୀଳମଣି ସାହୁ

ବାସି ମଡ଼ା - ସୁରେନ୍ଦ୍ର ମହାନ୍ତି

୩ୟ ଏକକ :   ପ୍ରବନ୍ଧ ଓ ସମାଲୋଚନା

ମହାସ୍ରୋତ - ବିଶ୍ୱନାଥ କର

ଚିତ୍ରଗ୍ରୀବର ଉଚିତ ଅଭିମାନ - ଗୋଲୋକ ବିହାରୀ ଧଳ

ତିନୋଟି ସମାଲୋଚନା – ବାଉରୀବନ୍ଧୁ କର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୪ର୍ଥ ଏକକ :   ଉପନ୍ୟାସ - ମାଟିର ମଣିଷ - କାଳିନ୍ଦୀ ଚରଣ ପାଣିଗ୍ରାହୀ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧. ଓଡ଼ିଆ ଉପନ୍ୟାସ ସାହିତ୍ୟର ପରିଚୟ, ସଂ ପଠାଣୀ ପଟ୍ଟନାୟକ ଓ ଭୋଲାନାଥ ରାଉତ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

୨. କାଳିନ୍ଦୀ ଚରଣଙ୍କ କଥାସାହିତ୍ୟ – ବିଷ୍ଣୁପ୍ରିୟା ଓତା, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୩. ଓଡ଼ିଆ ପ୍ରବନ୍ଧ ସାହିତ୍ୟ - ବାଉରୀବନ୍ଧୁ କର

୪. ଓଡ଼ିଆ ସମାଲୋଚନା ସାହିତ୍ୟ - ଓଡ଼ିଶା ସାହିତ୍ୟ ଏକାଡେମୀ

୫. ମାଟିର ମଣିଷ - କାଳିନ୍ଦୀ ଚରଣ ପାଣିଗ୍ରାହୀ

ପାଠ୍ୟ-୪/ **Course – 4 : ପ୍ରବନ୍ଧ ପ୍ରସ୍ତୁତି ଓ ଉପସ୍ଥାପନ। (Pass)**

ସନ୍ଦର୍ଭ ଲିଖନ - ୮୦ + ମୌଖିକ - ୨୦ = ୧୦୦

ଅନୁବାଦ ବା ସଂପାଦନା ବା ଓଡ଼ିଆ ସଂସ୍କୃତି ଉପରେ ଅନ୍ୟୂନ ୫୦ ପୃଷ୍ଠା ମଧ୍ୟରେ ନିବନ୍ଧ ପ୍ରସ୍ତୁତି।

କିମ୍ବା।

(ସମାଲୋଚନା, ଅନୁବାଦ, ସଂପାଦନା, ଗବେଷଣା)

୧. ପ୍ରଥମ ଏକକ : ସମାଲୋଚନାର ସଂଜ୍ଞା, ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ

୨. ଦ୍ୱିତୀୟ ଏକକ : ଅନୁବାଦର ସଂଜ୍ଞା, ସ୍ୱରୂପ ଓ ପ୍ରକାରଭେଦ

୩. ତୃତୀୟ ଏକକ : ସଂପାଦନା ବିଧି

୪. ଚତୁର୍ଥ ଏକକ : ଗବେଷଣା ପ୍ରବିଧି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଗବେଷଣା ଅନୁବାଦ ସଂପାଦନା କଳା – ସଂ ନାରାୟଣ ସାହୁ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୨. ଗବେଷଣା ପ୍ରବିଧି - ଡ. ସୁବୋଧ ଚାଟାର୍ଜୀ, ବିଦ୍ୟାପୁରୀ, କଟକ

୩. ଗବେଷଣା ପ୍ରକରଣ : ସଂପାଦନା ଓ ଅନୁବାଦ ପ୍ରବିଧି - କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ ଓ ନିର୍ମଳା କୁମାରୀ ରାଉତ

ଅନ୍ତର୍ବିଷୟ ଇଚ୍ଛାଧୀନ ପାଠ – ଓଡ଼ିଆ

Generic Electives (GE) - Course - Odia

ସୂଚନା : ଅନ୍ୟ ସଂଜ୍ଞାନର ବିଦ୍ୟାର୍ଥୀ ଏଥିମଧ୍ୟରୁ ୨ଗୋଟି କିମ୍ବା ୪ଗୋଟି ପତ୍ର ଅଧ୍ୟୟନ କରିପାରିବେ ; କିନ୍ତୁ ପାସ୍ ବିଦ୍ୟାର୍ଥୀ ଏଥିମଧ୍ୟରୁ ୧ମ ଓ ୨ୟ ପତ୍ରକୁ ଯଥାକ୍ରମେ ୫ମ ଓ ୬ଷ୍ଠ ପର୍ଯ୍ୟାୟରେ ପଢ଼ିବେ ।

୧ .   ପତ୍ର ସଂଖ୍ୟା - ୪

୨ .   ପ୍ରତ୍ୟେକ ପତ୍ର - ୧୦୦ ନମ୍ବର ବିଶିଷ୍ଟ, ମୋଟ୍ -୪୦୦ ନମ୍ବର

୩.   ପ୍ରତ୍ୟେକ ପତ୍ରରେ ୪ଗୋଟି ଏକକ ରହିବ ।

ନମ୍ବର ବିଭାଜନ ବିଧି :

 କ)   ପ୍ରତ୍ୟେକ ପତ୍ରର ମୋଟ ନମ୍ବର – ୧୦୦

ଖ)   ଅନ୍ତଃପରୀକ୍ଷା – ୨୦ ଓ ମୁଖ୍ୟ ପରୀକ୍ଷା – ୮୦

(ଗ)   ମୁଖ୍ୟ ପରୀକ୍ଷାରେ ପ୍ରତ୍ୟେକ ଏକକରୁ ଦୁଇଟି ଲେଖାଏଁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ପସନ୍ଦମୂଳକ ବୋଧଜ୍ଞାନମାପକ ୮ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡ଼ିବ । ୮ ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନରୁ ୪ଟିର ଉତ୍ତର ଦେବାକୁ ହେବ ।

(୧୫ x ୪ = ୬୦)

(ଘ)   ସମସ୍ତ ଏକକରୁ ୨ ନମ୍ବର ବିଶିଷ୍ଟ ଲବ୍ଧଜ୍ଞାନମୂଳକ ୧୫ଟି ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ମୋଟ ୧୫ ଗୋଟି ପ୍ରଶ୍ନରୁ ୧୦ ଗୋଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ ।

(୨ x ୧୦ = ୨୦)

ସବିଶେଷ ପାଠ୍ୟକ୍ରମ

ପ୍ରଥମ ପର୍ଯ୍ୟାୟ (Semester – I)

ପାଠ୍ୟ – ୧ / ପତ୍ର – ୧ (Core Course - 1): ଗଣମାଧ୍ୟମ, ବେତାର କଳା ଓ ବିଜ୍ଞାପନ କଳା

୧ମ ଏକକ : ଗଣମାଧ୍ୟମ ଓ ତା'ର ପ୍ରକାରଭେଦ

୨ୟ ଏକକ : ବିଜ୍ଞାପନର ପରିଭାଷା, ପରିସର ଓ ଉଦ୍ଦେଶ୍ୟ

୩ୟ ଏକକ : ସ୍ୱୟ ଲିଖନ ଓ ଫିଚର ଲିଖନ

୪ର୍ଥ ଏକକ : ପତ୍ରଲିଖନ (ବାଣିଜ୍ୟିକ, କାର୍ଯ୍ୟାଳୟ ଭିତ୍ତିକ, ବ୍ୟକ୍ତିଗତ ଓ ସମ୍ପାଦକଙ୍କୁ ପତ୍ର)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ସାହିତ୍ୟକୁ ଆକାଶବାଣୀର ଦାନ - ବ୍ରଜମୋହନ ମହାନ୍ତି, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର

୨. ସମ୍ବାଦପତ୍ର ଓ ଗଣମାଧମ -ମୃଣାଲ ଚାଟାର୍ଜୀ, ଶେଫାଳୀ କମ୍ୟୁନିକେଶନ, ଢେଙ୍କାନାଳ

୩. ସମ୍ବାଦ ଓ ସାମ୍ବାଦିକତା – ଚନ୍ଦ୍ରଶେଖର ମହାପାତ୍ର, ଓ.ରା.ପା.ପ୍ର. ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୪. ସଂଯୋଗ ଅନୁବିଧ,-ସନ୍ତୋଷ କୁମାର ତ୍ରିପାଠୀ, ନାଳନ୍ଦା, କଟକ

୫. ଯୋଗାଯୋଗମୂଳକ ମାତୃଭାଷା – ବିରଞ୍ଜ ନାରାୟଣ ସାମଲ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର

୬. ଯୋଗାଯୋଗର ଭାଷା – ସୁଧୀର ଚନ୍ଦ୍ର ମହାନ୍ତି, ପ୍ରାଚୀ ପ୍ରକାଶନ, କଟକ

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ (Semester – II)

ପାଠ୍ୟ – ୨ / ପତ୍ର – ୨ (Core Course -2) : ସାହିତ୍ୟ ଅଧ୍ୟୟନ

୧ମ ଏକକ : ଗଳ୍ପ ସାହିତ୍ୟ

        ବୁଢ଼ା ଶଙ୍ଖାରି - ଲକ୍ଷ୍ମୀକାନ୍ତ ମହାପାତ୍ର

        ମାଗୁଣୀର ଶଗଡ଼ - ଗୋଦାବରୀଶ ମହାପାତ୍ର

        ଶିକାର - ଭଗବତୀ ଚରଣ ପାଣିଗ୍ରାହୀ

୨ୟ ଏକକ : ଉପନ୍ୟାସ ସାହିତ୍ୟ

        ଶାସ୍ତି - କାହ୍ନୁଚରଣ ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିସର୍ସ, କଟକ

୩ୟ ଏକକ : ନାଟକ

        ଶେଷ କଥା - ଡକ୍ଟର ନାରାୟଣ ସାହୁ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର୍, କଟକ

୪ର୍ଥ ଏକକ : ରମ୍ୟ ରଚନା

        ବାଇ ମହାନ୍ତି ପାଞ୍ଜି (ପ୍ରଥମ ବିଡ଼ା) - ଗୋପାଳ ଚନ୍ଦ୍ର ପ୍ରହରାଜ

        ବଟୁଆ - ଗୋବିନ୍ଦ ତ୍ରିପାଠୀ

        ସାଧୁ ସଙ୍ଗ - ଚୌଧୁରୀ ହେମକାନ୍ତ ମିଶ୍ର

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. କାହ୍ନୁଚରଣ ବିଶେଷାଙ୍କ, କୋଣାର୍କ, ଓଡ଼ିଶା ସାହିତ୍ୟ ଏକାଡେମୀ

୨. ଓଡ଼ିଆ କ୍ଷୁଦ୍ରଗଳ୍ପର ଇତିହାସ, ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିସର୍ସ, କଟକ

୩. ଓଡ଼ିଆ କଥାସାହିତ୍ୟର କଥା ଓ ରମ୍ୟରଚନା, ମହାପାତ୍ର ନୀଳମଣି ସାହୁ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

୪. ଶାସ୍ତି - କାହ୍ନୁଚରଣ ମହାନ୍ତି, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିସର୍ସ, କଟକ

୫. ଉତ୍ତର ସତୁରୀ ଓଡ଼ିଆ ନାଟକ, ହେମନ୍ତ କୁମାର ଦାସ, ଗ୍ରନ୍ଥମନ୍ଦିର, କଟକ

୬. ଶେଷ କଥା - ନାରାୟଣ ସାହୁ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

ତୃତୀୟ ପର୍ଯ୍ୟାୟ (Semester – III)

ପାଠ୍ୟ – ୩ / ପତ୍ର - ୩ (Core Course -3): ପ୍ରାଚୀନ, ମଧ୍ୟଯୁଗ ଓ ଆଧୁନିକ ଓଡ଼ିଆ ସାହିତ୍ୟ

୧ମ ଏକକ : ସାରଳା ମହାଭାରତରେ କାହାଣୀ

ସତ୍ୟଆୟ

ତୁଳସୀବଣ ବାଘ

ଗଙ୍ଗା ବୋଇଲେ ଥିବି ଗାଙ୍ଗୀ ବୋଇଲେ ଯିବି

୨ୟ ଏକକ : ବଳରାମ ଦାସ ଓ ଜଗନ୍ନାଥ ଦାସଙ୍କ କାହାଣୀ

ବଳରାମ ଦାସଙ୍କ ବଉଳା ଅଧାୟ ଓ ମୃଗୁଣୀ ସ୍ତୁତି

ଜଗନ୍ନାଥ ଦାସଙ୍କ କପୋତ ଉପାଖ୍ୟାନ ଓ ପିଙ୍ଗଳା ଉପାଖ୍ୟାନ

୩ୟ ଏକକ : ମଧ୍ୟକାଳୀନ ସାହିତ୍ୟ ସ୍ରଷ୍ଟାଙ୍କ ସଂକ୍ଷିପ୍ତ ପରିଚୟ

ଦୀନକୃଷ୍ଣ ଦାସ, ଅଭିମନ୍ୟୁ ସାମନ୍ତସିଂହାର, କବିସମ୍ରାଟ୍ ଉପେନ୍ଦ୍ର ଭଞ୍ଜ

କବିସୂର୍ଯ୍ୟ ବଳଦେବ ରଥ

୪ର୍ଥ ଏକକ : ଆଧୁନିକ ଯୁଗର ସାହିତ୍ୟ ସ୍ରଷ୍ଟାଙ୍କ ସଂକ୍ଷିପ୍ତ ପରିଚୟ

ରାଧାନାଥ ରାୟ, ଫକୀର ମୋହନ ସେନାପତି, ଗଙ୍ଗାଧର ମେହେର, ମାୟାଧର ମାନସିଂହ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ - ମାୟାଧର ମାନସିଂହ, ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୨. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ – ସୂର୍ଯ୍ୟନାରାୟଣ ଦାଶ (୨ୟ ଓ ୩ୟ ଭାଗ) – ଗ୍ରନ୍ଥ ମନ୍ଦିର, କଟକ

୩. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ (୧୮୦୩-୧୯୨୦) ନଟ୍ବର ସାମନ୍ତରାୟ, ବାଣୀ ଭବନ, ଭୁବନେଶ୍ୱର

୪. ଆଲୋକ ଓ ଅମୃତର କବି ଗଙ୍ଗାଧର : ମଣୀନ୍ଦ୍ର କୁମାର ମେହେର, ପଢ଼ାପଢ଼ି, ଭୁବନେଶ୍ୱର

ଚତୁର୍ଥ ପର୍ଯ୍ୟାୟ (Semester – IV)

ପାଠ୍ୟ – ୪ / ପତ୍ର - ୪ (Core Course - 4): ଓଡ଼ିଆ କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା

୧ମ ଏକକ / ୟୁନିଟ୍-୧ : କମ୍ପ୍ୟୁଟର କ'ଣ ଓ କାହିଁକି

କମ୍ପ୍ୟୁଟର ର ବିଭିନ୍ନ ଅଂଶବିଶେଷ ଓ କାର୍ଯ୍ୟ

୨ୟ ଏକକ/ ୟୁନିଟ୍-୨ : ୟୁନିକୋଡ ମାଧ୍ୟମରେ ଓଡ଼ିଆ ଟିପି ଶିକ୍ଷା

୩ୟ ଏକକ/ ୟୁନିଟ୍-୩: ଇଣ୍ଟର୍ନେଟ୍ରେ ଓଡ଼ିଆ ଚିଠି

ଇଣ୍ଟର୍ନେଟ୍ରେ ସାମାଜିକ ଗଣମାଧ୍ୟମର ବ୍ୟବହାର

୪ର୍ଥ ଏକକ/ ୟୁନିଟ୍-୪ :	ପାୱାର ପଏଣ୍ଟ ସ୍ଲାଇଡ୍ ପ୍ରସ୍ତୁତି, ଟେବୁଲ୍ସ, ଫିଗର୍ସ ଏବଂ ପିକ୍ଚରସ
	ଏକ୍ସେଲ୍ର ବ୍ୟବହାର ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ମୌଳିକ କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା - ଦେବକାନ୍ତ ମିଶ୍ର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୨. ଓଡ଼ିଆରେ କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା – ରୁଦ୍ରନାରାୟଣ ମହାପାତ୍ର, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୩. ଓଡ଼ିଆ ଭାଷାରେ କମ୍ପ୍ୟୁଟର୍ର ପ୍ରୟୋଗ - ସୁଧୀର ଚନ୍ଦ୍ର ମହାନ୍ତି, ଏ.କେ. ମିଶ୍ର ପବ୍ଲିକେଶନ, ଭୁବନେଶ୍ୱର

୪. କମ୍ପ୍ୟୁଟରରେ ଓଡ଼ିଆ ଭାଷାର ବ୍ୟବହାର ଓ ପ୍ରୟୋଗ – ରୁଦ୍ରପ୍ରସାଦ ମିଶ୍ର, ଆଜିଅନ୍ତା ପବ୍ଲିଶର୍ସ, ଜଗତସିଂହପୁର

୫. କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା – ରାନୁ ବନିକ୍, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

ପାଠ୍ୟକ୍ରମର ସାରାଂଶ – ସଂରଚନା

Structure of B.A. Pass (DSC-Odia) Under CBCS

ପ୍ରଧାନ ପାଠ୍ୟ (Core Course) : ୪

ପ୍ରତ୍ୟେକ ପତ୍ର କ୍ରେଡ଼ିଟିସ୍ = ୪ + ୨ = ୬

ପ୍ରଥମ ପର୍ଯ୍ୟାୟ : (Ist Semester)

ପ୍ରଧାନ ପାଠ୍ୟ - ୧ (Core Course – 1)   ଓଡ଼ିଆ କବିତା ପ୍ରାଚୀନରୁ ଆଧୁନିକ

ପ୍ରଥମ ପତ୍ର – କ୍ରେଡ଼ିଟିସ୍ = ୪ + ୨ = ୬

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ : (2nd Semester)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୨ (Core Course – 2)   ଓଡ଼ିଆ ନାଟକ ଓ ଏକାଙ୍କିକା

୨ୟ ପତ୍ର - କ୍ରେଡ଼ିଟିସ୍ = ୪ + ୨ = ୬

ତୃତୀୟ ପର୍ଯ୍ୟାୟ : (3rd Semester)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୩ (Core Course – 3)   ଓଡ଼ିଆ କଥା ସାହିତ୍ୟ

୩ୟ ପତ୍ର- କ୍ରେଡ଼ିଟିସ୍ = ୪ + ୨ = ୬

ଚତୁର୍ଥ ପର୍ଯ୍ୟାୟ : (4th Semester)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ-୪ (Core Course - 04)   ବ୍ୟାବହାରିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ

୪ର୍ଥ ପତ୍ର - କ୍ରେଡ଼ିଟିସ୍ = ୪ + ୨ = ୬

CBCS : B.A. (PASS) 2019-20

ପସନ୍ଦ ଓ ଆସ୍ଥାଭିତ୍ତିକ ପାଠ୍ୟଖସଡ଼ା : ସ୍ନାତକ (ଓଡ଼ିଆ ଇଚ୍ଛାଧୀନ)
2019-20

Core Course – ପ୍ରଧାନ ପାଠ୍ୟ

ମୋଟ୍ ପତ୍ର ସଂଖ୍ୟା – ୦୪ (Four Paper – Discipline-1/ Four Paper – Discipline-2)

ପ୍ରତ୍ୟେକ ପତ୍ର – ୧୦୦ ନମ୍ବର ବିଶିଷ୍ଟ (୨୦ ନମ୍ବର ମହାବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ଅନ୍ତଃ ପର୍ଯ୍ୟାୟ ପରୀକ୍ଷା + ୮୦ ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ମାନକ ପରୀକ୍ଷା)

ଇଚ୍ଛାଧୀନ ଓଡ଼ିଆ : ଜଣେ ସ୍ନାତକ – (ଇଚ୍ଛାଧୀନ)– ମୋଟ୍ ୪୦୦ ନମ୍ବରର ପରୀକ୍ଷା ଦେବେ ।

କ) ଅତି କମ୍‌ରେ (ମୋଟ୍) ୫୦ଟି କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ (ପିରିୟଡ଼)ରେ ଗୋଟିଏ ପତ୍ରର ପାଠଦାନ ଶେଷ ହେବ । ଗୋଟିଏ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ ବା ପିରିୟଡ଼-୪୫ ମିନିଟ୍)

ଖ) ପ୍ରତ୍ୟେକ ପତ୍ର ୪ ଗୋଟି ୟୁନିଟ୍ (ଏକକ) ଉପାଂଶରେ ବିଭକ୍ତ ।

ଗ) ପ୍ରତ୍ୟେକ ପତ୍ର ୬ ଆସ୍ଥାଭିତ୍ତିକ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟ (୪ + ୨ କ୍ରେଡିଟ୍) ବିଶିଷ୍ଟ । ଗୋଟିଏ ଆସ୍ଥାଭିତ୍ତିକ କାର୍ଯ୍ୟ ନିର୍ଘଣ୍ଟର ମହତ୍ତ୍ୱ ହେଉଛି – ୧୦ ପିରିୟଡ଼ ସହିତ ସମାନ ।

ମୋଟ୍ ୪ ଗୋଟି ଇଚ୍ଛାଧୀନ ପତ୍ରର କ୍ରେଡିଟ୍ ହେଉଛି – ୪ x ୬ (୪ + ୨) = ୨୪ ।

ଘ) ପର୍ଯ୍ୟାୟ **(Semester)** ଓ ପ୍ରସ୍ତାବିତ ପାଠ ଯୋଜନା :

ପ୍ରଥମ ଶିକ୍ଷାବର୍ଷ

୧ମ ପର୍ଯ୍ୟାୟ ୧ମ -ପତ୍ର	୧୦୦ ନମ୍ବର
୨ୟ ପର୍ଯ୍ୟାୟ ୨ୟ -ପତ୍ର	୧୦୦ ନମ୍ବର

ଦ୍ୱିତୀୟ ଶିକ୍ଷାବର୍ଷ

୩ୟ ପର୍ଯ୍ୟାୟ ୩ୟ -ପତ୍ର	୧୦୦ ନମ୍ବର
୪ର୍ଥ ପର୍ଯ୍ୟାୟ ୪ର୍ଥ - ପତ୍ର	୧୦୦ ନମ୍ବର

ଙ) ନମ୍ବର / ମୂଲ୍ୟାଙ୍କ ବିଭାଜନ ପଦ୍ଧତି :

ମହାବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ଅନ୍ତଃପରୀକ୍ଷା	–	୨୦ ନମ୍ବର
ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ମୁଖ୍ୟ ପରୀକ୍ଷା	–	୮୦ ନମ୍ବର

ବିଶ୍ୱବିଦ୍ୟାଳୟ ସ୍ତରୀୟ ପରୀକ୍ଷାରେ ନିମ୍ନମତେ ପ୍ରଶ୍ନ ପଡ଼ିବ :

କ) ପ୍ରତ୍ୟେକ ପତ୍ର ପ୍ରତ୍ୟେକ ଏକରୁ ବିକଳ୍ପ ସହ ୮ଟି ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀ ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । (୧୫ x ୪ = ୬୦ ନମ୍ବର)

ଖ) ପ୍ରତ୍ୟେକ ପତ୍ର ପ୍ରତ୍ୟେକ ଏକରୁ ୧୫ଟି ୨ ନମ୍ବର ବିଶିଷ୍ଟ ସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । (୨ x ୧୦ = ୨୦)

ସବିଶେଷ ପାଠ୍ୟକ୍ରମ (Detail Syllabus)

(କ) ପ୍ରଥମ ପର୍ଯ୍ୟାୟ (Semester – 1) DSC 1/2 A

ପ୍ରଥମ ପତ୍ର: ଓଡ଼ିଆ କବିତା ପ୍ରାଚୀନରୁ ଆଧୁନିକ

ପ୍ରଧାନ ପାଠ (Core Course -1): ଓଡ଼ିଆ ସାହିତ୍ୟ ପ୍ରାଚୀନରୁ ଆଧୁନିକ

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ସାରଳା ମହାଭାରତ (ଦୁର୍ଯ୍ୟୋଧନଙ୍କ ରକ୍ତନଦୀ ସନ୍ତରଣ)

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଭାଗବତ (୨୪ ଗୁରୁ ପ୍ରସଙ୍ଗ) - ଜଗନ୍ନାଥ ଦାସ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଦୀନକୃଷ୍ଣ ଦାସଙ୍କ ରସକଲ୍ଲୋଲ (୧ମ ଛାନ୍ଦ) ଓ ଉପେନ୍ଦ୍ରଭଞ୍ଜଙ୍କ କୋଟିବ୍ରହ୍ମାଣ୍ଡ ସୁନ୍ଦରୀ (୧ମ ଛାନ୍ଦ)

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଆଧୁନିକ କବିତା

ମହାଯାତ୍ରା (ସପ୍ତମ ସର୍ଗ)- ଅମର୍ଷିଙ୍କ ଉଦ୍ବୋଧନ, ରାଧାନାଥ ରାୟ

ମଙ୍ଗେ ଅଇଲା ଉଷା – ଗଙ୍ଗାଧର ମେହେର

ବନ୍ଦୀର ସାଧ୍ୟ ଅନୁଚିନ୍ତା - ଗୋପବନ୍ଧୁ ଦାସ

ପ୍ରତିମା ନାୟକ - ସଚ୍ଚିଦାନନ୍ଦ ରାଉତରାୟ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୭. ସାରଳା ମହାଭାରତ (ସାରଳା ଦାସ)

୧. ଅବଧୂତ ଓ ଯଦୁରାଜା ସଂବାଦ, ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୧. କହେ କୃଷ୍ଣଦାସ କବି – କୃଷ୍ଣଚରଣ ସାହୁ, ବିଦ୍ୟାପୁରୀ, କଟକ

୨. ରସକଲ୍ଲୋଲ, ସଂପାଦନା – ଦେବେନ୍ଦ୍ର ମହାନ୍ତି

୩. ଦୁର୍ଲଭ ଦୀନକୃଷ୍ଣ, ଜ୍ୟୋତିରଞ୍ଜନ ସାମଲ, ବିଜୟିନୀ ପବ୍ଲିକେସନ୍, କଟକ

(ଖ) ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ (Semester – II) DSC 1/2 B

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୨ (Core Course - 2) : ଓଡ଼ିଆ ନାଟକ ଓ ଏକାଙ୍କିକା
ଦ୍ୱିତୀୟ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ରକ୍ତମାଟି - କାଳୀଚରଣ ପଟ୍ଟନାୟକ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ନନ୍ଦିକା କେଶରୀ -ମନୋରଞ୍ଜନ ଦାସ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : କୋକୁଆ – ବିଜୟ କୁମାର ଶତପଥୀ, ଅଗ୍ରଦୂତ, କଟକ

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଏକାଙ୍କିକା- ସ୍ମୃତି ବିଭ୍ରାଟ - ପ୍ରାଣବନ୍ଧୁ କର ଓ ଛଦ୍ମବେଶୀ - ବିଶ୍ୱଜିତ୍ ଦାସ

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଅଭିଯାନ - କାଳୀଚରଣ ପଟ୍ଟନାୟକ

୨. ନନ୍ଦିକା କେଶରୀ-ମନୋରଞ୍ଜନ ଦାସ କିୟା ତଟନିଚୀରଞ୍ଜନା – ବିଜୟ ମିଶ୍ର

୩. କୋକୁଆ – ବିଜୟ କୁମାର ଶତପଥୀ, ଅଗ୍ରଦୂତ, କଟକ କିୟା ଭୁଖା –ମଙ୍ଗଲୁ ଚରଣ ବିଶ୍ୱାଲ

୪. ଅଶ୍ରୁ ନୁହେଁ ଅନଳ, ହେମନ୍ତ କୁମାର ଦାସ

୫. ସ୍ୱାଧୀନୋତ୍ତର ଓଡ଼ିଆ ନାଟକର ମନସ୍ତାତ୍ତ୍ୱିକ ବିଶ୍ଳେଷଣ, ରଶ୍ମିତା ରାଉତରାୟ, ବିଜୟିନୀ ପବ୍ଲିକେସନ, କଟକ

୬. ସାହିତ୍ୟସାଧକ ମଙ୍ଗଲୁଚରଣ – ଗୌରିଦାସ ପ୍ରଧାନ

(ଚତୁର୍ଥ ପତ୍ର ନିମନ୍ତେ ପ୍ରଦତ୍ତ ସହାୟକ ପୁସ୍ତକଗୁଡ଼ିକ ଅନୁସରଣୀୟ ।)

ତୃତୀୟ ପର୍ଯ୍ୟାୟ (Semester – III) DSC 1/2 C

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ - ୩ (Core Course - 3) : ଓଡ଼ିଆ କଥା ସାହିତ୍ୟ

ତୃତୀୟ ପତ୍ର :

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଓଡ଼ିଆ କଥାସାହିତ୍ୟର ବିକାଶକ୍ରମ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : ଛ'ମାଣ ଆଠଗୁଣ୍ଠ - ଫକୀର ମୋହନ ସେନାପତି

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଦାନାପାଣି - ଗୋପୀନାଥ ମହାନ୍ତି କିୟା ନୟନତାରା -ଦୟାନିଧି ମିଶ୍ର

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଗଳ୍ପ ସାହିତ୍ୟ

ପାଠ୍ୟ ଗଳ୍ପ: ଦେବତାର ବିଧାତା – ଗୋଦାବରୀଶ ମହାପାତ୍ର

ମାଂସର ବିଳାପ - କାଳିନ୍ଦୀ ଚରଣ ପାଣିଗ୍ରାହୀ

୫ମ ଏକକ / ୟୁନିଟ୍ – ୫ : ପ୍ରକଳ୍ପ ପ୍ରସ୍ତୁତି

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ଓଡ଼ିଆ ଉପନ୍ୟାସ ସାହିତ୍ୟର ପରିଚୟ, ୟଁ ପଠାଣି ପଞ୍ଚନାୟକ ଓ ଭୋଲାନାଥ ରାଉତ, ଓଡ଼ିଶା ବୁକ୍ ଷ୍ଟୋର, କଟକ

୨. ଓଡ଼ିଆ କ୍ଷୁଦ୍ରଗଳ୍ପର ଉନ୍ମେଷ ଓ ଉତ୍ତରଣ – ବୈଷ୍ଣବ ଚରଣ ସାମଲ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୩. ଛ'ମାଣ ଆଠଗୁଣ୍ଠ - ଫକୀର ମୋହନ ସେନାପତି

୪. ଛ'ମାଣ ଆଠଗୁଣ୍ଠ ଭିନ୍ନ ଦୃଷ୍ଟି ଭିନ୍ନ ବ୍ୟାଖ୍ୟା, ପଞ୍ଚାନନ ମିଶ୍ର, ବିଜୟିନୀ ପବ୍ଲିକେସନ, କଟକ

୫. ଦାନାପାଣି - ଗୋପୀନାଥ ମହାନ୍ତି

୬. ନୟନତାରା - ଦୟାନିଧି ମିଶ୍ର

୭. କଥାଶିଳ୍ପୀ ମନୋଜ ଦାସ, ଶତୁଘ୍ନ ପାଣ୍ଡବ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୮. ମନସ୍ୱୀ ମନୋଜ, ମଣୀନ୍ଦ୍ର କୁମାର ମେହେର, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ

୯. ଓଡ଼ିଆ ଉପନ୍ୟାସର ସମାଜତାତ୍ତ୍ୱିକ ଆଲୋଚନା, କଇଳାଶ ପଞ୍ଚନାୟକ, ବିଦ୍ୟାପୁରୀ, କଟକ

ଚତୁର୍ଥ ପର୍ଯ୍ୟାୟ (Semester – IV)

ପ୍ରଧାନ ପାଠ୍ୟାଂଶ – ୪ (Core Course - 4) : ବ୍ୟାବହାରିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ (DSC 1/2 D)

୪ର୍ଥ ପତ୍ର

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ : ଓଡ଼ିଆ ବର୍ଣ୍ଣ ବିଚାର, ବାକ୍ୟର ଗଠନ ରୀତି ଓ ପ୍ରକାରଭେଦ ।

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ : କାରକ, ବିଭକ୍ତି, କୃଦନ୍ତ ଓ ତଦ୍ଧିତ

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ : ଉପସର୍ଗ, ସନ୍ଧି ଓ ସମାସ

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ : ଓଡ଼ିଆ ଶବ୍ଦସମ୍ଭାର

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ

୧. ସର୍ବସାର ବ୍ୟାକରଣ - ନାରାୟଣ ମହାପାତ୍ର ଓ ଶ୍ରୀଧର ଦାସ, ନିୟୁ ଷ୍ଟୁଡେଣ୍ଟ ଷ୍ଟୋର, କଟକ

୨. ଆଧୁନିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ - ଧନେଶ୍ୱର ମହାପାତ୍ର, କିତାବ ମହଲ, କଟକ

୩. ବ୍ୟାବହାରିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ, ବିଜୟ ପ୍ରସାଦ ମହାପାତ୍ର, ବିଦ୍ୟାପୁରୀ, କଟକ

୪. ଓଡ଼ିଆ ଭାଷାର ଉନ୍ମେଷ ଓ ବିକାଶ – ବାସୁଦେବ ସାହୁ, ଫ୍ରେଣ୍ଡସ୍ ପବ୍ଲିଶର୍ସ, କଟକ
   ଓଡ଼ିଆ ଭାଷା ଚର୍ଚ୍ଚାର ପରମ୍ପରା, ଗଗନେନ୍ଦ୍ର ନାଥ ଦାସ, ଓଡ଼ିଆ ଗବେଷଣା ପରିଷଦ, କଟକ

ଦକ୍ଷତାବର୍ଦ୍ଧକ ବାଧ୍ୟତାମୂଳକ ପାଠ୍ୟକ୍ରମ
Ability Enhancement Compulsory Course (AECC)
ଯୋଗାଯୋଗମୂଳକ ମାତୃଭାଷା – ଓଡ଼ିଆ
(2019-20)
MIL (Communications) – Odia

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ **(2nd Semester)** କଳା, ବିଜ୍ଞାନ ଓ ବାଣିଜ୍ୟ ସାଧାରଣ **(Pass)** / ସମ୍ମାନ **(Hons)** ଶ୍ରେଣୀ ପାଇଁ ଉଦ୍ଦିଷ୍ଟ

ମୋଟ୍ କ୍ରେଡିଟ୍‍ -୪ , ମୋଟ ଶ୍ରେଣୀ ପାଠଦାନ ନିର୍ଘଣ୍ଟ -୪୦, ଗୋଟିଏ ଶ୍ରେଣୀ ପାଠଦାନର (ପିରିୟଡ୍) ସମୟ ଅବଧି -୪୫ ମିନିଟ୍‍, ପାଠ୍ୟକ୍ରମ – ୨ , ପୂର୍ଣ୍ଣସଂଖ୍ୟା – ୧୦୦

(Credits – 4) Total Classes - 40, One Period - 45 Minutes, Course - II, Full Marks - 100

ପାଠ୍ୟକ୍ରମର ଭୂମିକା :

ଏହି ପାଠ୍ୟଖସଡ଼ାଟି ପସନ୍ଦ ଓ ଆସ୍ଥାଭିତ୍ତିକ (CBCS / ସିବିସିଏସ୍) ପାଠ୍ୟ ପ୍ରଣାଳୀ ଅନୁସାରେ ପ୍ରସ୍ତୁତ ହୋଇଛି । ବିଭିନ୍ନ ସ୍ତରରେ ଆବଶ୍ୟକ ଅନୁସାରେ ସମସାମୟିକ ପରିସ୍ଥିତିକୁ ନେଇ ଭାବବିନିମୟ ଓ ପାରସ୍ପରିକ ଯୋଗାଯୋଗ ସ୍ଥାପନ କିପରି ଓଡ଼ିଆ ଭାଷାରେ ସହଜରେ, ସରଳରେ ହୋଇପାରିବ – ଏ ଦିଗ ପ୍ରତି ଏଠାରେ ଧ୍ୟାନ ଦିଆଯାଇଛି । ଓଡ଼ିଆ ଭାଷା ଓ ସାହିତ୍ୟର ପ୍ରାୟୋଗିକ ଜ୍ଞାନର ବିକାଶ ନିମିଉ +୩ ସ୍ତରୀୟ ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ଏହି ପାଠ୍ୟକ୍ରମର ଖସଡ଼ାଟି ସାହାଯ୍ୟ କରିବ । ସେଥିପାଇଁ ପ୍ରଚଳିତ ଭାଷାର ବୈୟାକରଣିକ, ବ୍ୟାବହାରିକ ଓ ପ୍ରାୟୋଗିକ ଦିଗ ପ୍ରତି ଏଠାରେ ଧ୍ୟାନ ଦିଆଯାଇଛି । ଏଠାରେ ସଂଯୋଗ ପ୍ରକ୍ରିୟାର ଅନୁବିଦ୍ଧ, ଯୋଗାଯୋଗର ତଥ୍ୟ ଓ ତତ୍ତ୍ୱ ପ୍ରତି ଗୁରୁତ୍ୱ ଦିଆଯାଇଛି । ସରକାରୀ କାର୍ଯ୍ୟାଳୟରେ ଓଡ଼ିଆ ଭାଷାର ବ୍ୟବହାରରେ ଏହା ଦକ୍ଷତା ବୃଦ୍ଧି କରିବ । ଓଡ଼ିଆ ଭାଷାର ପ୍ରୟୋଗରେ ସେମାନେ ଶୁଦ୍ଧ ଓ ପରିଚ୍ଛନ୍ନ ଭାବରେ ଯେକୌଣସି ପ୍ରକାର ଜ୍ଞାନର ସୂଚନା ତଥ୍ୟ ଓ ସିଦ୍ଧାନ୍ତକୁ ମୌଖିକ ଓ ଲିଖିତ ସ୍ତରରେ ସହଜରେ ପ୍ରକାଶ କରିପାରିବେ ଏବଂ ସେମାନଙ୍କ ମାତୃଭାଷା ପ୍ରୟୋଗର ବିକାଶ ଘଟିପାରିବ ।

ମୂଲ୍ୟ ବିଭାଜନ ପଦ୍ଧତି : (ସବୁଥିରୁ ବିକଳ୍ପ ପଡ଼ିବ)

କ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକ (ୟୁନିଟ୍‍) ରୁ ବିକଳ୍ପସହ ଦୁଇଟି ଲେଖାଏଁ ମୋଟ ୮ଟି ୧୫ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘପ୍ରଶ୍ନ ପଡ଼ିବ । ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ ।(୧୫ x ୪ = ୬୦)

ଖ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକରୁ ୧୨ଟି ଅତିସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ସେଥିରୁ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୧୦ x ୨ = ୨୦)

ଗ) ମହାବିଦ୍ୟାଳୟସ୍ତରୀୟ ଅନ୍ତଃ ପରୀକ୍ଷା (୨୦)

ମୋଟ ମୂଲ୍ୟାଙ୍କ – ୧୦୦

ସବିଶେଷ ପାଠ୍ୟ

ଯୋଗାଯୋଗମୂଳକ ମାତୃଭାଷା – ଓଡ଼ିଆ (AECC)

ପାଠ୍ୟ-୧ / Course – 1: ଯୋଗାଯୋଗ ଅନୁବିଧ, ରୀତି ଓ ମାଧ୍ୟମ

୧ମ ଏକକ : ଯୋଗାଯୋଗର ପରିଭାଷା, ଅନୁବିଧ, ପରିସର ଓ ପ୍ରକାରଭେଦ

୨ୟ ଏକକ : ସାକ୍ଷାତକାର, ଭାଷଣ କଳା

୩ୟ ଏକକ : ସମ୍ବାଦର ପରିଭାଷା, ପରିସର ଓ ସମ୍ବାଦ ପ୍ରସ୍ତୁତି

୪ର୍ଥ ଏକକ : ଓଡ଼ିଆ ଭାଷାର ବର୍ଣ୍ଣମାଳା, ବର୍ଣ୍ଣାଶୁଦ୍ଧିର ନିରାକରଣ । (ବନାନ ତୁଟି – ସାଦୃଶ୍ୟଜନିତ ଅଶୁଦ୍ଧି, ଲିଙ୍ଗଗତ ଅଶୁଦ୍ଧି, ସନ୍ଧିଗତ ଅଶୁଦ୍ଧି, ସମାସଗତ ଅଶୁଦ୍ଧି, ବଚନ ଓ ବିଭକ୍ତିଗତ ଅଶୁଦ୍ଧି, ବାକ୍ୟ ବିନ୍ୟାସଜନିତ ଅଶୁଦ୍ଧି, ସମାର୍ଥବୋଧକ ଶବ୍ଦାଶୁଦ୍ଧି, ପ୍ରତ୍ୟୟ ଜନିତ ଅଶୁଦ୍ଧି, ଶବ୍ଦ ସଂଯୋଗାତ୍ମକ ଓ ସ୍ୱରସଙ୍ଗତି ଜନିତ ଅଶୁଦ୍ଧି)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ (ପାଠ୍ୟ-୧ / Course – 1)

୧. ଯୋଗାଯୋଗ ମୂଳକ ମାତୃଭାଷା (ଓଡ଼ିଆ) ସାମଲ ବିରଞ୍ଚି ନାରାୟଣ, ସତ୍ୟନାରାୟଣ ବୁକ ଷ୍ଟୋର, କଟକ ।

୨. ସଂଯୋଗ ଅନୁବିଧ, ସନ୍ତୋଷ କୁମାର ତ୍ରିପାଠୀ, ନାଳନ୍ଦା, କଟକ

୩. ଭାଷଣ କଳା ଓ ଅନ୍ୟାନ୍ୟ ପ୍ରସଙ୍ଗ – କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର, କଟକ

୪. ପ୍ରାୟୋଗିକ ଓଡ଼ିଆ ଭାଷା – ଓଡ଼ିଶା ରାଜ୍ୟପାଠ୍ୟ ପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୧. ସମ୍ବାଦ ଓ ସାମ୍ବାଦିକତା – ଚନ୍ଦ୍ରଶେଖର ମହାପାତ୍ର, ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୧. ନିର୍ଭୁଲ ଲେଖାର ମୂଳସୂତ୍ର, ନୀଳାଦ୍ରିଭୂଷଣ ହରିଚନ୍ଦନ, ପି.ସି.ଆର ପବ୍ଲିକେସନ, ଭୁବନେଶ୍ୱର

୨. ସର୍ବସାର ବ୍ୟାକରଣ – ନାରାୟଣ ମହାପାତ୍ର ଓ ଶ୍ରୀଧର ଦାସ, ନିୟୁ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର, କଟକ

COMPULSORY LANGUAGE / LITERATURE COURSE MIL (ODIA)- ARTS

ବାଧ୍ୟତାମୂଳକ ଭାଷା ଓ ସାହିତ୍ୟ – ଆଧୁନିକ ଭାରତୀୟ ଭାଷା (ଓଡ଼ିଆ)

+୩, ପ୍ରଥମ ବର୍ଷ କଳା ସାଧାରଣ (PASS) ଶ୍ରେଣୀ ପାଇଁ ଉଦ୍ଦିଷ୍ଟ

ପତ୍ର ସଂଖ୍ୟା – ପ୍ରଥମ

ପ୍ରଥମ ପର୍ଯ୍ୟାୟ (1ST SEMESTER)

ପ୍ରତ୍ୟେକ ପତ୍ରର ମୂଲ୍ୟ – ୧୦୦ ନମ୍ବର

(୨୦ ନମ୍ବର ଅନ୍ତଃ ପରୀକ୍ଷା + ୮୦ ନମ୍ବର ମୁଖ୍ୟ ପରୀକ୍ଷା)

ମୂଲ୍ୟ ବିଭାଜନ

(କ) ପ୍ରଥମ ଏକକ (ଗଦ୍ୟ ସାହିତ୍ୟ)ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଖ) ଦ୍ୱିତୀୟ ଏକକ (ପଦ୍ୟ ସାହିତ୍ୟ) ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ ।   (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଗ) ତୃତୀୟ ଏକକ (ଅତିରିକ୍ତ ପାଠ୍ୟ) ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଘ) ଚତୁର୍ଥ ଏକକରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ପ୍ରଶ୍ନରୁ ଗୋଟିକର ଉତ୍ତର ଦେବାକୁ ହେବ ।

(ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଙ) ପ୍ରତ୍ୟେକ ଏକକରୁ ତିନୋଟି କରି ୧୨ଟି ପ୍ରଶ୍ନ ଆସିବ, ସେଥିରୁ ବିଦ୍ୟାର୍ଥୀ ୧୦ ଗୋଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । (ମୋଟ୍ ୨ x ୧୦ = ୨୦)

ସବିଶେଷ ଅଧ୍ୟୟନ
ଅନୁମୋଦିତ ପାଠ୍ୟ

ପ୍ରଥମ ଏକକ– ଗଦ୍ୟ ସାହିତ୍ୟ

୧ –   ଜାତୀୟ ଜୀବନ - ମଧୁସୂଦନ ଦାସ

୨ –   ସୌନ୍ଦର୍ଯ୍ୟ ଓ ପ୍ରେମ – ଶଶିଭୂଷଣ ରାୟ

୩–   ସାହିତ୍ୟ ଓ ଗଣମାଧ୍ୟମ – ଶରତ କୁମାର ମହାନ୍ତି

ଦ୍ୱିତୀୟ ଏକକ – ପଦ୍ୟ ସାହିତ୍ୟ

୧ - କେଶବ କୋଇଲି - ମାର୍କଣ୍ଡ ଦାସ

୨ - ମନବୋଧ ଚଉତିଶା - ଭକ୍ତଚରଣ ଦାସ

୩ - କାକ ବାରତା - ନନ୍ଦକିଶୋର ବଳ

୪ - ଝିଅ ପାଇଁ ଗୋଟିଏ କବିତା - ରାଜେନ୍ଦ୍ର କିଶୋର ପଣ୍ଡା

ତୃତୀୟ ଏକକ - ଅତିରିକ୍ତ ପାଠ୍ୟ (ଗଳ୍ପ ସାହିତ୍ୟ)

୧ - ଅଶୁଭ ପୁତ୍ର କାହାଣୀ - ଅଚ୍ୟୁତାନନ୍ଦ ପତି

୨ - ସୁଲତାନ୍ - ରାଜକିଶୋର ପଟ୍ଟନାୟକ

୩ - ପାଟ୍ଦେଇ – ବୀଣାପାଣି ମହାନ୍ତି

ଚତୁର୍ଥ ଏକକ - ବ୍ୟାକରଣ

ପାଠ : ପଦ ପ୍ରକରଣ - (ବିଶେଷ୍ୟ, ବିଶେଷଣ, ସର୍ବନାମ, ଅବ୍ୟୟ ଓ କ୍ରିୟା)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧) ସର୍ବସାର ବ୍ୟାକରଣ - ପଣ୍ଡିତ ନାରାୟଣ ମହାପାତ୍ର ଏବଂ ଶ୍ରୀଧର ଦାଶ - ନିଉ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର, କଟକ

୨) ପ୍ରଚଳିତ ଓଡ଼ିଆ ଭାଷାର ବ୍ୟାକରଣ - ବିଜୟ ପ୍ରସାଦ ମହାପାତ୍ର - ବିଦ୍ୟାପୁରୀ, କଟକ

୩) ଆଧୁନିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ - ଧନେଶ୍ଵର ମହାପାତ୍ର - କିତାବ ମହଲ, କଟକ

୪) ଶେଷ ଦଶକର ରଚନା – ଶରତ କୁମାର ମହାନ୍ତି

COMPULSORY LANGUAGE / LITERATURE COURSE

MIL (ODIA)- ARTS

ବାଧତାମୂଳକ ଭାଷା ଓ ସାହିତ୍ୟ – ଆଧୁନିକ ଭାରତୀୟ ଭାଷା (ଓଡ଼ିଆ)

+୩, ପ୍ରଥମ ବର୍ଷ କଳା ସାଧାରଣ (PASS)ଶ୍ରେଣୀ ପାଇଁ ଉଦ୍ଦିଷ୍ଟ

2019-20

ପତ୍ର ସଂଖ୍ୟା – ଦ୍ୱିତୀୟ

ଦ୍ୱିତୀୟ ପର୍ଯ୍ୟାୟ (3RD SEMESTER)

(୨୦ ନମ୍ବର ଅନ୍ତଃ ପରୀକ୍ଷା + ୮୦ ନମ୍ବର ମୁଖ୍ୟ ପରୀକ୍ଷା = ୧୦୦ ନମ୍ବର)

ମୂଲ୍ୟ ବିଭାଜନ

(କ) ପ୍ରଥମ ଏକକ (ଗଦ୍ୟ ସାହିତ୍ୟ)ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଖ) ଦ୍ୱିତୀୟ ଏକକ (ପଦ୍ୟ ସାହିତ୍ୟ) ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଗ) ତୃତୀୟ ଏକକ (ଅତିରିକ୍ତ ପାଠ୍ୟ) ରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ଦୀର୍ଘଧର୍ମୀ ପ୍ରଶ୍ନ ଆସିବ ।
ବିଦ୍ୟାର୍ଥୀଙ୍କ ପସନ୍ଦ ଅନୁସାରେ ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଘ) ଚତୁର୍ଥ ଏକକରୁ ୧୫ ନମ୍ବର ବିଶିଷ୍ଟ ୨ଟି ପ୍ରଶ୍ନରୁ ଗୋଟିକର ଉତ୍ତର ଦେବାକୁ ହେବ ।

(ମୋଟ୍ ମୂଲ୍ୟ - ୧୫)

(ଙ) ପ୍ରତ୍ୟେକ ଏକକରୁ ତିନୋଟି କରି ୧୨ଟି ପ୍ରଶ୍ନ ଆସିବ, ସେଥିରୁ ବିଦ୍ୟାର୍ଥୀ ୧୦ ଗୋଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବେ । (ମୋଟ୍ ୨ x ୧୦ = ୨୦)

ସବିଶେଷ ଅଧ୍ୟୟନ

ଅନୁମୋଦିତ ପାଠ୍ୟ

ପ୍ରଥମ ଏକକ- ଗଦ୍ୟ ସାହିତ୍ୟ

୧ - ଅଛୁ ଓ ହେବୁ - ନୀଳକଣ୍ଠ ଦାସ

୨ - ସ୍ତ୍ରୀ ଶିକ୍ଷା - ରେବା ରାୟ

୩- ଝଙ୍କତି ଦାମ୍ଭିକେ - ବୈଷ୍ଣବ ଚରଣ ସାମଲ

ଦ୍ୱିତୀୟ ଏକକ - ପଦ୍ୟ ସାହିତ୍ୟ

   ୧ - ସବୁଥରୁ ବଞ୍ଚିତ କରି - କାନ୍ତକବି ଲକ୍ଷ୍ମୀକାନ୍ତ ମହାପାତ୍ର

   ୨ - ଅକୂର ଉବାଚ - ଗୁରୁ ପ୍ରସାଦ ମହାନ୍ତି

   ୩ - ଓଡ଼ିଶା - ସୀତାକାନ୍ତ ମହାପାତ୍ର

   ୪ - ହେ ମୋ ଦେଶ – ବ୍ରଜନାଥ ରଥ

ତୃତୀୟ ଏକକ - ଅତିରିକ୍ତ ପାଠ୍ୟ (ଜୀବନୀ)

   ୧ - ପିତୃପ୍ରସଙ୍ଗ (ସ୍ୱଭାବ କବି ଗଙ୍ଗାଧର ମେହେରଙ୍କ ଜୀବନୀ –କେବଳ ଜୀବନୀ ଅଂଶ)– ଭଗବାନ ମେହେର

ଚତୁର୍ଥ ଏକକ – ବ୍ୟାକରଣ- ବାକ୍ୟର ସଂଜ୍ଞା, ସ୍ୱରୂପ, ଲକ୍ଷଣ ଓ ରୂପାନ୍ତର, ଲୋକୋକ୍ତିର ଅର୍ଥ ଓ ପ୍ରୟୋଗ

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

   ୧) ସର୍ବସାର ବ୍ୟାକରଣ - ପଣ୍ଡିତ ନାରାୟଣ ମହାପାତ୍ର ଏବଂ ଶ୍ରୀଧର ଦାଶ - ନିଉ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର୍, କଟକ

   ୨) ପ୍ରାୟୋଗିକ ଓଡ଼ିଆ ଭାଷା, ଓଡ଼ିଶା ରାଜ୍ୟପାଠ୍ୟ ପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

ପାଠ୍ୟକ୍ରମ ସଂପର୍କରେ ଶିକ୍ଷକଙ୍କ ପ୍ରଶିକ୍ଷଣ ଯୋଜନା (୨୧ ଦିନ)

   ୨ - ବୌଦ୍ଧ, ଶୈବ, ବୈଷ୍ଣବ, ଜଗନ୍ନାଥ ତତ୍ତ୍ୱ

   ୩ - ଗବେଷଣା ପ୍ରବିଧି

   ୪ - ସାହିତ୍ୟତତ୍ତ୍ୱ (ପ୍ରାଚ୍ୟ-ପାଶ୍ଚାତ୍ୟ)

   ୫ - ଭାଷାବିଜ୍ଞାନ ଓ ଭାଷାତତ୍ତ୍ୱ

   ୬ - ଲୋକସାହିତ୍ୟ ଓ ସଂସ୍କୃତି

   ୭ - କଥା ସାହିତ୍ୟ (ଗଳ୍ପ ଉପନ୍ୟାସ)

   ୮ - ଅନୁବାଦ ଓ ସଂପାଦନା

   ୯ - କମ୍ପ୍ୟୁଟର ଶିକ୍ଷା

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN PHYSICS

(Bachelor of Science Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course structure of UG Physics Honors

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I 4 Papers (400 Marks)	Ability Enhancement Compulsory Course-I	AECC-1	4
	Core course-I	Mathematical Physics-I	4
	Core Course-I Practical/Tutorial	Mathematical Physics-I Lab	2
	Core course-II	Mechanics	4
	Core Course-II Practical/Tutorial	Mechanics Lab	2
	Generic Elective -1	GE-1	4/5
	Generic Elective -1	Practical/Tutorial	2/1
II 4 Papers (400 Marks)	Ability Enhancement Compulsory Course-II	AECC-II	4
	Core course-III	Electricity and Magnetism	4
	Core Course-III Practical/Tutorial	Electricity and Magnetism Lab	2
	Core course-IV	Waves and Optics	4
	Core Course-IV Practical/Tutorial	Waves and Optics Lab	2
	Generic Elective -2	GE-2	4/5
	Generic Elective -2	Practical/Tutorial	2/1
III 5 Papers (500 Marks)	Core course-V	Mathematical Physics-II	4
	Core Course-V Practical/Tutorial	Mathematical Physics-II Lab	2
	Core course-VI	Thermal Physics	4
	Core Course-VI Practical/Tutorial	Thermal Physics Lab	2
	Core course-VII	Analog Systems and Applications	4
	Core Course-VII Practical/Tutorial	Analog Systems & Applications Lab	2
	Skill Enhancement CompulsoryCourse -1	SECC-1	4
	Generic Elective -3	GE-3	4/5
	Generic Elective -3	Practical/Tutorial	2/1

IV	Core course-VIII	Mathematical Physics III	4
5 Papers	Core Course-VII Practical/Tutorial	Mathematical Physics-III Lab	2
	Core course-IX	Elements of Modern Physics	4
(500 Marks)	Core Course-IX Practical/Tutorial	Elements of Modern Physics Lab	2
	Core course-X	Digital Systems and Applications	4
	Core Course-XPractical/Tutorial	Digital Systems & Applications Lab	2
	Skill Enhancement Compulsory Course -2	SECC -2	4
	Generic Elective -4	GE-4	4/5
	Generic Elective -4	Practical/Tutorial	2/1
V 4 Papers	Core course-XI	Quantum Mechanics & Applications	4
	Core Course-XI Practical/Tutorial	Quantum Mechanics Lab	2
(400 Marks)	Core course-XII	Solid State Physics	4
	Core Course-XII Practical/Tutorial	Solid State Physics Lab	2
	Discipline Specific Elective -1	DSE-1	4/5
	Discipline Specific Elective -1	Practical/Tutorial	2/1
	Discipline Specific Elective -2	DSE-2	4/5
	Discipline Specific Elective- 2	Practical/Tutorial	2/1
	Core course-XIII	Electro-magnetic Theory	4
	Core Course-XIII Practical/Tutorial	Electro-magnetic Theory Lab	2
VI 4 Papers (400 Marks)	Core course-XIV	Statistical Mechanics	4
	Core Course-XIV Practical/Tutorial	Statistical Mechanics Lab	2
	Discipline Specific Elective4	DSE-4	4/5
	Discipline Specific Elective -4	Practical/Tutorial	2/1
	Or Discipline Specific Elective-4	(Eligible Students may do a Project in DSE-IV)	6
		Total Credits	148

Generic Elective Papers (GE) (Minor-Physics) for other Departments/Disciplines: (Credit: 06 each)

Depending on their requirements, Universities may choose 2 (two)GE subjects with 2 papers from each subject or only one GE subject with 4 papers from it.

Two papers GE subject will be :

1.   GE-I (Mechanics & Properties of matter, Oscillation & Waves, Thermal
Physics, Electricity and Magnetism & Electronics) + Lab

2.   **GE-II** (Optics, Special Theory of Relativity, Atomic Physics, Quantum
Mechanics and Nuclear Physics)+ Lab

A student who chooses to read only Physics subject GE will take 4 DSC papers of
the Pass Course as below

1.**GE-I** as **DSC-1**(Mechanics)+ Lab

2.**GE-II** as **DSC-2**,(Electricity, Magnetism & Emt))+ Lab

3. **GE-III** as **DSC-3**,(Thermal Physics & Statiscal Mechanics))+ Lab

4. **GE-IV** as **DSC-4** (Waves And Optics))+ Lab

(GE-I same paper as DSC-1,GE-II same as DSC-2 ,GE-III same as DSC-3,GE-IV
same as DSC-4)

PHYSICS

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 5 papers suggested)

Generic Elective for Non Physics students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper –

For practical paper: Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

For non practical paper: Midterm : 20 marks, End term : 80 marks

 Total – 100 marks   Credit per paper – 6

Teaching hours per paper –

Practical paper-40 hours theory classes + 20 hours Practical classes

Non Practical paper-50 hours theory classes + 10 hours tutorial

CORE PAPER-1

MATHEMATICAL PHYSICS-I

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen andunseen.

UNIT-I

 Calculus -I: Plotting of functions, Intuitive ideas of continuous, differentiable functions and plotting of curves, Approximation: Taylor and binomial series (statements only), First Order Differential Equations and Integrating Factor, Second Order Differential equations: Homogeneous Equations with constant coefficients, Wronskian and general solution, Statement of existence and UniquenessTheoremforInitialValueProblems,ParticularIntegral.

UNIT-II

Calculus-II: Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration, Constrained Maximization using Lagrange Multipliers,

Vector algebra: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar tripleproductandtheirinterpretationintermsofareaandvolumerespectively, Scalar and Vectorfields.

UNIT-III

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems, Comparison of velocity and accelerationincylindricalandsphericalcoordinatesystem

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular Function, Properties of Dirac delta function.

UNIT-IV

Vector Differentiation: Directional derivatives and normal derivative, Gradientofascalarfieldanditsgeometricalinterpretation,Divergenceandcurlof a vector field, Del and Laplacian operators, Vectoridentities

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs)

TextBooks:

1. MathematicalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013,7th Edn.,Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India)

Reference books:

1. Mathematical Physics C. Harper (Prentice Hall India)

2. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition , Mc-Graw Hill Education)

3. Complex variables and applications, J. W. Brown and R.V.Churchill
   • Mathematical Physics, Satya Prakash (SultanChand)

4. Mathematical Physics, B. D. Gupta (4th edition, Vikas Publication)
   • Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K.Dash (Srikrishna Prakashan)

5. Mathematical Physics–H.K.Dass, Dr. Rama Verma (S. ChandPublishing)

CORE PAPER I LAB:

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physicalproblems
- Thecoursewillconsistoflectures(boththeoryandpractical)intheLab
- Evaluation done not on the programming but on the basis of formulating theproblem
- Aim at teaching students to construct the computational problem to be solved
- Studentscanuseanyoneoperatingsystem LinuxorMicrosoftWindows

Introduction and Overview: Computer architecture and organization, memory and Input/output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating pointnumbers,algorithms,Sequence,SelectionandRepetition,singleanddouble precision arithmetic, underflow and overflow emphasize the importance of makingequationsintermsofdimensionlessvariables,Iterativemethods. Algorithm
Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations. Systematic and Random Errors, Propagation of Errors, Normal Law of Errors, Standard and Probable Error.

Review of C and C++ Programming: Introduction to Programming, constants,

variables and Fundamentals data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data format- ting, Control statements (decision making and looping statements) (If Statement,IfelseStatement,NestedIfstructure,ElseIfStatement,Ternaryoperator, Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions,Structures and Unions, Idea of classes andobjects

Programs: Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search

Random number generation: Area of circle, area of square, volume of sphere, value ofπ.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw–HillPub.
3. NumericalRecipesinC:TheArtofScientificComputing,W.H.Pressetal, 3rd Edn. 2007, Cambridge UniversityPress.
4. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007 , Wiley India Edition.
6. Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier DoverPub.
7. AnIntroductiontocomputationalPhysics,T.Pang,2ndEdn., 2006,Cam- bridge Univ.Press.

CORE PAPER-II
MECHANICS

UNIT-I

Rotational Dynamics: Centre of Mass, Motion of CoM, Centre of Mass and Laboratory frames, Angular momentum of a particle and system of particles, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Perpendicular and Parallel Axis Theorems, Routh Rule, Calculation of moment of inertia for cylindrical and spherical bodies, Kinetic energy of rotation, Eulers Equations of Rigid Body motion, Motion involving both translation and rotation. Moment of Inertia of a Flywheel.

Non-Inertial Systems: Non-inertial frames and fictitious forces, Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and itsapplications.

UNIT-II Elasticity: Relation between Elastic constants, Twisting torque on a Cylinder or Wire, Bending of beams, External bending moment, Flexural rigidity, Single and double cantilever

Fluid Motion: Kinematics of Moving Fluids: Poiseuilles Equation for Flow of a Liquid through a Capillary Tube, Surface tension, Gravity waves andripple
Viscocity: Poiseuilles Equation for Flow of a Liquid with corrections.

UNIT-IIIGravitation and Central Force Motion: Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Potential and field due to spherical shell and solid sphere, Motion of a particle under a central force field, Two-body problem and its reduction to one-body problem and its solution, Differential Equation of motion with central force and its solution, The first Integrals (two), Concept of power Law Potentials, Keplers Laws of Planetary motion, Satellites:. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS), Physiological effects on astronauts.

UNIT-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Equation of motion and solution(,cases of oscillatory, critically damped and overdamped) Forced oscillations: Transient and steady states; Resonance, sharpness of resonance;powerdissipationandQualityFactor,BarPendulum,KatersPendulum

 Special Theory of Relativity: Michelson-Morley Experiment and its out- come, Postulates of Special Theory of Relativity, Lorentz Transformations,Simultaneityandorderofevents,Lorentzcontraction,Timedilation, Relativistic transformation of velocity, Frequency and wave number, Relativistic addition of velocities, Variation of mass with velocity, Massless Particles,Mass-energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics,Transformation of Energy andMomentum.

Text Books:
1. Mechanics, D.S. Mathur (S. Chand Publishing)
2. Introduction to Special Relativity, R. Resnick (John Wiley)

Reference Books:
1. Introduction to Mechanics Daniel Klapnner and Robert Kolenkow, McgrawHill.
2. Mechanics by K.R Simon
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W. Knight, etal (Tata McGraw-Hill)
4. Physics, Resnick, Halliday and Walker (8/e.2008,Wiley)
5. Theoretical Mechanics-M.R. Spiegel (Tata McGrawHill).
6. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands (Pearson)
7. Mechanics-M.Das, P.K.Jena and R.N. Mishra (SrikrishnaPublications)

CORE PAPER-1I LAB

(minimum 5 experiments are to be done):

1. To study surface tension by capillary rise method
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuilles method).
6. To determine the Modulus of Rigidity of a Wire by Maxwellsneedle.
7. To determine the value of g using BarPendulum.
8. To determine the value of g using KatersPendulum

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11thEdn, 2011, Kitab Mahal

CORE PAPER-III
ELECTRICITY AND MAGNETISM

UNIT-I

Electric Field and Electric Potential

Electric field: Electric field lines, Electric flux, Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field. Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Potential calculation indifferentsimplecases,LaplacesandPoissonequations,TheUniquenessTheorem,

Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.

Electrostaticenergyofsystemofcharges,Electrostaticenergyofacharged sphere,ConductorsinanelectrostaticField,Surfacechargeandforceonaconductor.

UNIT-II

Magnetic Field: Magnetic Force, Lorentz Force, Biot Savarts Law, Cur- rent Loop as a Magnetic Dipole and its Dipole Moment (analogy withElectric Dipole), Amperes Circuital Law and its application to (1) Solenoid (2)Toroid
(3) Helmhotz coil, Properties of B:curl and divergence, Vector Potential, Ballistic Galvanometer: Torque on a current Loop, Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping, CDR.

UNIT-III

Dielectric Properties of Matter: Electric Field in matter, Polarization, PolarizationCharges,ElectricalSusceptibilityandDielectricConstant,Capacitor (parallelplate,spherical,cylindrical)filledwithdielectric,Displacementvector   D, Relations between E, P and D, Gauss Law in dielectrics. Magnetic Properties of Matter: Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H, M, Ferromagnetism, B-H curve andhysteresis.

Electromagnetic Induction: Faradays Law, Lenzs Law, Self Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to MaxwellsEquations

UNIT-IV

Electrical Circuits: AC Circuits: Kirchhoffs laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit: (1) Resonance (2) Power Dissipation (3) Quality Factor, (4) Band Width, Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources,

Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to DC circuits. Transient Currents Growth and decay of current in RC and LR circuits.

Text Books:
1. Introduction to Electrodynamics – D.J. Griffiths (Pearson, 4th edition, 2015)
2. Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)

Reference Books:
1. Classical Electrodynamics, J. D. Jackson (Wiley).
2. Electricity and Magnetism D. C. Tayal (Himalaya Publishing house)
3. Electricity, Magnetism and Electromagnetic Theory- S. Mahajan and Choudhury (Tata McGraw Hill)
4. Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands (Pear- son)
5. Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press)

CORE PAPER-II1
LAB (minimum of 6 experiments are to be done)

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, c)DC Current, (d) Capacitances, and (e) Checking electricalfuses.

1. To study the characteristics of a series RCCircuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters Bridge. To compare capacitances using DeSautysbridge.
4. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
5. To verify the Thevenin and Norton theorems.

6. To determine self inductance of a coil by Andersons bridge.

7. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.

8. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonance frequency and (b) Quality factor Q.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

2. A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

CORE PAPER-1V: WAVES AND OPTICS

UNIT - I

Geometrical optics : Fermats principle, reflection and refraction at plane interface, Matrix formulation of geometrical Optics, Cardinal points and Cardinal planes of an optical system, Idea of dispersion, Application to thick Lens and thin Lens, Ramsden and Huygens eyepiece. Wave Optics : Electromagnetic nature of light. Definition and properties of wave front Huygens Principle. Temporal and SpatialCoherence.

UNIT - II

Wave Motion : Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Traveling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Trans- port, Intensity of Wave. Superposition of two perpendicular Harmonic Oscillations : Graphical and

Analytical Methods, Lissajous Figures (1:1 and 1:2) and theiruses,SuperpositionofNharmonicwaves.

UNIT- III

Interference : Division of amplitude and wave front, Youngs double slit experiment, Lloyds Mirror and Fresnels Bi-prism, Phase change on reflection: Stokes treatment, Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes), Fringes of equal thickness (Fizeau Fringes), Newtons Rings: Measurement of wavelength and refractive index. Interferometer : Michelsons Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility ofFringes, Fabry-Perot interferometer.

UNIT - IV

Fraunhofer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnels Assumptions, Fresnels Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light, Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnels Integral, Fresnel diffraction patternofastraightedge,aslitandawire.

TextBooks:
1. AtextbookofOpticsN.SubrahmanyamandBrijLal(S.Chand Publishing)
2. Optics - Ajoy Ghatak (McGraw Hill)

Reference Books:
1. Optics-E.Hecht(Pearson)
2. FundamentalsofOptics-F.A.JenkinsandH.E.White(McGraw-Hill)
3. Geometrical and Physical Optics R.S. Longhurst (OrientBlackswan)
4. ThePhysicsofVibrationsandWaves-H.J.Pain(JohnWiley)
5. OpticsP.K.Chakrabarty

6. PrinciplesofOptics-MaxBornandEmilWolf(PergamonPress)

7. ThePhysicsofWavesandOscillations-N.K.Bajaj(McGrawHill)

CORE PAPER-IV LAB
• (minimum 5 experiments are to be done)

1. TodeterminethefrequencyofanelectrictuningforkbyMeldesexperiment and verify 2 Tlaw.

2. To plot the I-D curve and to determine the refractive index of a prism

3. To determine refractive index of the Material of a prism using sodium source.

4. . To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

5. To determine wavelength of sodium light using Newtons Rings.

6. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.

7. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

2. A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

4. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani

CORE PAPER-V
MATHEMATICAL PHYSICS-II

Theemphasisofthecourseisonapplicationsinsolvingproblemsofinterest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Fourier Series-I: Periodic functions, Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only), Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients, Complex representation of Fourier series, Expansion of functions with arbitrary period, Expansion of non-periodic functions over an interval, Even and odd functions and their Fourier expansions and Application, Summing of Infinite Series, Term-by-Term differentiation and integration of Fourier Series, Parseval Identity.

UNIT-II

Frobenius Method and Special Functions: Singular Points of Second OrderLinearDifferentialEquationsandtheirimportance,SingularitiesofBessels and Laguerre Equations, Frobenius method and its applications to differential equations:LegendreandHermiteDifferentialEquations,LegendreandHermite Polynomials: Rodrigues Formula, Generating Function,Orthogonality.

UNIT-III

Polynomials: Simple recurrence relations of Legendre and Hermite Polynomials, Expansion of function in a series of Legendre Polynomials, Associated Legendre Differential Equation, Associated Legendre polynomials, Spherical Harmonics

Some Special Integrals: Beta and Gamma Functions and relation between them, Expression of Integrals in terms of Gamma Functions, Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations using

separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string

Text Books:

1. MathematicalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013, 7th Edn.,Elsevier)
2. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India)

Reference Books:

1. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)
2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing)
3. Mathematical Physics C. Harper (Prentice HallIndia)ComplexVariable:
4. Schaum's Outlines Series M. Spiegel (2nd Edition, McGraw Hill Education)
5. Complex variables and applications J.W.Brown and R.V.Churchill
6. Mathematical Physics, Satya Prakash (Sultan Chand)
7. Mathematical Physics B.D.Gupta (4th edition, VikasPublication

CORE PAPER-VLAB

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem.

Topics

Introduction to Numerical computation software Scilab: Introduction to Scilab, Advantages and disadvantages, Scilab computation software Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2),

Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program(2).

Curve fitting, Least square fit Goodness of fit, standard constant
Deviation: Ohms law to calculate R, Hookes law to calculate spring constant

Solution of Linear system of equations by Gauss elimination Solution method and Gauss Seidal method. Diagonalization matrices, Inverse of a matrix, Eigen vectors, problems: Solution of mesh equations of electriccircuits(3meshes),Solutionofcoupledspringmasssystems(3masses)

Solution of ODE First order Differential equation Euler, modiftedEuler Runge-Kutta second methods Second order differential equation. Fixed difference method: First order differentialequation

- Radioactivedecay
- Current in RC, LC circuits with DCsource
- Newtons law ofcooling
- Classical equations ofmotion

Second order DifferentialEquation

- Harmonic oscillator (nofriction)
- Damped Harmonicoscillator
- Overdamped
- Criticaldamped
- Oscillatory
- Forced Harmonicoscillator

- Transient and Steady statesolution
- Apply above to LCR circuitsalso

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge UniversityPress
2. Complex Variables, A.S. Fokas and M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. Firstcourseincomplexanalysiswithapplications,D.G.ZillandP.D.Shana-han, 1940, Jones andBartlett
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fern- ndez. 2014 Springer
5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
6. Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand andCompany
7. Scilab Image Processing: Lambert M. Surhone. 2010 BetascriptPublishing

CORE PAPER-VI

THERMAL PHYSICS

UNIT-I

Introduction to Thermodynamics Recapitulation of Zeroth and First law of thermodynamics,

Second Law of Thermodynamics: Reversible and Irreversible process with examples, Kelvin-Planck and Clausius Statements and their Equivalence, Carnots Theorem, Applications of Second Law of Thermodynamics: Thermodynamic ScaleofTemperatureanditsEquivalencetoPerfectGasScale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of

increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy of the Principle of Increase of Entropy, Temperature Entropy diagrams for Carnots Cycle, Third Law of Thermodynamics, Unattainability of AbsoluteZero.

UNIT-II

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables,

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy,GibbsFreeEnergy,TheirDefinitions,PropertiesandApplications,Sur-faceFilmsandVariationofSurfaceTensionwithTemperature,MagneticWork, Cooling due to adiabaticdemagnetization

Phase Transitions: First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Maxwells Thermodynamic Relations: Derivations and applications of Maxwells Relations, Maxwells Relations: (1) Clausius Clapeyron equation (2) Relation between$C_p$andC_v(3)TdSEquations,(4)Joule-KelvincoefficientforIdealand Van der Waal Gases (5) Energy equations (6) Change of Temperature during Adiabatic Process.

UNIT-III

Kinetic Theory ofGases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Sterns Experiment, Mean, RMS and Most Probable Speeds, Degrees of Freedom, Law of Equipartition of Energy (No proof required), Specific heats of Gases.

Molecular Collisions: Mean Free Path, Collision Probability, Estimates of Mean Free Path,

Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

UNIT-IV

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation, The Virial Equation, Andrews Experiments on CO_2 Gas. Critical Constants, Continuity of Liquid and Gaseous State. Vapour and Gas, Boyle Temperature, Van der Waals Equation of State for Real Gases, Values of Critical Constants, Law of Corresponding States, Comparison with Experimental Curves, P-V Diagrams, Joules Experiment, Free Adiabatic Expansion of a Perfect Gas, Joule- Thomson Porous Plug Experiment, Joule- Thomson Effect for Real and Van der Waal Gases, Temperature of Inversion, Joule-ThomsonCooling

Text Books:

1. Thermal Physics, A. B. Gupta (Books and allied Ltd)
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw- Hill)

Reference Books:

1. Theory and experiments on thermal Physics, P.K.Chakrabarty (New cen- tral book agency limited)
2. Thermodynamics,KineticTheoryandStatisticalThermodynamics-Searsand Salinger(Narosa)
3. A Treatise on Heat- Meghnad Saha and B.N.Srivastava (The Indian Press) Heat, Thermodynamics and Statistical Physics, N.Subrahmanyam and Brij Lal (S.Chand Publishing)
4. Thermal and Statistical Physics M.Das, P.K. Jena, S. Mishra, R.N.Mishra (Shri Krishna Publication)

CORE PAPER-VI LAB

(minimum 5 experiments are to be done):

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flow method.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charltons disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To determine J byCaloriemeter
6. Todeterminethespecificheatofliquidbythemethodofcooling
7. Todeterminethespecificheatofsolidbyapplyingradiationofcorrection.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

<div align="center">

CORE PAPER-VII

ANALOG SYSTEMS AND APPLICATIONS

</div>

UNIT-I

Semiconductor Diodes: P and N type semiconductors, energy level diagram, conductivity and Mobility, Concept of Drift velocity, PN junction fabrication (simple idea), Barrier formation in PN Junction Diode, Static and Dynamic Resistance, Current flow mechanism in Forward and Reverse Biased Diode, Drift velocity, derivation for Barrier Potential, Barrier Width and current Step Junction.

Two terminal device and their applications: (1) Rectifier Diode: Half-

waveRectifiers.center-tappedandbridgetypeFull-waveRectifiers,Calculation of Ripple Factor and Rectification Efficiency,L and C Filters (2) Zener Diode and Voltage Regulation, Principle and structure of LEDS, (2) Photo diode(3) SolarCell.

UNIT II

Bipolar Junction Transistors: n-p-n and p-n-p transistors, Characterstics of CB, CE and CC Configurations, Current gains a and b, Relation between a and b, Load line analysis of Transistors, DC Load line and Q-point, Physical mechanismofcurrentflow,Active,Cut-offandSaturationRegions.

Transistors Biasing: Transistor Biasing and Stabilization circuits, Fixed Bias and Voltage DividerBias.

Amplifiers: Transistors as 2-port network h-parameter Equivalent Circuit, Analysis of a single stage CE amplifier using Hybrid Model, Input and Output impedance, Current, Voltage and Power Gains, Classification of class A, B and C amplifiers, Push-pull amplifier (classB)

UNIT-III

Coupled Amplifier: RC-coupled amplifier and its frequency response.

Feedback in Amplifiers: Effect of Positive and Negative Feedback on In- put Impedance, Output Impedance, Gain Stability, Distortion and Noise. Sinusoidal Oscillations: Barkhausens Gaterian for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency, Hartley and Colpitts oscillators.

UNIT-IV

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical OP-AMP (IC741). Open-loop and Closed loop Gain. Frequency Response. CMRR, Slew Rate and concept of virtualground.

Application of Op-Amps: (1) Inverting and non-inverting amplifiers (2) Adder (3) Subtractor (4) Differentiator, (5) Integrator (6) Log amplifier, (7) Zero

crossing detector (8) Wein bridgeoscillator.

Text Books:

.

1. Foundations of Electronics-Raskhit and Chattopadhyay (New age International Publication)

2. Concept of Electronics- D.C.Tayal (HimalayPublication)

Reference Books:

1. ElectronicdevicesandcircuitsR.L.Boylstad(PearsonIndia)

2. Electronic Principles- A.P.Malvino (Tata McGrawHill)

3. Principles of Electronics- V. K. Mehta and Rohit Mehta (S. Chand Publication)

4. OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (PrenticeHall)

5. PhysicsofSemiconductordevices,DonaldANeamen(PrenticeHall)

CORE PAPER-VII LAB

(minimum 5 experiments are to bedone)

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.

2. Study of V-I and power curves of solar cells, and find maximum power point and efficiency.

3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.

4. To study the various biasing configurations of BJT for normal class A operation.

5. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.

6. TodesignaWienbridgeoscillatorforgivenfrequencyusinganop-amp.

7. TodesignaphaseshiftoscillatorofgivenspecificationsusingBJT.

8. To study the Colpitt'soscillator.

Reference Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw
2. Hill.
3. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
4. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
5. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

CORE PAPER-VIII
MATHEMATICAL PHYSICS-III

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation Eulers formula, De Moivres theorem, Roots of complex Numbers, Functions of Complex Variables, Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts, Integration of a function of a complex variable, Cauchys Inequality, Cauchys Integral formula, Simply and multiply connected region, Laurent and Taylors expansion, Residues and Residue Theorem, Application in solving Definite Integrals.

UNIT-II

Integral Transforms-I: Fourier Transforms: Fourier Integral theorem,Fourier Transform,Examples,FourierTransformoftrigonometric,Gaussian,finitewave train and other functions, Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse FourierTransform.

UNIT-III

Integral Transforms-II : Convolution theorem, Properties of Fourier Trans- forms (translation, change of scale, complex conjugation), Three dimensional Fouriertransformswithexamples,ApplicationofFourierTransformstodifferentialequations: OnedimensionalWaveandDiffusion/HeatflowEquations.

UNIT-IV

Laplace Transforms: Laplace Transforms (LT) of Elementary functions,

Properties of Laplace Transforms: Change of Scale Theorem, Shifting Theorem, LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Text Books:
1. MathematicalMethodsforPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris (2013,7th Edn.,Elsevier)
2. AdvancedEngineeringMathematics,ErwinKreyszig(WileyIndia)

Reference Books:
1. MathematicalPhysicsandSpecialRelativity–M.Das,P.K.JenaandB.K. Dash (SrikrishnaPrakashan)
2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing) Mathematical Physics C. Harper (Prentice Hall India)
3. Complex Variable: Schaum's Outlines Series M. Spiegel (2nd Edition , Mc- Graw

Hill Education)

4. Complex variables and applications J.W.Brown and R.V.Churchill
5. Mathematical Physics, Satya Prakash (Sultan Chand)
6. **MathematicalPhysicsB.D.Gupta(4thedition,VikasPublication)**

CORE PAPER-VIII LAB

Scilab based simulations(XCos) experiments based on Mathematical Physics problems like

- Direct Delta Function

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.Hobson and S. J. Bence, 3rd ed., 2006, Cambridge UniversityPress

2. MathematicsforPhysicists,P.DenneryandA.Krzywicki,1967,DoverPub- lications

3. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN: 978-3319067896

4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

5. Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand

andCompany

6. Scilab Image Processing: Lambert M. Surhone. 2010 BetascriptPublishing

CORE PAPER-IX

ELEMENTS OF MODERN PHYSICS

UNIT- I

Atomic Spectra and Models: Inadequacy of classical physics, Brief Review of Black body Radiation, Photoelectric effect, Compton Effect, dual nature of radiation wave nature of particles, Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle, Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations.

Atomic Model: Bohrs Model of Hydrogen atom, explanation of atomic spec- tra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Experiment, Sommerfelds modification of BohrsTheory.

UNIT- II

Wave Packet: superposition of two waves, phase velocity and group velocity, wave packets, Gaussian Wave Packet, spatial distribution of wave packet, Localizationofwavepacketintime,Timedevelopmentofawavepacket,Wave Particle Duality,Complemntarity.

Wave Particle Duality: de Broglie hypothesis, Experimental confirmation ofmatterwave,DavissonGermerExperiment,velocityofdeBrogliewave,wave

particle duality,Complementarity.

Uncertainty Principle: Heisenberg Uncertainty Principle, Illustration of the PrinciplethroughthoughtExperimentsofGammaraymicroscopeandelectron

diffraction through a slit, Estimation of ground state energy of harmonicoscillator and hydrogen atom, non existence of electron in the nucleus,Uncertainty andcomplementarities.

UNIT- III

Nuclear Physics- I: Size and structure of atomic nucleus and its relation with atomic weight, Impossibility of an electron being in the nucleus as a con- sequence of the uncertainty principle, Nature of the nuclear force, NZ graph, Liquid Drop model: semi empirical mass formula and binding energy, Nuclear Shell Model and magicnumbers.

UNIT- IV

Nuclear Physics- II: Radioactivity, stability of the nucleus, Law of radioactivedecay,MeanlifeandHalflifeAlphadecay,Betadecay-energyreleased,spectrum and Paulis prediction of neutrino, Gamma ray emission energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus, Fission and fusion mass deficit, relativity and generation of energy, Fission-nature of fragments and emission of neutrons, Nuclear reactor: slow neutron interacting with Uranium 235, Fusion and thermonuclear reactions driving stellar energy (brief qualitativediscussion).

Text Books:
1. Concepts of Modern Physics Arthur Beiser (McGrawHill)
2. Modern Physics Murugeshan and Sivaprasad(S.Chand)

Reference Books:
1. QuantumMechanics:TheoryandApplications,A.K.GhatakandS.Lokanathan, (Macmillan)
2. Introduction to Quantum Theory, David Park (DoverPublications)
3. TheoryandProblemsofModernPhysics,Schaum'soutline,R.Gautreau and W.Savin- (Tata McGraw-Hill)
4. Modern Physics-Serway (CENGAGELearnings)
5. Physics of Atoms and Molecules Bransden and Joachim (PearsonIndia)
6. Atomic and Nuclear Physics-A.B.Gupta (NewCentral)

7. Theoretical Nuclear Physics , J.M.Blatt and V.F. Weisskopf(Springer)

CORE PAPER-IX LAB

(minimum 4 experiments are to bedone):

1. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
2. To determine the wavelength of laser source using diffraction of single slit.
3. To determine the wavelength of laser source using diffraction of double slits.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.
5. Todetermine the Plancks constant using LEDs of at least 4 differentcolours.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Books Book of Practical Physics, I.Prakashand Ramakrishna, 11th Edn, 2011,Kitab Mahal

CORE PAPER-X
DIGITAL SYSTEMS AND APPLICATIONS

UNIT-I

Integrated Circuits (Qualitative treatment only): Active and Passive Components, Discrete components, Wafer Chip, Advantages and Drawbacks of ICs, Scale of Integration: SSI, MSI, LSI and VLSI (basic idea and definitions only), Classification of ICs, Examples of Linear and Digital ICs.

Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversation, BCD, Octal and Hexadecimal numbers, AND, OR and NOT. Gates (realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.

UNIT-II

Boolean algebra: De Morgans Theorems: Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms andMaxterms,ConversionofaTruthtableintoEquivalentLogicCircuitby

(1) Sum of Products Method and (2) KarnaughMap.

Introduction to CRO: Block Diagram of CRO, Electron Gun, Deflection system and Time Base, Deflection Sensitivity,

Applications of CRO: (1) Study of Wave Form, (2) Measurement of Volt- age, Current, Frequency and Phase Difference.

UNIT-III

Data Processing Circuits: Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2s complement. Half and Full Adders. Half and Full Subtractors, 4 bit binary Adder/Subtractor.

Timers: IC 555: block diagram and application is Astable multivibrator and Monostable multivibrator.

UNIT-IV

Introduction to Computer Organization: Input/output Devices, Data storage (idea of RAM and ROM), Computer memory, Memory organization and addressing, Memory Interfacing, Memory Map.

Shift registers: Serial-in-serial-out, Serial-in-Parallel-out, Parallel-in-Serial- out

and Parallel-in-Parallel-out. Shift Registers (only up to 4 bits)

Counters (4 bits): Ring Counter, Asynchronous counters, Decade Counter. Synchronous Counter.

Text Books:

1. DigitalCircuitsandLogicdesign:SamuelC.Lee(PrinticeHall)
2. Digital Principles and Applications - A.P. Malvino, D.P.Leach and Saha (TataMcGraw)

Reference Books :

1. The Art of Electronics by Paul Horowitz and Wilfield Hill ,Cambridge University
2. Electronics by Allan R. Hambley ,Prentice Hall 3. Principles of Electronics V.K.Mehta and Rohit Mehta (S.Chand Publishing)
3. Digital Logic and Computer design M. Morris Mano (Pearson) 5. Concepts of Electronics D.C.Tayal (Himalaya Publishing house)

CORE PAPER--X LAB
(minimum 6 experiments are to bedone):

1. To measure (a) Voltage, and (b) Time period of a periodic waveform usingCROandtotestaDiodeandTransistorusingaMillimeter.
2. To design a switch (NOT gate) using atransistor.
3. To verify and design AND, OR, NOT and XOR gates using NANDgates.
4. Half Adder, Full Adder and 4-bit binaryAdder.
5. Half Subtractor, Full Subtractor, Adder-Subtractor using Full AdderI.C.
6. TobuildFlip-Flop(RS,ClockedRS,D-typeandJK)circuitsusingNAND gates.
7. To design an astable multivibrator of given specifications using 555Timer.
8. To design a monostable multivibrator of given specifications using 555 Timer.

Reference Books:
1. Basic Electronics: A Text Books lab manual, P.B. Zbar, A.P. Malvino,
2. M.A. Miller, 1994, Mc-GrawHill.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
    ElectronicDevicesandcircuitTheory,R.L.BoylestadandL.D.Nashelsky,2009, Pearson

CORE PAPER-XI
QUANTUM MECHANICS AND APPLICATIONS

UNIT- I

Schrodinger equation : Time dependent Schrodinger equation , Properties of Wave Function, Interpretation of wave function, Probability and probability current densities in three dimensions, Conditions for Physical Acceptability of Wave Function, Normalization, Linearity and Superposition Principles. Wave function of a free particle ,Wave Packet, Fourier Transform and momemtum space Wavefunction ,Spread of Gaussian Wave packet, Evolution with time, Position and MomentumUncertainty.

UNIT-II

Operators: Operators, Commutator Algebra, Position, Momentum Angular Momentum and Energy operators, Hermitian Operators, Expectation valuesof position and momentum, Ehrenfest Theorem, Eigenvalues andEigenfunctions of Hermitian Operator, Energy Eigen Spectrum, Degeneracy, Orthonormality of Eigen functions, Linear Dependance.Orthogonalisation.

UNIT-III

Time Independent Schrodinger equation in one dimension (1d), 2d and 3d, Hamiltonian, stationary states and energy eigen values, expansion of an arbitrary

wave function as a linear combination of energy eigen functions, General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states. General Discussion of Bound states in an arbitrary potential: Continuity of wave function, Boundary condition and emergence of discrete energy levels, Application to one dimensional problem-Square well potential, Quantum mechanics of simple Harmonic Oscillator-Energy Levels and energy eigen functions, ground state, zero point energy and uncertainty principle, One dimensional infinitely rigid boxenergy eigen values and eigen functions, normalization, quantum dot as example, Quantum mechanical scattering and tunnelling in one dimension across a step potential and rectangular potential barrier.

UNIT-IV

Atoms in Electric and Magnetic Fields: Electron angular momentum. Spacequantization,ElectronSpinandSpinAngularMomentum,LarmorsTheorem,SpinMagneticMoment,SternGerlachExperiment,VectorAtomModel,L-S and J-J coupling, Zeeman Effect, Electron Magnetic Moment and Magnetic Energy,GyromagneticRatioandBohrMagneton.AtomsinExternalMagnetic Fields:-NormalandAnomalousZeemanEffect,PaschenbackandStarkEffect (qualitative Discussiononly)

Text Books:
1. Introduction to Quantum Theory David Park (DoverPublications)
2. Introduction to Quantum Theory, D. J. Griffiths(Pearson)

Reference Books :
1. QuantumMechanics,TheoryandapplicationsA.GhatakandS.Lokanathan (McMillanIndia)
2. QuantumMechanics-G.Aruldhas(PrinticeHallofIndia)
3. Quantum Physics–S. Gasiorowicz (Wiley)
4. QuantumMechanics-G.R.ChatwalandS.K.Anand

5. Quantum Mechanics -J.L. Powell and B. Craseman(Narosa)

6. Introduction to Quantum Mechanics M.Das and P.K.Jena (Shri Krishna Publication)

CORE PAPER- XILAB

[illegible text]

Laboratory based experiments:

1. Study of Electron spin resonance- determine magnetic field as a function of the resonancefrequency
2. StudyofZeemaneffect:withexternalmagneticfield;Hyperfinesplitting
3. To show the tunneling effect in tunnel diode using I-Vcharacteristics.
4. Quantum efficiency ofCCDs

Reference Books:

1. Schaum'soutlineofProgrammingwithC++.J.Hubbard,2000,McGraw–HillPublication
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.

3. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cam- bridge Univ. Press

4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernndez.2014 Springer.

5. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011S. Chand andCo.

6. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:9786133459274

CORE PAPER-XII

SOLID STATE PHYSICS

UNIT-I

Crystal Structure: Solids, Amorphous and Crystalline Materials, Lattice translation Vectors, Lattice with a Basis. Central and Non-Central Elements. Unit Cell, Miller Indices, Types of Lattices, Reciprocal Lattice, Brillouin zones, DiffractionofX-raysbycrystals,BraggLaw,AtomicandGeometricalFactor

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear, Monotomic and Diatomic Chains, Acoustical and Optical Phonons, Qualitative Description of the phonon spectrum in solids, Dulong and Petits Law, Einstein and Debye theories of specific heat of solids, T^3 Law

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevins theory of dia and Paramagnetic Domains, Curies law,WeissTheoryofFerromagnetismandFerromagneticDomains,Discussion of B-H Curve, Hysteresis and EnergyLoss.

UNIT-III

Dielectric Properties of Materials: Polarization Local Electrical Field at anAtom,DepolarizationField,ElectricSusceptibility,Polarizability,Clausius
Mosotti Equation, Classical theory of ElectronicPolarizability.

Lasers: Einsteins A and B co-efficientnts, Metastable States, Spontaneous and Stimulated emissions, Optical Pumping and population Inversion, Three Level and Four Level Lasers, Ruby Laser and He-Ne Laser.

UNIT-IV

Elementary band theory: Kronig-Penny model of band Gap, Conductor , Semiconductor(PandNtype)andinsulator,ConductivityofSemiconductor, mobility,HallEffect,Measurementofconductivity(04probemethod)andHall Co-efficient.

Superconductivity: Experimental Results, Critical Temperature, Critical magneticfield,Meissnereffect,TypeIandtypeIISuperconductors,Londons EquationandPenetrationDepth,Isotopeeffect,IdeaofBCStheory(Noderivation)

Text Books:

1. Introduction to Solid State Physics- Charles Kittel (WileyIndia)
2. LASERS:FundamentalsandApplications-
   ThyagarajanandGhatak(McMil- lanIndia)

Reference Books:

1. SolidStatePhysics-N.W.AshcroftandN.D.Mermin(Cengage)
2. Solid State Physics- R.K.Puri and V.K. Babbar (S.ChandPublication)
3. Solid State Physics S. O. Pillai (New AgePublication)
4. Lasers and Non linear Optics B.B.Laud (WileyEastern)
5. Elements of Solid State Physics-J.P. Srivastava (Prentice Hall ofIndia)
6. Elementary Solid State Physics-Ali Omar (AddisonWiley)

CORE PAPER-XII LAB

(minimum 4experiments are to bedone)

1. Measurement of susceptibility of paramagnetic solution (Quincks Tube-Method)

2. To measure the Magnetic susceptibility ofSolids.

3. To measure the Dielectric Constant of a dielectric Materials with frequency

4. To determine the Hall coefficient of a semiconductorsample.

5. To draw the BH curve of Fe using solenoid and to determine the energy loss fromHysteresis

6. To measure the band gap of a given semiconductor by four-probemethod.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

3. A Text Books Book of Practical Physics, I.Prakashand Ramakrishna, 11 Ed., 2011, Kitab Mahal

4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice- Hall of India.

CORE PAPER-XIII
ELECTROMAGNETIC THEORY

UNIT-I

Maxwell Equations: Maxwells equations, Displacement Current, Vector and ScalarPotentials,GaugeTransformations:LorentzandCoulombGauge,Boundary Conditions at Interface between Different Media, Wave Equations, Plane Waves in Dielectric Media, Poynting Theorem and Poynting Vector, Electro-magnetic(EM)EnergyDensity,PhysicalConceptofElectromagneticFieldEnergyDensity

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuumandisotropicdielectricmedium,transversenatureofplaneEMwaves, refractive index and dielectric constant, wave impedance, Propagationthrough conductingmedia,relaxationtime,skindepth,Electricalconductivityofionized gases,plasmafrequency,refractiveindex,skindepth,applicationtopropagation throughionosphere.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface betweentwomedia,ReflectionandRefractionofplanewavesatplaneinterface betweentwodielectricmedia,LawsofReflectionandRefraction,Fresnel'sFormulaefor perpendicularandparallelpolarizationcases,Brewster'slaw,ReflectionandTransmiss ioncoefficients,Totalinternalreflection,evanescentwaves,   Metallic   reflection (normalIncidence)

UNIT IV

Polarization of Electromagnetic Waves: Description of Linear, Circular andEllipticalPolarization,UniaxialandBiaxialCrystals,LightPropagationin UniaxialCrystal,DoubleRefraction,PolarizationbyDoubleRefraction,Nicol Prism,Ordinaryandextraordinaryrefractiveindices,Productionanddetection   of Plane, Circularly and Elliptically PolarizedLight,

Phase Retardation Plates: Quarter-Wave and Half- Wave Plates. Babinets Compensator and its Uses, Analysis of Polarized Light.

Rotatory Polarization: Optical Rotation, Biots Laws for Rotatory Polarization, Fresnels Theory of optical rotation, Calculation of angle of rotation, Experimental verification of Fresnels theory, Specific rotation, Laurents half- shade polarimeter.

Text Books:
 1. Introduction to Electrodynamics, D.J. Griffiths (Pearson)

2. PrinciplesofOptics-MaxBornandE.Wolf

Reference Books :

1. Classical Electrodynamics by J.D.Jackson
2. Foundationofelectromagnetictheory:RitzandMilford(Pearson)
3. Electricity and Magnetism : D C Tayal (HimalayaPublication)
4. Optics : A.K.Ghatak
5. Electricity and Magnetism : Chattopadhyaya, Rakhit (NewCentral)

CORE PAPER XIII LAB

(minimum 4 experiments are to bedone):

1. ToverifythelawofMalusforplanepolarizedlight.
2. To determine the specific rotation of sugar solution usingPolarimeter.
3. To analyze elliptically polarized Light by using a Babinetscompensator.
4. To determine the refractive index of liquid by total internal reflection using Wollastonsair-film.
5. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussianeyepiece.
6. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
7. ToverifytheStefan'slawofradiationandtodetermineStefansconstant.
8. To determine the Boltzmann constant using V-I characteristics of PN junctiondiode.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Books Book of Practical Physics, I.Prakashand Ramakrishna, 11 Ed., 2011, Kitab Mahal Electromagnetic Field Theory for Engineers and Physicists, G. Lehner, 2010,Springer

CORE PAPER-XIV

STATISTICAL MECHANICS

UNIT- I

Classical Statistics-I: Macrostate and Microstate, Elementary Concept of Ensemble, Microcanonical, Canonical and Grand Canonical ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function.

UNIT- II

Classical Statistics-II : Thermodynamic Functions of an Ideal Gas, classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of equipartition of Energy (with proof)- Applications to Specific Heat and its Limitations, Thermodynamic Functions of a two energy levels system, NegativeTemperature.

UNIT-III

Quantum Statistics: Identical particles, macrostates and microstates, Fermions and Bosons, Bose Einstein distribution function and Fermi- Dirac distribution function. Bose- Einstein Condensation, Bose deviation from Plancks law, Effect of temperature on Fermi-Dirac distribution function, degenerate Fermi gas, Density of States Fermienergy.

UNIT-IV

Radiation: Properties of Thermal Radiation, Blackbody Radiation, Pure Temperature dependence, Kirchhoffs law, Stefan Boltzmann law: Thermodynamic proof, Radiation Pressure, Weins Displacement law, Wiens distribution Law, Sahas Ionization Formula, Rayleigh Jeans Law, Ultra Violetcatastrophe.

Plancks Law of Black body Radiation: Experimental verification, Deduction of

(1) Wiens Distribution Law, (2) Rayleigh Jeans Law, (3) Stefan Boltzmann Law, (4)Weins Displacement Law from Plancks Law.

Text Books:

1. Introduction to Statistical Physics by Kerson Huang(Wiley).
2. StatisticalPhysics,BerkeleyPhysicsCourse,F.Reif(TataMcGraw-Hill)

ReferenceBooks:

1. Statistical Mechanics, B.K.Agarwal and Melvin Eisner (New Age International)
2. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: FrancisW.SearsandGerhardL.Salinger(Narosa)
3. Statistical Mechanics: R.K.Pathria and Paul D. Beale (AcademicPress)

CORE PAPER-XIV LAB

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. PlotPlanckslawforBlackBodyradiationandcompareitwithWeins
2. Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
3. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einsteindistributionfunction,(c)Debyedistributionfunctionforhightemperature

   (roomtemperature)andlowtemperatureandcomparethemforthesetwocases
4. Plot Maxwell-Boltzmann distribution function versustemperature.
5. Plot Fermi-Dirac distribution function versustemperature.
6. Plot Bose-Einstein distribution function versustemperature.

Reference Books:

1. Elementary Numerical Analysis, K.E.Atkinson, 3rdEdn. 2007, Wiley India Edition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford UniversityPress.

3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, FrancisW.SearsandGerhardL.Salinger,1986,Narosa.

4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009,Springer

5. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN: 978-3319067896

6. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444

7. Scilab Image Processing:L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

Discipline Specific Elective Paper-1

CLASSICALDYNAMICS

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Generalised co-ordinates and Velocities, Generalised Force, Principle of virtual work Derivation of Lagranges equation of motion from DAlemberts Principles, Lagrangian and its Application to Simple, Compound and Double Pendulums, Single Particle in Space, Atwoods Machine, Dumb-bell, Linear harmonic oscillator.

UNIT-II

Hamiltons Principle, Calculus of Variation and derivation of Euler-Lagranges equation, Langranges Equations derived from Hamiltons Principles, Hamiltoian and its applications to Shortest Distance between two points in a plane, Geodesic Problem, minimum surface of revolution, Brachistochrone problem, The Equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, canonical momenta, Hamiltions equations of motion, Motion of charged particles in external electric and magnetic fields, Applicationstocentralforcemotionandcoupledoscillators.

UNIT- III

SpecialtheoryofRelativity(Postulatesofspecialtheoryofrelativity),Lorentz transformations, Minkowski space, The invariant interval, light cone and world lines, space time diagrams, Times-dilation, length contraction and Twin paradox, Variation of mass with velocity mass energyrelation

UNIT- IV

Four Vectors: Space Like, Time-like and light-like. Four velocity and acceleration, Four momentum and energy-momentum relation. Doppler effects from a four vector perspective, Concept of four-force, Conservation of four momentum,Applicationtotwobodydecayofanunstableparticle

Text Books:
1.Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko (Pearson)
2.Classical Mechanics N C Rana and P S Joag.

Reference Books :
1. Mechanics-D.S.Mathur (SultanChand)
2. Solved problems in Classical Mechanics, O.L. Delange and J.Pierrus (Oxford Press)(2010)
3. Classical Mechanics-M. Das, P.K.Jena, M. Bhuyan, R.N.Mishra (SrikrishnaPrakashan)
4. Mathematical Physics with Classical Mechanics-Satya Prakash (Sultan Chand andsons)
5. Introduction to classical dynamics R.K.Takwale and S.Puranik (Tata McGrawHill)
6. Classical Mechanics J.C.Upadhyay (HimalayanPublisher)
7. Classical Dynamics of particles and systems -S.T.Thorton and Marion (Cengagepublication)

Discipline Specific Elective Paper-1I
Nuclear and Particle Physics

UNIT-I

General properties of Nuclei: Constituents of nucleus and their intrinsic properties, Quantitative facts about mass, radius, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment electric moments, nuclear excites states.

Radioactivity decays: (a) Alpha decay: basics of alpha- decay processes, theory of alpha-emission, Gamow factor, Geiger Nuttall law (b) beta-decay: energy kinematics for beta-decay, positron emission, electron capture, neutrino hypothesis.

(c) Elementary idea of Gamma decay.

UNIT-II

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, conditions of nuclear stability, two nucleon separation energies, evidence for nuclear shell structure, nuclear magic number, basic assumption of shell models.

UNIT-III

Detector for nuclear radiations: Detector for nuclear radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic Principle of Scintillation Detectors and Construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge Particle and photon detection (Concept of charge carrier and mobility), neutron detector.
Particle Accelerators: Van-de Graff generator (Tandem Accelerator), Lin- ear accelerator, Cyclotron, Synchrotrons

UNIT-IV

Particle Physics: Particle interactions, basic features, types of particles and itsfamilies,

Symmetries and conservation laws: Energy and momentum, angular momentum,parity,baryonnumber,Leptonnumber,Isospin,strangenessandcharm, Elementary ideas of quarks andgluons.

Text Books:

1. Introduction to Nuclear Physics By Roy andNigam
2. AtomicandNuclearPhysics-N.Subramanyam,BrijLalandJivanSeshan (S. ChandPublishing)

Reference Books:

1. IntroductiontoModernPhysics-H.S.ManiandG.K.Mehta(Affilatedeast and west)
2. Introductory nuclear Physics-Kenneth S. Krane (Wiley India Pvt. Ltd)
3. Introduction to Elementary Particles-D. Griffith (John Wiley andSons)
4. Concepts of Nuclear Physics - Bernard L. Cohen. (Tata Mcgraw Hill).
5. Concepts of Modern Physics-Arthur Beiser (McGrawHill)

<div align="center">

Discipline Specific Elective Paper- II1

Nano Materials and Applications

</div>

UNIT-I

Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, size effects in nano systems, Quantum confinement Applications of Schrodinger equation-infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructure and itsconsequences.

UNIT-II

Synthesis of Nanostructure Materials: Top down and botton up approach,PhotolithographyBallmilling.Gasphasecondensation,Vacuumdeposition, Physical vapour deposition (PVT): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD), Sol-Gel Electrodeposition,Spraypyrolysis,Hydrothemalsynthesis,Preparationthrough colloidal methods, MBE growth of quantumdots.

UNIT-III

Characterization: X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning TunnelingMicroscopy

UNIT-IV

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nonmaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots-magmetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems(NEMS)

Text Books:
1. S.K. Kulkarni, Nanotechnology: Principles and Practices (Capital PublishingCompany)
2. Nano science and nano technology, K.K.Choudhury(Narosa)

Reference Books:
1. NanoScienceandnanotechnology,SundarSingh(PragatiPrakashan)
2. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt.Ltd.).

3. RichardBooker,EarlBoysen,Nanotechnology(JohnWileyandSons).

4. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier,2007).

5. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning PrivateLimited).

Discipline Specific Elective Paper-1V

Project

OR

Basic Instrumentation

Basic Instrumentation

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

Multimeter: Principles of measurement of dc voltage and dc current, ac volt- age, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage,measurement(blockdiagramonly).SpecificationsofanelectronicVoltmeter/ Multimeter and theirsignificance.

AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

UNIT-II

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls.

Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle ofworking.

UNIT-III

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator, Brief idea for testing, specifications, Distortion factor meter, waveanalysis.

UNIT-V

Digital Instruments: Principle and working of digital meters, Comparison of analog and digital instruments, Characteristics of a digital meter, Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter, Working principle of time interval, frequency and period measurement using universalcounter/frequencycounter,time-basestability,accuracyandresolution.

The test of lab skills will be of the following test items:
1. Use of anoscilloscope.
2. CRO as a versatile measuringdevice.
3. Circuit tracing of Laboratory electronicequipment,
4. Use of Digital multimeter/VTVM for measuringvoltages
5. Circuit tracing of Laboratory electronicequipment,
6. Winding a coil /transformer.
7. Study the layout of receivercircuit.
8. Trouble shooting acircuit
9. Balancing ofbridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage acrossalowresistanceandhighresistance.

2. To observe the limitations of a multimeter for measuring highfrequency voltage andcurrents.

3. To measure Q of a coil and its dependence on frequency, using a Q-meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequencycounter.
6. Measurement of rise, fall and delay times using aCRO.
7. MeasurementofdistortionofaRFsignalgeneratorusingdistortionfactor meter.
8. MeasurementofR,LandCusingaLCRbridge/universalbridge.

Open Ended Experiments:

1. Using a Dual TraceOscilloscope
2. Convertingtherangeofagivenmeasuringinstrument(voltmeter,ammeter)

More emphasis should be given on hands-on experiments.

Text Books:

1. A Text Books book of electrical technology-B.L.Theraja (S.ChandPublishing)
2. Digital circuits and systems Venugopal (Tata McGraw Hill)

Reference Books :

1. Digital Electronics-Subrata Ghoshal (CengageLearning)
2. Electronic Devices and circuits - S. Salivahanan and N. S.Kumar (Tata Mc-GrawHill)
3. Electronic Devices-Thomas L. Floyd (Pearson)

Additional Reference Books for Practical papers :

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop (Asia PublishingHouse)
2. Practical Physics-B.B.Swain (KitabMahal)
3. Practical Physics-B.Ghosh (Vol. I andII)
4. ALaboratoryManualofPhysicsforUndergraduateClasses,D.P.Khandelwal (VaniPublication)
5. B.Sc. Practical Physics- C.L.Arora (S.ChandPublishing)
6. B.Sc. Practical Physics H. Singh and P.S. Hemne (S. ChandPublishing)

Generic Elective Paper I

(Mechanics and Properties of matter, Oscillation and Waves, Thermal Physics, Electricity and Magnetism and Electronics

UNIT-I

Mechanics and Properties of Matter

Moment of Inertia Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points, Relationamongelasticconstants,depressionatfreeendofalightcantilever,Surface tension,pressure,differenceacrossacurvedmembrane,viscousflow,Poiseulles formula.

UNIT-II
Oscillation and Waves

Simple harmonic motion, damped harmonic motion, under damped, over damped and critically damped motion, Forced vibration, Resonance, Wave equation in a medium, Velocity of Longitudinal waves in an elastic medium and velocity of transverse wave in a stretched string, Composition of SHM, Lissajous figures for superposition of two orthogonal simple harmonic vibrations (a) with same frequency, (b) frequency with 2:1.

UNIT-III
Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck,

Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension, Maxwell thermodynamic relation (statement only), Clausius Clapeyron equation, Black body radiation, Planck radiation formula (Noderivation).

UNIT-IV
Electricity and Magnetism

Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution, Magnetic induction B, Lorentz force law, Biot Savarts law, Magnetic induction due to long straight current carrying conductor, and in the axis of a current carrying circular coil, Amperes Circuital law,itsdifferentialform,Thelawofelectromagneticequations,itsdifferential and integral form, Maxwells electro-magnetic equations and their physical significance, Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance.

P-type and N-type semiconductors, PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V-Icurve.

Text Books:
1. Properties of Matter D.S. Mathur (S. ChandPublication).
2. Heat and Thermodynamics A.B. Gupta and H.B. Ray (New Central BookAgency).
3. A Text Books book of oscillations, waves and acoustics(5thed.)M. Ghosh and D. Bhattacharya (S. ChandPublication).
4. Electricity and magnetism- R. Murugeshan (S.ChandPublishing)
5. Fundamentals of Electronics-Raskhit and Chattopadhyay (New age InternationalPublication)

Reference Books:

1. Physics of Degree students Vol.I M. Das, P.K. Jena etal (Sri krishna Prakashan).
2. Physics of Degree students Vol.II M. Das, P.K. Jena etal (Sri krishna Prakashan).
3. Waves and Oscillations (2nd ed) N. Subramaniyam and Brij Lal (Vikas Publications)
4. A Text Books book of Sound (2nd ed) - N. Subramaniyam and Brij Lal (S. ChandPublications)

Generic Elective Paper I Lab–
(minimum 6 experiments are to be done)

1. Todeterminethemomentofinertiaofaflywheel.
2. To determine the Youngs modulus Y of a wire by Searlsmethod.
3. TodeterminethemodulusofrigidityofawirebyMaxwellsneedle/Torsion Pendulum (Dynamicmethod).
4. To determine g by barpendulum.
5. To determine the value of Y of a rubber by using travellingmicroscope.
6. To determine the Rigidity of modulus by staticmethod.
7. To determine the frequency of a telescope by usingSonometer.
8. VerificationofLawsofVibrationofastringbyusingSonometer.

TEXT BOOKS:

1. To compare capacitances using DeSautybridge.
2. To determine the Law of resistance by using Fosterbridge.
3. Compare the specific heat of two liquids by method ofCooling.

Reference Books:

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop, 1971, Asia PublishingHouse
2. ALaboratoryManualofPhysicsforUndergraduateClasses,D.P.Khandelwal (1985), VaniPublication
3. ATextBooksbookofPracticalPhysics,InduPrakashAndRamakrishna,11th Edition (2011), Kitab Mahal, NewDelhi

Generic Elective Paper -II

(Optics, Special Theory of Relativity, Atomic Physics, Quantum Mechanics and NuclearPhysics)

UNIT-I

Optics-I: Elementary ideas of monochromatic aberrations and their minimization, chromatic aberration, achromatic combination, Theory of formation of primary and secondary rainbow, condition of interference, coherent sources, Youngs double slit experiment, biprism and measurement of wave length of light of by it, color of thin films and Newtons rings, Fresnel and Fraunhoffer diffraction, diffraction by single slit plane transmissiongrating.

Optics-II : Electromagnetic nature of light, polarized and unpolarized light, polarization by reflection and refraction, Brewsters Law, Mauls Law, Double refraction, Ordinary and extraordinary rays.

UNIT-II Atomic Physics

Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Plancks quantum theory of radiation, particle nature of electromagnetic radiation photo electric effect, Compton effect, dual nature of radiation, wave nature of particles, de-Broglie hypothesis, matter wave, wave-particle duality, Davisson-Germerexperiment.

Bohrs theory of Hydrogen atom, explanation of Hydrogen Spectra, correction for finite mass of the nucleus, Bohrs correspondence principle, limitations of Bohrs theory, Discrete energy, exchange by atom Frank Hertzexperiment.

UNIT-III

Quantum Mechanics : Heisenbergs Uncertainty relation, Time dependent Schrodingers wave equation in one dimension and three dimensions, The physical interpretation of the wave function, Probability density and probability current

density, Equation of continuity, Normalization of the Wave function, Expectation value of an observable, Ehrenfests theorem. Time independent Schrodingers wave equation in one dimension particle in a box, energy eigen values and eigenfunctions.

UNIT-IV

Nuclear Physics : Properties of the nucleus Charge, Size, Spin, Magnetic Moment, Mass, Mass defect, Binding energy, Packing fraction, Nuclear force and its characteristics features, Radioactive decay laws, average life, half life, nuclear fission, nuclear fusion, Linear accelerators, and cyclotron.

Relativity: Galilean transformation, Newtonian relativity and its limitation, MichelsonMorleyexperimentanditsconsequence,postulatesofspecialtheory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energyrelation.

Text Books:

1. University Physics, H. D. Young, R. A. Freedman(Person)
2. Fundamentals of Physics, Resnick, Halliday, Walker(WIley)

Reference Books :

1. A Text Books book of Optics N.Subrahmanyam and Brij Lal (S.Chand Publishing)
2. Introduction to Special Relativity-R. Resnick (JohnWiley)
3. ConceptsofModernPhysics ArthurBeiser(McGrawHill)
4. Modern Physics H.S. Mani and G.K.Mehta

Generic Elective Paper II LAB
(minimum6experimentsaretobedone):

1. Determination of E.C.E. of a Copper by taking 3readings.
2. DeterminationofRefractiveindexofthematerialofaprismusingSodium light.
3. Todeterminethewavelengthoflightusingplanediffractiongrating.

4. TodeterminethewavelengthoflightusingNewtonsring.

5. Determination of refractive index of (a) glass and (b) liquid by using travellingmicroscope.

6. To plot the I-D curve and to determine the refractive index of aprism

7. Determination of radius of curvature of a convex/concave mirror by using Kohlrauschsmethod.

8. T o determine the magnifying power of a giventelescope.

9. ToObtainthestaticcharacteristicsofaP-N-P/N-P-Ntransistor/ TriodeValve.

10. To determine the reduction factor of a tangentGalvanometer.

11. To study the Variation of magnetic field along the axis of a circular coil carryingcurrent.

Reference Books:

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop, 1971, Asia PublishingHouse

2. ALaboratoryManualofPhysicsforUndergraduateClasses,D.P.Khandel wal (1985), VaniPublication

3. ATextBooksbookofPracticalPhysics,InduPrakashAndRamakrishna, 11th Edition (2011), Kitab Mahal, NewDelhi

Course structure of UG Physics Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Mechanics	04	75
	DSC-I	Practical	02	25
II	DSC-II	Electricity, Magnetism &EMT	04	75
	DSC-II	Practical	02	25
III	DSC-III	Thermal Physics & Statistical Mechanics	04	75
	DSC-III	Practical	02	25
IV	DSC-IV	Waves and Optics	04	75
	DSC-IV	Practical	02	25
V	DSE-I	Digital and Analog Circuits& Instrumentation	04	75
	DSE-I	Practical	02	25
VI	DSE-II	Elements of Modern Physics	04	75
	DSE-II	Practical	02	25
			36	**600**

PHYSICS PAPERS FOR PASS STUDENTS

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

 Marks per paper –

Practical paper: Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

For non practical paper: Mid term : 20 marks, End term : 80 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper –

Practical papers:40 hours + 20 hours practical

Non practical papers:50 hours + 10 hours tutorial

Discipline Specific Core Paper 1

MECHANICS

UNIT-I

Rotational Dynamics: Centre of Mass, Motion of CM , Centre of Mass and Laboratory frames. Angular momentum of a particleand system of particles.Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia.Perpendicular and Parallel Axis Theorems, Routh Rule, Calculation of moment of inertia for cylindrical and spherical bodies. Kinetic energy of rotation. Euler's Equations of Rigid Body motion,Motion involving both translation and rotation.Moment of Inertia of a Flywheel

 Non Inertial frames and fictitious Forces: Uniformely Rotating frame, laws of Physics in rotatingCoordinate system,centrifugalForces,Coriolis force and its applications.

UNIT-II

Gravitation: Newton'sLaw of gravitation. Gravitational field Intensity and Potential,

. Potential and field Applications.

Central Force:

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Differential Equation of motion with central force and its solution.The first Integrals(two),Concept of power Law Potentials, Kepler's Laws of Planetary motion.

Satellites:. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts.

UNIT-III

Elasticity: Relation between Elastic constants. Torsion of a right circularcylinder,torsionalwire,Bending of Beams,External Bending Moment,flexturalrigidity,singleCantilever,double cantilever(weightless cantilever,and with its own weight)

Fluid Properties:

Surface Tension- Express Pressure across a curved membrane, S.T., Quincke's drop, gravity waves and ripple,

Viscocity: Poiseuille's Equation for Flow of a Liquid with corrections.

Unit-IV

Oscillations: Simple Harmonic Oscillations. Kinetic energy, potential energy, total energy andtheir time-average values. Damped oscillation. Equation of motion and solution(,cases of oscillatory,critically damped and overdamped) Forced oscillations: Transient and steady states;

Resonance, sharpness of resonance; power dissipation and Quality Factor. Bar Pendulum, Kater's Pendulum. Composition of two SHMs propagating perpendicularly to each other(with frequency in the ratio 1:1,2:1) Lissajous figures

Text Books:

1. Mechanics, D.S. Mathur (S. Chand Publishing)
2. Introduction to Special Relativity-R. Resnick (John Wiley)

Reference Books :

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W. Knight, etal (Tata McGraw-Hill)
2. Physics, Resnick-Halliday and Walker (8/e. 2008,Wiley)
3. Theoretical Mechanics-M.R. Spiegel (Tata McGraw Hill).
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands (Pearson)
5. Mechanics-M.Das, P.K.Jena and R.N. Mishra (Srikrishna Publications)

Discipline Specific Core Paper I LAB

(minimum 6 experiments are to be done)

1. To study the random error in observations.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of igidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. To determine the value of g using Kater's Pendulum.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011, Kitab Mahal

Discipline Specific Core Paper-1I

ELECTRICITY , MAGNETISM AND EMT

UNIT-I

Vector Analysis: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

UNIT-II

Electrostatic Energy Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

UNIT-III

Magnetism:

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials.

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self andmutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

UNIT-IV

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity

ofcurrent, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric

medium, transverse nature of EM waves, polarization.

Text:

1. Introduction to Electricity and Magnetism – D.C.Tayal (Himalaya Publishing house)

Reference:

1. Electricity, Magnetism & Electromagnetic Theory- S. Mahajan and Choudhury (Tata McGraw Hill)
2. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands (Pearson)
3. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I (Oxford Univ. Press)
4. Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)

Discipline Specific Core Paper 1I LAB

(minimum 6 experiments are to be done)

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
(i) Measurement of charge and current sensitivity
(ii) Measurement of CDR

(iii) Determine a high resistance by Leakage Method

(iv) To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.

4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)

5. To study the Characteristics of a Series RC Circuit.

6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor

7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and

(b) Quality factor Q

8. To determine a Low Resistance by Carey Foster's Bridge.

9. To verify the Thevenin and Norton theorems

10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed.2011, Kitab Mahal

Discipline Specific Core Paper III

THERMAL PHYSICS AND STATISTICAL MECHANICS

UNIT-I

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle

&theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamical Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energyfunctions, Maxwell's relations and applications - Joule-Thomson Effect, Clausius- Clapeyron Equation, Expression for $(CP – CV)$, CP/CV, TdS equations.

UNIT-II

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocitiesandits experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

UNIT-III

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density,Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

UNIT-IV

Classical Statistical Mechanics: Macrostate& Microstate, Elementary Concept ofEnsemble,Microcanonical, Canonical and grand canonical ensemble. Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression,Gibbs Paradox.

Text:

1. Thermal Physics, A. B. Gupta (Books and allied Ltd)
2. Theory and experiments on thermal Physics, P.K.Chakrabarty (New central book agency limited)

Reference:

1. Thermal and Statistical Physics – M.Das, P.K. Jena, S. Mishra, R.N.Mishra (Shri Krishna Publication)
2. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman (McGraw-Hill)
3. Thermal Physics, S. Garg, R. Bansal and Ghosh-(Tata McGraw-Hill)
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics- Sears & Salinger (Narosa)
5. A Treatise on Heat- Meghnad Saha and B.N.Srivastava (The Indian Press)
6. Heat, Thermodynamics and Statistical Physics-- N.Subrahmanyam and Brij Lal (S.Chand Publishing)

Discipline Specific Core Paper 1II LAB

(minimum 6 experiments are to be done)

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off- Balance Bridge

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal,1985, Vani Publication.

<div align="center">

Discipline Specific Core Paper 1V

WAVES AND OPTICS
</div>

UNIT-I

Geometrical optics: Fermat's principle, reflection and refraction at plane interface,Matrixformulation of geometrical Optics. Idea of dispersion.

Cardinal Points and cardinal planes of an optical system,location of cardinal points and cardinal planes of (1)thick lens(2) thin lens and (3) co axial combination of two thin lenses using matrix formulation.

Aberrations: Chromatic Aberration and remedy,Monochromatic Aberration :Spherical

Aberration and remedy,Simple idea on Coma,Distortion,Astigmatism and Curvature and their

Remedy,Huygens eyepiece., Ramsden eye piece and their comparison.

UNIT-II

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves.PlaneProgressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Wave Optics: Electromagnetic nature of light. Definition and properties of wavefrontHuygensPrinciple. Temporal and Spatial Coherence

UNIT-III

Interference-I- Division of amplitude and wavefront. Young's double slit experiment.Lloyd'sMirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment

Interference-II:

Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes);Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required),Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and

Visibility of Fringes. Fabry-Perot interferometer.Fabry Perot etalon with theory.Applications-Determination of wavelength (2) Wavelengthdifference of two sodium d-lines.

UNIT-IV

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope.

Doubleslit. Multiple slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane

Wave.Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Text:

1. A text book of Optics – N.Subrahmanyam and Brij Lal (S.Chand Publishing)

2. Optics - Ajoy Ghatak (McGraw Hill

Reference:

1. Optics-E.Hecht (Pearson)
2. Fundamentals of Optics- F.A. Jenkins and H.E. White (McGraw-Hill)
3. Geometrical and Physical Optics– R.S. Longhurst(Orient Blackswan)
4. The Physics of Vibrations and Waves- H. J. Pain(John Wiley)
5. Optics – B.K.Mathur
6. Principles of Optics-Max Born and Emil Wolf (Pergamon Press)

Discipline Specific Core Paper 1V LAB

(minimum 6 experiments are to be done)

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda 2 - T$ Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light
8. To determine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani

(two papers are to be selected)

Discipline Specific Elective Paper –I

**DIGITAL AND ANALOG CIRCUITSAND
INSTRUMENTATION**

UNIT-1:
Digital Circuits

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

UNIT-II
Semiconductor Devices and Amplifiers:

Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell.
Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation

UNIT-III
BJT and Amplifiers

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff, and Saturation Regions. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, and C Amplifiers.Class B Push Pull Amplifier.
Feedback in Amplifiers,Positive and Negative feedback,Effects of Feedback
Oscillators:Hartley and Colpitt's Oscillator

UNIT-IV:
Operational Amplifiers (Black Box approach) :

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting

Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Instrumentations:
Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Text:

1. Electronics: Fundamentals and applications – D. Chattopadhyay and P.C.Rakshit (New Age international)

2. Digital Principles and Applications - A.P. Malvino, D.P.Leach and Saha (Tata McGraw)

3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.

Reference :

1. Principles of Electronics – V.K.Mehta and Rohit Mehta (S.Chand Publishing)
2. Hand book of electronics – Gupta Kumar (Pragati Prakashan)
3. Digital Logic and Computer design – M. Morris Mano (Pearson)
4. Text book of Electronics – B. B. Swain (Kitab Mahal)
5. Concepts of Electronics – D.C.Tayal (Himalaya Publishing house)
6. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.

<div align="center">

Discipline Specific Elective Paper –I LAB

DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTS

(minimum 6 experiments are to be done)

</div>

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.

6. To design an astable multivibrator of given specifications using 555 Timer.

7. To design a monostable multivibrator of given specifications using 555 Timer.

8. To study IV characteristics of PN diode, Zener and Light emitting diode

9. To study the characteristics of a Transistor in CE configuration.

10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.

11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.

12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.

13. To study a precision Differential Amplifier of given I/O specification using Opamp.

14. To investigate the use of an op-amp as a Differentiator

15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994,Mc-Graw Hill.

2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.

3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.

4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

Discipline Specific Elective Paper II

ELEMENTS OF MODERN PHYSICS

UNIT-I

Planck's quantum, Planck's constant and Compton scattering. De Broglie experiment. light as a collection of photons; Photoelectric effect ,wavelength and matter waves; Davisson-Germer Experiment

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

UNIT-II

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

UNIT-III

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy

UNIT-IV

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

Text:

1. Concepts of Modern Physics – Arthur Beiser (McGraw Hill)

2. Modern Physics – Murugeshan and Sivaprasad (S.Chand)

Reference:

1. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, (Macmillan)

2. Introduction to Quantum Mechanics, David J. Griffith (Pearson)

3. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W.Savin- (Tata McGraw-Hill)

4. Modern Physics-Serway (CENGAGE Learnings)

5. Physics of Atoms and Molecules – Bransden (Pearson India)

6. Quantum Mechanics– Satya Prakash (Pragati Prakashan)

7. Atomic and Nuclear Physics-A.B.Gupta (New Central)

DSE II LAB: ELEMENTS OF MODERN PHYSICS

(minimum 6 experiments are to be done)

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.

2. To determine work function of material of filament of directly heated vacuum diode.

3. To determine the ionization potential of mercury.

4. To determine value of Planck's constant using LEDs of at least 4 different colours.

5. To determine the wavelength of H-alpha emission line of Hydrogen atom.

6. To determine the absorption lines in the rotational spectrum of Iodine vapour.

7. To study the diffraction patterns of single and double slits using laser and measure its intensityvariation using Photosensor & compare with incoherent source – Na.

8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energyof photo-electrons versus frequency of light

9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted

3. 1985, Heinemann Educational Publishers

4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Optional for SECC II paper

Skill Enhancement Compulsory Courses (SECC Option-I)

APPLIED OPTICS

The quest to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. This paper provides the conceptual understanding of these branches of modern optics to the students.

Theory includes only qualitative explanation. Minimum **three** experiments should be performed covering minimum three sections.

Unit-I

(i) Photo-sources and Detectors

Lasers: an introduction, Planck's radiation law (qualitative idea), Energy levels, Absorption process, Spontaneous and stimulated emission processes, Theory of laser action, Population of energy levels, Einstein's coefficients and optical amplification, properties of laser beam, Ruby laser, He-Ne laser, and semiconductor lasers; Light Emitting Diode (LED) and photo-detectors.

(ii) Elementary ideas of Fourier Optics

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens.

Unit-II

Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

Photonics: Fibre Optics

(ii)   Photonics: Fibre Optics

Optical fibres: Introduction and historical remarks, Total Internal Reflection, Basic

characteristics of the optical fibre: Principle of light propagation through a fibre, the coherent bundle, The numerical aperture, Attenuation in optical fibre and attenuation limit; Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.

Skill Enhancement Compulsory Courses (SECC Option-I) LAB

Minimum **three** experiments should be performed covering minimum two sections.

Experiments on Lasers:

1. To determine the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
2. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
3. To find the polarization angle of laser light using polarizer and analyzer
4. To determine the wavelength and angular spread of laser light by using plane diffraction grating.

Experiments on Semiconductor Sources and Detectors:

1. V-I characteristics of LED
2. Study the characteristics of solid state laser
3. Study the characteristics of LDR
4. Characteristics of Photovoltaic Cell/ Photodiode.
5. Characteristics of IR sensor

Experiments on Fibre Optics

1. To measure the numerical aperture of an optical fibre
2. To measure the near field intensity profile of a fibre and study its refractive index profile

Reference Books:

1. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
2. Introduction to Fiber Optics, A. Ghatak & K. Thyagarajan, Cambridge University Press.
3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
4. Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University Press
5. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.

<div align="center">

Skill Enhancement Compulsory Courses (SECC Option-II)

RENEWABLE ENERGY AND ENERGY HARVESTING

</div>

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Unit-I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

Unit-II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Skill Enhancement Compulsory Courses (SECC Option-II)-LAB

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into volta geusing thermoelectric modules.

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

<u>Faculty Training to be imparted in the following Topics</u>

Computational Physics Lab—C, C++,

Scilab Programming for Core I,C-V,C-VIII,C-XI and C-XIII Practicals.

2. Digital Electronics. Theory and Practicals.

3. Quantum Mechanics Problem Solving

4. Solid State Physics- Elementary Band Theory and Superconductivity

5. Statistical Mechanics.-Quantum Distribution

6. Nanotechnology.

ESSENTIAL LABORATORY EQUIPMENT RECOMMENDED :

Every college must have CRO, Function generator, Laser and Logic Gate packages.

STATE MODEL SYLLABUS FOR UNDER GRADUATE
COURSE IN POLITICAL SCIENCE
(Bachelor of Arts Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course structure of UG Political Science Honours

Semester	Course	Course Name	Credits	Total marks
I	AEC-I	AEC-I	04	100
	C-I	Understanding Political Theory	06	100
	C-II	Constitutional Government and Democracy in India	06	100
	GE-I	Feminism: Theory and Practice	06	100
			22	
II	AEC-II	AEC-II	4	100
	C-III	Political Theory-Concepts and Debates	06	100
	C-IV	Political Process in India	06	100
	GE-II	Governance: Issues and Challenges	06	100
			22	
III	C-V	Introduction to Comparative Government and Politics	06	100
	C-VI	Introduction to Public Administration	06	100
	C-VII	Perspectives on International Relations	06	100

Semester	Course	Course Name	Credits	Total marks
	GE-III	Gandhi and the Contemporary World	06	100
	SEC-I	SEC-I	04	100
			28	
IV	C-VIII	Political Processes and Institutions in Comparative Perspective	06	100
	C-IX	Public Policy and Administration in India	06	100
	C-X	Global Politics	06	100
	GE-IV	United Nations and Global Conflicts	06	100
	SEC-II	SEC-II	04	100
			28	
Semester	Course	Course Name	Credits	Total marks
V	C-XI	Western Political Philosophy	06	100
	C-XII	Indian Political Thought(Ancient & Medieval)	06	100
	DSE-I	Introduction to Human Rights	06	100
	DSE-II	Development Process and Social Movements in Contemporary India	06	100

			24	
VI	C-XIII	Contemporary Political Philosophy	06	100
	C-XIV	Modern Indian Political Thought	06	100
	DSE-III	India's Foreign Policy in a Changing world	06	100
	DSE-IV	Women, Power and Politics	06	100
	OR			
	DSE-IV	Dissertation	06	100*
			24	

Discipline Specific Elective Papers: (Credit: 06 each) (4 papers to be selected by students of Political Science Honours): DSE 1-IV

1. Human Rights in a Comparative Perspective

2. Development Process and Social Movements in Contemporary India (PROJECT)

3. India's Foreign Policy in a Globalizing world

4. Women, Power and Politics

5. Project *Dissertation (can be opted as alternative of DSE-IV only and of 6 credits. **Dissertation content: 50, Seminar: 30, Viva: 20)**

POLITICAL SCIENCE

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers
Generic Elective for Non Political Science students– 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm: 20 marks, End term : 80 marks, Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 50 hours + 10 hours tutorial

Core Paper I

UNDERSTANDING POLITICAL THEORY

Introduction: This course is divided into two sections. Section 'A' introduces the students to the idea of political theory, its history and approaches and an assessment of its critical and contemporary trends. Section 'B' is designed to reconcile political theory and practices through reflections on the ideas and practices related to democracy.

UNIT-1: Introducing Political Theory

(i) What is Politics: Theorizing the 'Political'
(ii) Traditions of Political Theory: Liberal, Marxist, Anarchist and Conservative
(iii)Approaches to Political Theory: Normative, Historical, Behavioural and Post-behavioural

UNIT-II: **Critical and Contemporary Perspectives in Political Theory**

 (i) Theories of Feminism: Feminist and Postmodern
 (ii) Modernism and Post -modernism

UNIT-III: Political theory and Practice

 (i) Democracy: Liberal and Marxist.
 (ii) Procedural Democracy and its critique

 UNIT-IV: The Grammar of Democracy

(i) Deliberative Democracy
(ii) Participation and Representation

Text Books

- Bhargava, R. and Ashok Acharya (2008) '*Political Theory: An Introduction.* New Delhi: Pearson Longman.
- Vinod, M.J and Deshpande, Meena (2013) 'Contemporary Political Theory', PHI, New Delhi
- Verma, S. P. (1996) 'Modern Political Theory', Vikash Publishing, 3rd Reprint, New Delhi.
- Ramaswamy, Sushila (2010), 'Political Theory: Ideas and Concepts', PHI Learning, New Delhi
- Bellamy, R. (1993), (ed.) 'Theories and Concepts of Politics'. New York: Manchester University Press.
- Marsh, D. and Stoker, G. (eds.) 'Theory and Methods in Political Science'. London: Macmillan.
- Heywood, Andrew (2016) (Reprint) 'Political Theory: An Introduction', Palgrave, UK.

Further Reading

- Kukathas, Ch. and Gaus, G. F. (2004) (eds.) 'Handbook of Political Theory'. New Delhi, Sage.
- Vincent, A. (2004) 'The Nature of Political Theory'. New York: Oxford University Press.
- Mckinnon, C. (ed.) (2008) 'Issues in Political Theory', New York: Oxford University Press.
- Arblaster, A. (1994) 'Democracy', (2nd Edition), Buckingham: Open University Press.
- Parekh, B. (2000), 'Rethinking Multiculturalism: Cultural Diversity and Political Theory', Macmillan Press, London.

Core Paper II

CONSTITUTIONAL GOVERNMENT AND DEMOCRACY IN INDIA

Introduction: This course acquaints students with the Constitutional design of state structures and institutions, and their actual working over time. The Indian Constitution accommodates conflicting impulses (of liberty and justice, territorial decentralization and a strong union, for instance) within itself. The course traces the embodiment of some of these conflicts in constitutional provisions, and shows how these have played out in political practice. It further encourages a study of state institutions in their mutual interaction, and in interaction with the larger extra-constitutional environment.

UNIT-I: The Constituent Assembly and the Constitution
    i)   Formation and working of the Constituent Assembly
    ii) The Philosophy of the constitution: The Preamble and its Features.
    iii) Fundamental Rights, Directive Principles of State Policy, Fundamental Duties

UNIT-II: Organs of Government
    i)   The Legislature and the Executive
    ii) The Judiciary: Supreme Court and High Courts

UNIT-III: Federalism
    i)   Federalism: Centre-State relations
    ii) Recent trends in federalism

UNIT-IV: Decentralization

    i)   Panchayati Raj Institutions: Composition, Powers and functions of Gram Panchayat, Panchayat Samiti and Zilla Parishad.

    ii) Municipalities: Composition Powers and function of Municipal Corporation, Municipal Council and Notified Area Council

Text Books

- G. Austin, (2010) 'The Indian Constitution: Cornerstone of a Nation', New Delhi, Oxford University Press, 15th print.
- R. Bhargava (ed.) 'Politics and Ethics of the Indian Constitution', New Delhi, Oxford University Press.
- D. Basu, (2012) 'Introduction to the Constitution of India', New Delhi, Lexis Nexis.
- S. Chaube, (2009) 'The Making and Working of the Indian Constitution', New Delhi, National Book Trust.
- G. Austin, (2000) 'Working a Democratic Constitution', New Delhi, Oxford University Press.
- B. Shankar and V. Rodrigues, (2011), 'The Indian Parliament: A Democracy at Work', New Delhi: Oxford University Press.
- P. Mehta and N. Jayal (2010) (eds.) 'The Oxford Companion to Politics in India', New Delhi, Oxford University Press.

Reference Books

- Mehra and G. Kueck (eds.) 'The Indian Parliament: A Comparative Perspective', New Delhi, Konark.
- B. Kirpal et.al (eds.) 'Supreme but not Infallible: Essays in Honour of the Supreme Court of India', New Delhi, Oxford University Press.
- L. Rudolph and S. Rudolph, (2008) 'Explaining Indian Institutions: A Fifty Year Perspective, 1956-2006', Volume 2, New Delhi, Oxford University Press.
- M. Singh, and R. Saxena (2011) (eds.), 'Indian Politics: Constitutional Foundations and Institutional Functioning', Delhi: PHI Learning Private Ltd.
- K. Roy, C. Saunders and J. Kincaid (2006) (eds.) 'A Global Dialogue on Federalism', Volume 3Montreal, Queen's University Press

Core Paper III

POLITICAL THEORY-CONCEPTS AND DEBATES

Introduction: This course is divided into two sections. Section A helps the student familiarize with the basic normative concepts of political theory. Each concept is related to a crucial political issue that requires analysis with the aid of our conceptual understanding. This exercise is designed to encourage critical and reflective analysis and interpretation of social practices through the relevant conceptual toolkit. Section B introduces the students to the important debates in the subject. These debates prompt us to consider that there is no settled way of understanding concepts and that in the light of new insights and challenges, besides newer ways of perceiving and interpreting the world around us, we inaugurate new modes of Political debates.

UNIT-I: Importance of Freedom

(i)   Negative Freedom and Positive Freedom, Freedom of belief, expression and dissent
(ii) Equality: Meaning and Types, Egalitarianism: Social Exclusion & Affirmative action

UNIT-II: Indispensability of Justice

(i)   Justice: Meaning and Types
(ii)   Procedural, Distributive and Global Justice.

UNIT-III: The Universality of Rights

(i)   Rights: Natural, Moral and Legal
(ii) Three Generations of Rights

UNIT-IV: Major debates

(i)   Political obligation: Grounds
(ii)   Cultural Relativism and Multiculturalism.

Text Book

- Verma, S. P. (1996) 'Modern Political Theory', Vikash Publishing, 3rd Reprint, New Delhi.
- Vinod, M.J and Deshpande, Meena (2013) Contemporary Political Theory, PHI, New Delhi
- Ramaswamy, Sushila (2010), 'Political Theory: Ideas and Concepts', PHI Learning, New Delhi
- Bellamy, R. (1993), (ed.) *Theories and Concepts of Politics*. New York: Manchester University Press.
- Marsh, D. and Stoker, G. (eds.) 'Theory and Methods in Political Science'. London, Macmillan.
- Heywood, Andrew (2016) (Reprint), 'Political Theory: An Introduction', Palgrave, UK.

Reference Books

- Bellamy, Richard and Mason, Andrew (1993) (eds.) 'Political Concepts' Manchester, Manchester University Press.
- Knowles, Dudley. (2001) 'Political Philosophy', London, Routledge.
- Mckinnon, Catriona (2008) (ed.) 'Issues in Political Theory', New York: Oxford University Press.
- Swift, Adam. (2001) 'Political Philosophy: A Beginners Guide for Student's and Politicians', Cambridge, Polity Press.
- La Follett, Hugh (2003) (ed.) 'The Oxford Handbook of Practical Ethic'. New York, Oxford University Press.
- Knowles, Dudley. (2001) 'Political Philosophy', London, Routledge.

Core Paper IV

POLITICAL PROCESS IN INDIA

Introduction: Actual politics in India diverges quite significantly from constitutional legal rules. An understanding of the political process thus calls for a different mode of analysis - that offered by political sociology. This course maps the working of 'modern' institutions, premised on the existence of an individuated society, in a context marked by communitarian solidarities, and their mutual transformation thereby. It also familiarizes students with the working of the Indian state, paying attention to the contradictory dynamics of modern state power.

Political Parties, the Party system and Determinants of voting Behaviour

UNIT-I: Indian party system

  (i)   Party System in India: Features and Trends
  (ii) Voting Behaviour and Its determinants: Caste, Class, Gender and Religion.
  (iii) Election Commission: Constitution and Functions, Electoral Reforms

UNIT-II: Regionalism, Religion and Politics

  (i) Regionalism: Causes and its trends,
  (ii) Secularism and Communalism: Debates

UNIT-III: Caste and Politics

  i) Caste and Politics: Politicisation of Caste
  ii) Affirmative Action: Policies, Women, Caste and Marginalized Class

UNIT-IV: The Changing Nature of the India State

  (i) Developmental and Welfare Dimensions
  (ii) Coercive Dimension

Text books

  • Kaviraj, Sudipta(2009) 'Politics in India', Oxford University Press, New Delhi
  • Kohli, Atul (2004) (ed.) 'The Success of India's Democracy', New Delhi, Cambridge University Press.
  • Kothari,R (1970) 'Caste in Indian Politics', Delhi, Orient Longman.
  • M. John, (ed) (2008) 'Women in India: A Reader, Penguin , India
  • P. Brass, (1999) 'The Politics of India since Independence, New Delhi, Cambridge University Press and Foundation Books.
  • P. Mehta and N. Jayal (2010) (eds.) 'The Oxford Companion to Politics in India', New Delhi, Oxford University Press.
  • Z. Hasan (2002) (ed.) 'Parties and Party Politics in India', New Delhi: Oxford University Press.

- Z. Hasan, E. Sridharan and R. Sudarshan (2002) (eds.) 'India's Living Constitution: Ideas, Practices, Controversies', New Delhi, Permanent Black.

Reference Books

- N. Menon and A. Nigam, (2007) 'Power and Contestation: India since 1989', London, Fernwood Publishing, Halifax and Zed Books.
- R. Vora and S. Palshikar (eds.) 'Indian Democracy: Meanings and Practices', New Delhi, Sage.
- Shah, G (ed.) 'Social Movements and the State', New Delhi, Sage Publications.
- P. deSouza and E. Sridharan (eds.) 'India's Political Parties', New Delhi, Sage Publications.
- A S. Ganguly, L. Diamond and M. Plattner (eds.) 'The State of India's Democracy', Baltimore, John Hopkins University Press.

Core Paper V

INTRODUCTION TO COMPARATIVE GOVERNMENT AND POLITICS

Introduction: This is a foundational course in comparative politics. The purpose is to familiarize students with the basic concepts and approaches to the study of comparative politics. More specifically the course will focus on examining politics in a historical framework while engaging with various themes of comparative analysis in developed and developing countries.

UNIT-1: Understanding Comparative Politics

(i) Meaning, Nature, scope and Evolution
(ii) Approaches to the study of Comparative Politics

UNIT-II: Historical context of modern government
(i) Capitalism: meaning and development
(ii) Globalization: Features & impact

UNIT-III: Historical context of Modern Government- II

(i) Socialism: Meaning, Types and its growth
(ii) Rise and Decline of Communism as a Ruling Ideology
(iv) Colonialism and decolonization: meaning, context, forms of colonialism

UNIT-IV: Themes of Comparative Politics

(i) A comparative study of Governments of USA & China
(ii) US: President, Congress, Supreme Court
(iii) China: People's Congress, National Assembly, Role of Communist Party of China

Text books:

- Bhagwan, Vishnoo et al (2012) 'World Constitutions', Sterling Publishers , New Delhi
- Chilcote, Ronald (1994) 'Theories of Comparative Politics: The Search for a Paradigm

Reconsidered', Westview Press, Boulder.
- G. Ritzer, (2002) 'Globalization: A Basic Text'. London, Wiley-Blackwell.
- Huntington, Samuel, (1968) 'Political Order in Changing Societies', Yale University Press, New Haven.
- Kapur, A.C and K.K. Mishra (2010) 'Select Constitutions', S. Chand, New Delhi
- Suresh. R(2010), 'Economy and Society : Evolution of Capitalism', Sage , New Delhi

Reference Books

- P. Burnell, et. al, 'Politics in the Developing World'. New Delhi: Oxford University Press,

- J. McCormick, (2007) 'Comparative Politics in Transition', UK, Wadsworth.

- L. Barrington et. al (2010) 'Comparative Politics - Structures and Choices', Boston, Wadsworth,

- M. Kesselman, J. Krieger and William (2010), 'Introduction to Comparative Politics: Political Challenges and Changing Agendas', UK, Wadsworth.

- J. Kopstein and M. Lichbach. (eds.) 'Comparative Politics: Interest, Identities and Institutions in a Changing Global Order'. Cambridge: Cambridge University Press.

Core Paper VI

INTRODUCTION TO PUBLIC ADMINISTRATION

Introduction: The course provides an introduction to the discipline of public administration. This paper encompasses public administration in its historical context with an emphasis on the various classical and contemporary administrative theories. The course also explores some of the recent trends, including feminism and ecological conservation and how the call for greater democratization is restructuring public administration. The course will also attempt to provide the students a comprehensive understanding on contemporary administrative developments.

UNIT-1 : Public Administration as a Discipline

(i) Meaning, Scope and Significance of the Discipline,Public and Private Administration
(ii) Evolution of Public Administration

UNIT-II: Theoretical Perspectives

Classical Theories

(i) Scientific management (F. W. Taylor), Ideal-type bureaucracy (Max Weber)
(ii) Administrative Management (Gullick, Urwick and Fayol)

UNIT-III: Neo-Classical and Contemporary Theories

(i) Human Relations theory (Elton Mayo), Rational decision-making (Herbert Simon)
(ii) Ecological approach (Fred Riggs), Innovation and Entrepreneurship (Peter Drucker)

UNIT-IV: Public Policy and Major Approaches in Public Administration

(i) Public Policy-Concept and approaches, Formulation, implementation and evaluation
(ii) New Public Administration, New Public Management, New Public Service Approach
(iii) Good Governance, Feminist Perspectives in Governance

Readings

- B. Chakrabarty and M. Bhattacharya (eds), 'Administrative Change and Innovation: A Reader', New Delhi, Oxford University Press.
- Basu, Rumki, (2014) 'Public Administration: Concepts and Theories', Sterling Publishers, New Delhi
- D. Ravindra Prasad, Y. Pardhasaradhi, V. S. Prasad and P. Satyrnarayana, (2010) (eds.) 'Administrative Thinkers', Sterling Publishers.
- J. Shafritz, and A. Hyde, (2004) (eds.) 'Classics of Public Administration', 5th Edition. Belmont, Wadsworth.
- M. Bhattacharya, (2008) 'New Horizons of Public Administration', 5th Revised Edition. New Delhi, Jawahar Publishers.
- M. Bhattacharya, (2011) 'New Horizons of Public Administration', New Delhi: Jawahar Publishers.
- M. Bhattacharya, (2012) 'Restructuring Public Administration: A New Look', New Delhi, Jawahar Publishers,
- N. Henry, (2013) 'Public Administration and Public Affairs', 12th edition. New Jersey, Pearson,
- Shafritz, J. and Hyde, A. , (1997) (eds.) 'Classics of Public Administration', 4th Edition. Forth Worth, Hartcourt Brace, TX.

Reference Books

- B. Chakrabarty and M. Bhattacharya (2003) (eds.), 'Public Administration: A Reader', New Delhi, Oxford University Press.
- B. Chakrabarty, (2007) 'Reinventing Public Administration: The India Experience'. New Delhi, Orient Longman,
- B. Miner, (2006) 'Organisational Behaviour: Historical Origins and the Future'. New York,
- F. Riggs, (1964) 'Administration in Developing Countries: The Theory of Prismatic Society'. Boston, Houghton Miffin.
- F. Riggs, (1961) 'The Ecology of Public Administration', Part 3, New Delhi, Asia Publishing House.
- M. Bhattacharya, (2006) 'Social Theory, Development Administration and Development Ethics', New Delhi, Jawahar Publishers.
- Nivedita Menon (1999), (ed.) 'Gender and Politics', New Delhi, Oxford University Press.
- Peter F. Ducker, (2006) 'The Practice of Management', Harper Collins.
- S. Maheshwari,(2009) 'Administrative Thinkers', New Delhi: Macmillan

Core Paper VII

PERSPECTIVES ON INTERNATIONAL RELATIONS

Introduction: This paper seeks to equip students with the basic intellectual tools for understanding International Relations. It introduces students to some of the most important theoretical approaches for studying international relations. The course begins by historically contextualizing the evolution of the international state system before discussing the agency-structure problem through the levels-of-analysis approach. After having set the parameters of the debate, students are introduced to different theories in International Relations. It provides a fairly comprehensive overview of the major political developments and events starting from the twentieth century. Students are expected to learn about the key milestones in world history and equip them with the tools to understand and analyze the same from different perspectives. A key objective of the course is to make students aware of the implicit Euro-centricism of International Relations by highlighting certain specific perspectives from the Global South.

UNIT-I: Studying International Relations

(i) International Relations: Meaning, Scope and Evolution, Emergence of International State System
(ii) National Interest-Key Determinant of International Relations

(iii) Power-Cornerstone of International Relations

UNIT-II: Theoretical Perspectives
   (i)   Classical Realism & Neo-Realism, Liberalism & Neo-liberalism
   (ii)   Marxist Approaches, Feminist Perspectives, Euro- centricism & Perspective from the Global South

UNIT-III: An Overview of Twentieth Century IR History-I

   (i)   World War I: Causes & Consequences, significance of Bolshevik Revolution
   (ii) Rise of Fascism / Nazism, World war II-Causes &Consequences

UNIT-IV: An Overview of Twentieth Century IR -II

   (i)   Cold War Evolution& Different Phases (4 Lectures) Disintegration of USSR
   (ii) Emergence of the Third World, End of the Cold War

Text Books

- Basu, Rumki (2012) (ed.) 'International Politics: Concepts, Theories and Issues', New Delhi.
- Baylis & S. Smith (2002) (eds.), 'The Globalization of World Politics', Oxford University Press, UK, 4th edition, 2007 W.Bello, Deglobalization, Zed Books, London.
- M. Nicholson, (2002) 'International Relations: A Concise Introduction', New York, Palgrave.
- P. Viotti and M. Kauppi, (2007) 'International Relations and World Politics: Security, Economy, Identity', Pearson Education.
- R. Jackson and G. Sorensen, (2007) 'Introduction to International Relations: Theories

and Approaches', 3rd Edition, Oxford, Oxford University Press.

- S. Joshua. Goldstein and J. Pevehouse, (2007) 'International Relations', New York, Pearson Longman.

<u>**Reference Books**</u>

1. Calvocoressi, P. (2001) 'World Politics: 1945—2000'. Essex, Pearson.
1. Dey, Dipankar (2007)(ed.), 'Sustainable Development: Perspectives and Initiatives', ICFAI University Press, Hyderabad,
2. K. Booth and S. Smith, (eds), 'International Relations Theory Today', Pennsylvania, The Pennsylvania State University Press.
3. M. Smith and R. Little (2000) (eds.), 'Perspectives on World Politics', New York, Routledge

Core Paper VIII

POLITICAL PROCESSES AND INSTITUTIONS IN COMPARATIVE PERSPECTIVE

Introduction: In this course students will be trained in the application of comparative methods to the study of politics. The course is comparative in both what we study and how we study. In the process the course aims to introduce undergraduate students to some of the range of issues, literature, and methods that cover comparative political.

UNIT-I: Approaches to Studying Comparative Politics

(i) Political Culture –Meaning, Types &relevance.
(ii) New Institutionalism –Meaning, Background, Significance

UNIT-II: Election& Party System

(i) Definition and procedures: Types of election system (First Past the Post, Proportional Representation, Mixed Representation)
(ii) Party System -Evolution, Theories and types

UNIT-III: Nation-state

(i) Nation-state; Meaning and Evolution in West Europe
(ii) Nation and State; Debates in Post-colonial contexts

UNIT-IV: Democratization in Post- colonial societies

(i) Democratization in Post-authoritarian countries and in Post-communist countries
(ii) Federalism: Meaning and Features, Federation& Confederation: Debates around territorial division of power.

Text Books

- A. Heywood, (2002) 'Politics', New York, Palgrave.
- J. Bara and M. Pennington, (eds.) *Comparative politics*. New Delhi: Sage Publications.
- J. Bara and Pennington. (2009) (eds.) 'Comparative Politics: Explaining Democratic System', Sage Publications, New Delhi.
- J. Ishiyama, and M. Breuning, (2011) (eds) '21st Century Political Science: A Reference Book', Los Angeles, Sage Publications.
- M. Lichback and A. Zuckerman, (eds.) 'Comparative Political: Rationality, Culture, and Structure'. Cambridge, Cambridge University Press.

Reference Books

- R. Watts, (2008) 'Comparing Federal Systems'. Montreal and Kingston, McGill Queen's University Press.
- Saxena, R (2011) (eds.) 'Varieties of Federal Governance: Major Contemporary Models', New Delhi, Cambridge University Press.
- T. Landman, (2003) 'Issues and Methods of Comparative Methods: An Introduction'. London, Routledge.

Core Paper IX

PUBLIC POLICY AND ADMINISTRATION IN INDIA

Introduction: The paper seeks to provide an introduction to the interface between public policy and administration in India. The essence of public policy lies in its effectiveness in translating the governing philosophy into programs and policies and making it a part of the community living. It deals with issues of decentralization, financial management, citizens and administration and social welfare from a non-western perspective.

UNIT-I: Public Policy

i) Definition, characteristics and models
ii) Public Policy Process in India

UNIT-II: Decentralization
(i) Meaning, significance, types and approaches to decentralization.
(ii) Local Self Governance: Rural and Urban

UNIT-III: Budget and Social Welfare Administration

(i) Concept and Significance of Budget, Budget cycle in India, Types of Budgeting
(ii) Concept and Approaches of Social Welfare.
(iii) Social Welfare Policies:
    (a) **Education:** Right to Education,

(b) **Health:** National Health Mission,
(c) **Food:** Right to Food Security,
(d) **Employment:** MNREGA

UNIT-I V: Citizen and Administration Interface

(i) Public Service Delivery System;
(ii) Redressal of Public Grievances: RTI, Lokpal, Citizens' Charter and e-Governance

Text books:

Text Books
* Basu Rumki (2015) 'Public Administration in India Mandates, Performance and Future Perspectives', New Delhi, Sterling Publishers
* Bidyut Chakrabarty, (2007) 'Reinventing Public Administration: The Indian Experience', Orient Longman,
* Henry, N. (1999) 'Public Administration and Public Affairs', New Jersey, Prentice Hall
* Jean Drèze and Amartya Sen, (1995) 'India, Economic Development and Social Opportunity', Oxford, Oxford University Press.
* R.B. Denhardt and J.V. Denhardt, (2009) 'Public Administration', New Delhi, Brooks/Cole
* Satyajit Singh and Pradeep K. Sharma (2007) (eds.) 'Decentralization: Institutions and Politics in Rural India', Oxford University Press, New Delhi.
* Singh, S. and Sharma, P. (2007) (eds.) 'Decentralization: Institutions and Politics in Rural India'. New Delhi, Oxford University Press.
* Vasu Deva, (2005) 'E-Governance In India: A Reality', Commonwealth Publishers.
* Vijaya Kumar, (2012) 'Right to Education Act 2009: Its Implementation as to Social Development in India', Delhi: Akansha Publishers.

 Reference Books
* 'World Development Report', (1992) World Bank, Oxford University Press,.
* Anderson, (1975) 'Public Policy Making', New York, Thomas Nelson and sons Ltd.
* Gabriel Almond and Sidney Verba, (1965) 'The Civic Culture', Boston, Little Brown.
* J.Dreze and Amartya Sen, (1997) 'Indian Development: Selected Regional Perspectives', Oxford, Clareland Press
* Jayal, N.G (1999) 'Democracy and The State: Welfare, Secular and Development in Contemporary India', Oxford, Oxford University Press.
* Jugal Kishore, (2005) National Health Programs of India: National Policies and Legislations, Century Publications.
* Lee and Mills, (1983) 'The Economic of Health In Developing Countries', Oxford, Oxford University Press.
* M. Howlett, M. Ramesh, and A. Perl, (2009), 'Studying Public Policy: Policy Cycles and Policy subsystems', 3rd edition, Oxford University Press, New Delhi
* Marma Mukhopadhyay and Madhu Parhar (2007) (ed.) 'Education in India: Dynamics of Development' New Delhi, Shipra Publications.
* Noorjahan Bava, (2001) 'Development Policies and Administration in India', Delhi, Uppal Publishers.
* R. Putnam, (1993) 'Making Democracy Work', Princeton University Press.
* T. Dye, (2002) 'Understanding Public Policy', New Delhi, Pearson

- United Nation Development Programme, (1997)'Reconceptualising Governance', New York
- Y. Dror, (1989) 'Public Policy Making Reexamined'. Oxford, Transaction Publication.

Core Paper X

GLOBAL POLITICS

Introduction: This course introduces students to the key debates on the meaning and nature of globalization by addressing its political, economic, social, cultural and technological dimensions. In keeping with the most important debates within the globalization discourse, it imparts an understanding of the working of the world economy, its anchors and resistances offered by global social movements while analyzing the changing nature of relationship between the state and trans-national actors and networks. The course also offers insights into key contemporary global issues such as the proliferation of nuclear weapons, ecological issues, international terrorism, and human security before concluding with a debate on the phenomenon of global governance.

UNIT-I: Globalization: Conceptions

  (i) Understanding Globalization and its Alternative Perspectives, Non-Proliferation Regimes
  (ii) Global Economy: Its significance & anchors of Global Political Economy: IMF, World Bank, WTO, TNCs

UNIT-II: Globalization: Perspectives

  (i)   Political Debates on Sovereignty and Territoriality
  (ii) Cultural and Technological Dimension
  (iii) Global Resistances (Global Social Movements and NGOs)
  (iv) Ecological Issues: International Environmental Agreements, Climate Change

UNIT-III: Contemporary Global Issues-I
  (i) Proliferation of Nuclear Weapons
  (ii) International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments

UNIT-IV: Contemporary Global Issues-II
  (i) Migration & Human Security
  (ii) Global Shifts: Power and Governance

Text Books
- G. Ritzer,   (2010) 'Globalization: A Basic Text', Sussex: Wiley-Blackwell.
- M. Strager, (2009) 'Globalization: A Very Short Introduction', London, Oxford University Press.
- Heywood, (2011) 'Global Politics', New York, Palgrave-McMillan.
- J. Baylis, S. Smith and P. Owens (2011) (eds.) 'Globalization of World Politics: An Introduction to International Relations', New York, Oxford University Press.
- W. Ellwood, (2005) 'The No-nonsense Guide to Globalization', Jaipur, Rawat Publications.
- D. Held and A. McGrew (2000) (eds.) 'The Global Trans-Formations Reader', Cambridge, Polity

Press.

Reference Books

- A. Narlikar, (2005) 'The World Trade Organization: A Very Short Introduction', New York, Oxford University Press.
- Goldstein, (2006) 'International Relations', New Delhi, Pearson.
- P. Hirst, G. Thompson and S. Bromley, (2009) 'Globalization in Question', Cambridge, Polity Press.
- D. Held et al, (1999) 'Global Transformations: Politics, Economics and Culture', California, Stanford University Press.
- F. Lechner and J. Boli (ed.), (2004) 'The Globalization Reader', London, Blackwell.(WTO).
- G. Ritzer, (2010) 'Globalization: A Basic Text', Sussex, Wiley-Blackwell.
- T. Cohn, (2009) 'Global Political Economy', New Delhi, Pearson.
- D. Held and A. McGrew (eds.), (2002) 'Global Transformations Reader: Politics, Economics and Culture', Cambridge, Polity Press.
- A. Vanaik, (ed.), (2004) 'Globalization and South Asia: Multidimensional Perspectives', New Delhi, Manohar Publications.

Core Paper XI

WESTERN POLITICAL PHILOSOPHY

Introduction: This course goes back to Greek antiquity and familiarizes students with the manner in which the political questions were first posed. Machiavelli comes as an interlude inaugurating modern politics followed by Hobbes and Locke, Rousseau, Marx. This is a basic foundation course for students.

UNIT-I : Text and Interpretation: Antiquity

    (i)   Plato
    (ii)   Aristotle

UNIT-II
    (i)   Machiavelli
    (ii)   Hobbes

UNIT-III
    (i)   Locke
    (ii)   Rousseau

UNIT-IV
    (i)   J. S. Mill
    (ii)   Karl Marx

Text Books

- C. Kukathas and G. Gaus, (eds.) 'Handbook of Political Theory', London, Sage Publications Ltd.

- D. Boucher and P. Kelly (2009), (eds) 'Political Thinkers: From Socrates to the Present', Oxford, Oxford University Press.
- J. Coleman, (2000) 'A History of Political Thought: From Ancient Greece to Early Christianity, Oxford, Blackwell Publishers.
- Mukherjee, Subrato and Susheela Ramaswamy(2011) 'History of political Thought: Plato to Marx', PHI Publishers , New Delhi
- Okin, S. (1992), 'Women in Western Political Thought', Princeton, Princeton University Press.
- R. Kraut (1996) (ed.) 'The Cambridge Companion to Plato', Cambridge, Cambridge University Press.

Reference Books
1. A. Skoble and T. Machan, (2007) 'Political Philosophy: Essential Selections', New Delhi, Pearson Education.
2. J. Barnes (1995) (ed.), 'The Cambridge Companion to Aristotle'. Cambridge, Cambridge University Press.

Core Paper XII

INDIAN POLITICAL THOUGHT (ANCIENT AND MEDIEVAL)

Introduction: This course introduces the specific elements of Indian Political Thought spanning over two millennia. The basic focus of study is on individual thinkers whose ideas are however framed by specific themes. The course as a whole is meant to provide a sense of the broad streams of Indian thought while encouraging a specific knowledge of individual thinkers and texts. Selected extracts from some original texts are also given to discuss in class. The list of Reference books is meant for teachers as well as the more interested students.

UNIT-I: Traditions of Pre-colonial Indian Political Thought

i) Brahmanic and Shramanic
ii) Islamic and Syncretic.

UNIT-II : Ved Vyasa (Shantiparva) and Manu
(i) Ved Vyasa : Rajadharma
(ii) Manu : Social Laws

UNIT-III: Kautilya, Barani and Aggannasutta

(i) Kautilya: Theory of State, Foreign Policy, Role of King
(ii) Aggannasutta- Theory of Kingship
(iii) Barani: Ideal Polity

UNIT-IV :Kabir and Abul Faza
(i)   AbulFazal-Monarchy
(ii)   Kabir: Syncretism

Text Books

- A. Appodoroy, (2002) 'Political Thought in India, Delhi, Khama Publication.
- A. B. M, (1976), 'The Foundation of Muslim Rule in India', Allahabad, Central Book Depot.
- Brown, (2003) 'The Verses of Vemana', Asian Educational Services, Delhi.
- Habib, Irfan.(1995) 'Essays in Indian History', New Delhi, Tulika Publications.
- Roy, Himanshu and Singh, M. (2017), 'Indian Political Thought: Themes and Thinker', Second Edition, New Delhi, Pearson.
- S. Saberwal, (2008) 'Spirals of Contention', New Delhi, Routledge,
- Sharma, R. S (1991) 'Aspects of Political Ideas Institutions in Ancient India, Delhi, Motilal Banarsidas.
- T. Pantham, and K. Deutsch (1986) (eds.), Political Thought in Modern India, New Delhi, Sage Publications.
- Thapar, Romila, (1997) 'Ashok and the Decline of the Mauryas, ' New York, Oxford University Press.
- V. Mehta, (1992) 'Foundations of Indian Political Thought, New Delhi, Manohar Publications.
- V.P. Varma, (1974) 'Studies in Hindu Political Thought and Its Metaphysical Foundations', New Delhi, Motilal Banarsidass.

Reference Books

- A. Fazl, (1873) 'The Ain-i Akbari ' (translated by H. Blochmann), Calcutta: G. H. Rouse.

- J. Spellman, (1964) 'Political Theory of Ancient India: A Study of Kingship from the Earliest time to Ceirca AD 300, Oxford, Clarendon Press.
- L. Hess and S. Singh, (2002) 'The Bijak of Kabir', New Delhi, Oxford University Press.
- R. Kangle (ed. and trns.), 'Arthasastra of Kautilya', New Delhi, Motilal Publishers.
- S. Collins, (2001) 'Agganna Sutta: The Discussion on What is Primary (An Annotated Translation from Pali), Delhi, Sahitya Akademi.

Core Paper XIII

CONTEMPORARY POLITICAL PHILOSOPHY

Introduction: Philosophy and politics are closely intertwined. Students will be exposed to the manner in which the questions of politics have been posed in terms that have implications for larger questions of thought and existence. Contemporary political philosophy and debates are introduced to the students here.

UNIT-I
i) Lenin

UNIT-II

i) Mao Zedong (Mao Tse Tung)

UNIT-III

   (i)   Antonio Gramsci

UNIT-IV

   (i)   John Rawls

Reading List

- B. Nelson, (2008) 'Western Political Thought'. New York, Pearson Longman.
- D. Boucher, and P. Kelly, (2003) (eds.) 'Political Thinkers: From Socrates to the Present'. New York, Oxford University Press.
- Gramsci, Antonio(1996), 'Selections from the Prison Notebooks', Orient Longman, Hyderabad
- Hacker, A. (1961), 'Political Theory: Philosophy, Ideology, Science', Macmillan, New York.
- Mukherjee, Subrato and Susheela Ramaswamy(2011) 'History of political Thought: Plato to Marx', PHI Publishers , New Delhi
- Rawls, John (2011), 'A Theory of Justice', Universal Law Publishing Co., New Delhi.
- Sabine, George, H. (1973). 'A History of Political Theory', Oxford and I.B.H. Publishing, New Delhi.
- Wayper. C.L (1989), 'Political Thought', B.I. Publications, Bombay.

Reference Books

- D. Germino (1972). Modern Western Political Thought: Machiavelli to Marx, Chicago University Press, Chicago.
- F.W. Coker (1971). Recent Political Thought, The World Press Pvt. Ltd., Calcutta.
- J.H. Hallowell (1960). Main Currents in Modern Political Thought, Holt, New York.

<div align="center">

Core Paper XIV

MODERN INDIAN POLITICAL THOUGHT

</div>

Introduction: Based on the study of individual thinkers, the course introduces a wide span of thinkers and themes that defines the modernity of Indian political thought. The objective is to study general themes that have been produced by thinkers from varied social and temporal contexts. Selected extracts from original texts are also given to discuss in the class. The list of Reference books is meant for teachers as well as the more interested students.

UNIT-I: Introduction

   (i) Rammohan Roy: Rights, Reform Movement, Liberalism
   (ii) Pandita Ramabai: Gender, critique of orthodoxy

(iii)Vivekananda: Ideal Society, Humanism, Nationalism

UNIT-II: Gandhi & Ambedkar

(i)   Gandhi: Swaraj, Swadeshi(8 lectures)
(ii)   Ambedkar: Social Justice

UNIT-III : Tagore&Savarkar

(i)   Tagore Critiqueof Nationalism   (8 lectures)
(ii)   Savarkar: Hindutwa-A critical Assessment

UNIT-IV: Nehru,Lohia and J.P. Narayan

(i)   Nehru: Secularism, Socialism
(ii)   Lohia: Socialism,
(iii)   J.P.Narayan: Total Revolution

Text books:

- A. Sen, (2003) 'Swami Vivekananda', Delhi, Oxford University Press.
- D. Dalton, (1982) 'Indian Idea of Freedom: Political Thought of Swami Vivekananda, Aurobindo Ghose, Rabindranath Tagore and Mahatma Gandhi', Academic Press, Gurgaon.
- G. Omvedt, (2008) 'Ramabai: Women in the Kingdom of God', in *Seeking Begumpura*: *The Social Vision of Anti Caste Intellectuals,* New Delhi, Navayana.
- M. Kosambi (2000) (ed.), 'Pandita Ramabai Through her Own Words: Selected Works', New Delhi, Oxford University Press.
- Raghuramaraju, (2007) 'Debates in Indian Philosophy: Classical, Colonial, and Contemporary', Delhi, Oxford University Press.
- S. Sarkar, (1985) 'A Critique on Colonial India', Calcutta, Papyrus.
- Sh. Kapila (2010) (ed.), 'An intellectual History for India', New Delhi: Cambridge University Press.
- T. Pantham and K. Deutsch (1986), (eds.) 'Political Thought in Modern India', New Delhi, Sage.
- V. Mehta and T. Pantham (eds.), (2006) 'A Thematic Introduction to Political Ideas in Modern India: Thematic Explorations, History of Science, Philosophy and Culture in Indian civilization' Vol. 10, Part: 7, New Delhi, Sage Publication.

Reference Books

- P. Chatterjee, (1986) 'Nationalist Thought and the Colonial World: A Derivative Discourse? London, Zed Books.
- S. Hay (1991) (ed.), 'Sources of Indian Tradition', Vol. 2.Second Edition, New Delhi, Penguin.
- S. Thorat and Aryama (2007) (eds.), 'Ambedkar in Retrospect - Essays on Economics, Politics and Society', Jaipur, IIDS and Rawat Publications.

Discipline Specific Elective Paper-I

INTRODUCTION TO HUMAN RIGHTS

Introduction: This course attempts to build an understanding of human rights among students through a study of specific issues in a comparative perspective. It is important for students to see how debates on human rights have taken distinct forms historically and in the contemporary world. The course seeks to anchor all issues in the Indian context, and pulls out another country to form a broader comparative frame.

Human Rights: Theory and Institutionalization
UNIT-I:

   i) Understanding Human Right
   ii) Three Generations of Rights

UNIT-II

   i) Universal Declaration of Human Rights

UNIT-III

   i) Rights in National Constitutions: South Africa and India

UNIT-IV

   i) International Refugee Law, International Humanitarian Law

Text Books

   - Alston Philip (1995), 'The United Nations and Human Rights-A Critical Appraisal', Oxford, Clarendon.
   - Baxi, Upendra (1995) (ed.), 'The Right to be Human', Delhi, Lancer,
   - Beetham, David (1987) (ed.), 'Politics and Human Rights', Oxford, Blackwell.
   - Desai, A R. (1986)(ed), 'Violations of Democratic Rights in India', Bombay, Popular Prakashan.
   - Evans, Tony (2001), 'The Politics of Human Rights: A Global Perspective', London, Pluto Press.
   - Hargopal. G.(1999) 'Political Economy of Human Rights', Hyderabad, Himalaya.
   - J. Hoffman and P. Graham, (2006) 'Introduction to Political Theory', Delhi, Pearson.

Reference Books

   - Kothari, Smitu and Sethi, Harsh (1991)(eds.), 'Rethinking Human Rights', Delhi, Lokayan.
   - Saksena, K.P. (1999) (ed.), 'Human Rights: Fifty Years of India's Independence', Delhi, Gyan.
   - Subramanian, S.(1997), 'Human Rights: International Challenges', Delhi, Manas Publications.

- Vistaar Iyer, V.R. Krishna (1999), 'The Dialectics and Dynamics of Human Rights in India', Delhi, Eastern Law House.

Discipline Specific Elective Paper II

DEVELOPMENT PROCESS AND SOCIAL MOVEMENTS IN CONTEMPORARY INDIA
(Project)

Introduction: Under the influence of globalization, development processes in India have undergone transformation to produce spaces of advantage and disadvantage and new geographies of power. The high social reproduction costs and dispossession of vulnerable social groups involved in such a development strategy condition new theatres of contestation and struggles. A variety of protest movements emerged to interrogate and challenge this development paradigm that evidently also weakens the democratic space so very vital to the formulation of critical consensus. This course proposes to introduce students to the conditions, contexts and forms of political contestation over development paradigms and their bearing on the retrieval of democratic voice of citizens.

UNIT-I: Development Process since Independence

(i)Welfare State, Development and the role of Planning commission
(ii)Development in the era of Liberalization and Reforms

UNIT-II: Development Strategy and its Impact on the Social Structure

(i) Industrial Development and its impact on organized and unorganized labour
(ii) Agricultural Development and Agrarian Crisis, Land Reforms and Green Revolution,

UNIT-III: Social Movements

i) Social Movements: Meaning and Approaches, New Social Movements
ii) Women's Movement, Environmental Movements

UNIT-IV: Social Movements

i) Dalit Movement, Tribal Movement,
ii) Left wing Extremism: Issues and Challenges

Text Books

- A. Desai, (1986) (ed.), 'Agrarian Struggles in India After Independence', Delhi, Oxford University Press
- A. F. Frankel, (2005) 'India's Political Economy (1947-2004): The Gradual Revolution', Delhi, Oxford University Press.

- B. Nayar, (2007) (ed.), 'Globalization and Politics in India', Delhi, Oxford University Press.
- G. Omvedt, (1983) 'Reinventing Revolution, New Social Movements and the Socialist Tradition in India', New York, Sharpe.
- G. Rath, (2006) (ed.), 'Tribal development in India: The Contemporary Debate', New Delhi, Sage Publications.
- G. Shah, (2004) 'Social Movements in India: A Review of Literature', New Delhi, Sage Publications.
- G. Shah, (ed.), (2002) 'Social Movements and the State'. New Delhi, Sage Publications.
- R. Mukherji (2010) (ed.) 'India's Economic Transition: The Politics of Reforms', Delhi, Oxford University Press.
- S. Roy and K. Debal, (2004) 'Peasant Movements in Post-Colonial India: Dynamics of Mobilization and Identity', Delhi, Sage.

Reference Books

- J. Harris, (2009) 'Power Matters: Essays on Institutions, Politics, and Society in India', Delhi, Oxford University press.
- J. Harriss, (2006) (ed) 'Power Matters: Essays on Institutions, Politics, and Society in India,' Delhi. Oxford University Press.
- K. Suresh, (ed.), (1982) 'Tribal Movements in India', Vol I and II, New Delhi, Manohar (emphasis on the introductory chapter).
- L. Fernandes, (2007) 'India's New Middle Class: Democratic Politics in an Era of Economic Reform', Delhi, Oxford University Press.
- M. Jayal, and P. Mehta, (2010) (eds.), 'The Oxford Companion to Politics in India', Delhi, Oxford University Press.
- M. Mohanty, P. Mukherji and O. Tornquist, (1998)(eds.) 'People's Rights: Social Movements and the State in the Third World', New Delhi, Sage.
- N. Jayal (2012)(ed.) 'Democracy in India', New Delhi, Oxford India Paperbacks, Sixth impression.

Discipline Specific Elective Paper III

INDIA'S FOREIGN POLICY IN A CHANGING WORLD

Introduction: This course's objective is to teach students the domestic sources and the structural constraints on the genesis, evolution and practice of India's foreign policy. The endeavour is to highlight integral linkages between the 'domestic' and the 'international' aspects of India's foreign policy by stressing on the shifts in its domestic identity and the corresponding changes at the international level. Students will be instructed on India's shifting identity as a postcolonial state to the contemporary dynamics of India attempting to carve its identity as an 'aspiring power'. India's evolving relations with the superpowers during the Cold War and after, bargaining strategy and positioning in international politics facilitate an understanding of the changing positions and development of India's role as a global player since independence.

UNIT-I : India's Foreign Policy in a changing world

   i)   India's Foreign Policy: Major bases and determinants
   ii)   India's Foreign Policy: Postcolonial Perspective

UNIT-II : India's Relation with USA& Russia
   i)   India's Relations with the USA
   ii)   India's Relation with USSR/Russia,

UNIT-III : India-China Relations, India and South Asia
   (i)   India-China Relations
   (ii)   India and South Asia: SAARC, Look East Policy, Act East Policy

UNIT-IV : India and Contemporary World

   (i)   India as an emerging Global Power, Myth and Reality
   (ii)   India in the Contemporary World

Reading List

- Appadorai, A. and M.S. Rajan(1988), 'India's Foreign Policy and Relations', New Delhi, South Asian Publishers Pvt. Ltd.
- Bahadur, Kalim (ed.)(1986), 'South Asia in transition: Conflicts and Tensions', New Delhi, Patriots.
- Bandyopadhyaya, J.(2006), 'The making of India's Foreign Policy', New Delhi, Allied Publishers Pvt. Ltd.
- Banerjee, A.K. (ed.)(1998), 'Security issues in South Asia: Domestic and External Sources of Threats to Security', Calcutta, Minerva.
- Bidwai, Praful and Achin Vanaik (eds.)(1999), 'South Asia on a Short Fuse: Nuclear Politics and the Future of Global Disarmament', New Delhi, Oxford University Press.
- D. Scott (2011)(ed.), 'Handbook of India's International Relations', London, Routeledge.
- Dutt, V.P.(2007), 'India's Foreign Policy Since Independence', New Delhi, National Book Trust.
- Tellis and S. Mirski (2013) (eds.), 'Crux of Asia: China, India, and the Emerging Global Order', Carnegie Endowment for International Peace, Washington.

  Reference Books

- A. Ganguly, S. and Rahul Mukherji(2011), India since 1980, New Delhi: Cambridge University Press.
- Ghosh, Partha S.(1989), Cooperation and conflict in South Asia, New Delhi: Manohar.
- Gould, H.A. and Sumit Ganguly (eds.)(1993), The Hope and the Reality: U.S.-Indian Relations from Roosevelt to Reagan, New Delhi: Oxford & IBH.
- Gujral, I.K.(1998), A foreign policy for India, Delhi: External publicity division, MEA, Government of India.

- Mansingh, Surjeet(1984), India's search for power: Indira Gandhi's foreign policy, 1966-1982 New Delhi: Sage.
- Muni, S.D.(2010), India's Foreign Policy the democracy dimension, New Delhi: Foundation Books.
- Nayar, B.R. and T.V. Paul(2004), India in the world order searching for major power status, New Delhi: Cambridge University Press.
- S. Cohen, (2002) *India: Emerging Power*, Brookings Institution Press.
- S. Mehrotra, (1990) 'Indo-Soviet Economic Relations: Geopolitical and Ideological Factors', in *India and the Soviet Union: Trade and Technology Transfer*, Cambridge University Press: Cambridge.
- Sengupta, Bhabani(1998), Fulcrum of Asia relations among China, India, Pakistan and the USSR, New Delhi: Konark Publishers.
- W. Anderson, (2011) 'Domestic Roots of Indian Foreign Policy', in W. Anderson, *Trysts with Democracy: Political Practice in South Asia*, Anthem Press: University Publishing Online.

Discipline Specific Elective Paper IV

WOMEN, POWER AND POLITICS

Introduction: This course opens up the question of women's agency, taking it beyond 'women's empowerment' and focusing on women as radical social agents. It attempts to question the complicity of social structures and relations in gender inequality. This is extended to cover new forms of precarious work and labour under the new economy. Special attention will be paid to feminism as an approach and outlook.

UNIT-I: Feminism
   (i) Meaning and Development
  (ii)Liberal, Socialist and Radical Feminism

UNIT-II: **Issues**
  i) Patriarchy
  ii) Sex and Gender
  iii) Gender, Power and Politics

UNIT-III: Issues

  (i)   Women Movement in India
  (ii)   Women Empowerment: Policies and Practices
  (iii)   Violence against Women

UNIT-IV: **Women and Development**

  i) WID (Women in Development), WAD
     (Women and Development), GAD (Gender
     and Development
  ii) Women and Work (Visible and Invisible)

Text Books

.

- B. Hooks, (2010) 'Feminism: A Movement to End Sexism', in C. Mc Cann and S. Kim (eds),
- M. John.(2008) (ed) *Women's Studies in India,* New Delhi: Penguin.
- M. Kosambi, (2007) *Crossing the Threshold,* New Delhi, Permanent Black.
- Menon, (2008) 'Power', in R. Bhargava and A. Acharya (eds), *Political Theory: An Introduction,* Delhi: Pearson.
- *Naarivaadi Rajneeti: Sangharsh evam Muddey,* University of Delhi: Hindi Medium Implementation Board.
- T. Shinde, (1993) 'Stree Purusha Tulna', in K. Lalitha and Susie Tharu (eds), *Women Writing in India,* New Delhi, Oxford University Press.
     The Feminist Reader: Local and Global Perspectives, New York: Routledge.
- U. Chakravarti, (2001) 'Pitrasatta Par ek Note', in S. Arya, N. Menon & J. Lokneeta (eds.)
- V Geetha, (2002) *Gender,* Kolkata, Stree Publications.

Reference Books

- N. Gandhi and N. Shah, (1992) *Issues at Stake – Theory and Practice in the Women's Movement,* New Delhi: Kali for Women.
- N. Menon, (2004) 'Sexual Violence: Escaping the Body', in *Recovering Subversion,* New Delhi: Permanent Black.
- P. Swaminathan, (2012) 'Introduction', in *Women and Work,* Hyderabad: Orient Blackswan.
- R. Kapur, (2012) 'Hecklers to Power? The Waning of Liberal Rights and Challenges to Feminism in India', in A. Loomba *South Asian Feminisms,* Durham and London: Duke University Press.
- U. Chakravarti, (2003) *Gendering Caste through a Feminist Len,* Kolkata, Stree pubications.
- V. Bryson, (1992) *Feminist Political Theory,* London*:* Palgrave-MacMillan.

DSE Paper – IV

DISSERTATION / RESEARCH PROJECT

(College can give this choice only for students with above 60% aggregate marks)

Project Paper- Development Process and Social Movements in Contemporary India (DSE-II)

Introduction:

   The research experience of students is greatly enriched by early exposure to conducting research. There are numerous benefits of undergraduate students who get involved in research. They are better off in understanding published works, determine an area of interest, can discover their passion for research and may start their career as a researcher. Further students will be able to develop ability for scientific inquiry and critical thinking, ability in the knowledge base and communication. This course is included to promote above mentioned abilities among the students.

Learning Objectives:

- To help students to learn how to develop scientific research designs in the study of public administration.
- To guide students to understand the previous research in their field of interest and review them to arrive at a research problem
- To encourage the students to learn ways to describe and evaluate public policy implementation.
- To help students understand the logic of hypothesis testing in both quantitative and qualitative research.
- To make students to learn the methods of writing a research report.

Expected outcomes: Students will be able to
- Independently prepare a research design to carry out a research project
- Review the related research papers to find out a research problem and relevant hypotheses
- Understand the dynamics of citizen – administrative interface and administrative behaviours.
- Learn the use of statistical techniques for interpretation of data.
- Learn the APA style of reporting a research project.

Unit I A student is required to carry out a project on an issue of interest to him / her under the guidance and supervision of a teacher. In order to do so s/he must have the knowledge in research methodology and of steps in planning and conducting a research. The supervisors may help the students to go on field study / study tour relevant to their work. Thirty hours of class may be arranged in the routine to help students understand research methodology, and planning, conduction and reporting on the research. An external examiner with the supervisor as the internal examiner will evaluate the research project on the basis of scientific methodology in writing the report, and presentation skill and performance in the viva.

- **Format**
    - **Abstract** – 150 words including problem, method and results.
    - **Introduction** – Theoretical considerations leading to the logic and rationale for the present research
    - **Review**- Explaining current knowledge including substantive findings and theoretical and methodological contributions to the topic, objectives and hypotheses of the present research
    - **Method** – Design, Sample, Methods of data collection, Procedure
    - **Results**- Quantitative analysis of group data-- (Raw data should not be attached in Appendix) Graphical representation of data wherever required.¬ Qualitative analysis wherever done should indicate the method of¬ qualitative analysis.
    - **Discussion**
    - **References (APA Style) & Appendices**
- Project should be in Soft binding. It should be typed in Times New Roman 14 letter size with 1.5 spacing on one sides of the paper. Total text should not exceed 50 pages (References & Appendices extra).
- Two copies of the project should be submitted to the College.
- *Project - American Psychological Association (APA) – Publication Manual 2006 to be followed for project writing*

Mark distribution for dissertation / Research project

Identification of problem	Review of Literature	Methodology	Analysis	Findings	Viva-voce	Total
10	10	10	25	20	25	100

Broad areas identified for Project: Social Movements: Environment, Women, Dalit, Peasant, Social Development, Political Development in Odisha, Political Socialization, Political Participation, Political Modernization and Communication, Decentralized democracy: Rural and Urban Local Self Governance, Functionary of Gram Sabha, Empowerment of Women and other marginals in PRIs, Development, Displacement, Rehabilitation, Resettlement in Odisha, Role of NGOs in Development, Regional Development and Regional Imbalances, Implementation of ORTPS- 2012, RTE-2009, Food Security Act, 2013, FRA, 2007.

Generic Elective Paper I

FEMINISM: THEORY AND PRACTICE

Introduction: The aim of the course is to introduce students to contemporary debates on feminism and the history of feminist struggles. The course begins with a discussion on construction of gender and an understanding of complexity of patriarchy and goes on to analyze theoretical debates within feminism. It offers a gendered analysis of Indian society, economy and polity with a view to understanding the structures of gender inequalities. And the last section aims to understand the issues with which contemporary Indian women's movements are engaged with.

UNIT-I: Understanding Feminism

(i)   Feminist theorizing of the sex/gender distinction; Public Man and Private Woman

(ii)   Understanding Patriarchy and Feminism

UNIT-II: Theories of Feminism

(i)   Liberal and Socialist,
(ii)   Radical feminism and Eco-feminism

UNIT-III: Feminist issues and women's participation: The Indian Experience

(i) Women's participation in anti-colonial and national liberation movements with special focus on India
(ii) Traditional Historiography and Feminist critiques; Social Reforms Movement and position of women in India, History of Women's struggle in Post- Independent India

UNIT-IV: Family in contemporary India and Understanding Woman's Work and Labour

(i)   Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights

(ii)   Understanding Woman's Work and Labour – Sexual Division of Labour, Productive

and Reproductive labour, Visible - invisible work – Unpaid (reproductive and care), Underpaid and Paid work,- Methods of computing women's work , Female headed households

Text Books

- Bina Agarwal, (2013) 'Gender And Green Governance', Oxford University Press, Oxford,
- Forbes, Geraldine (1998) 'Women in Modern India'. Cambridge, Cambridge University Press
- Geetha, V. (2002) 'Gender'. Calcutta, Stree Publications.
- Geetha, V. (2007) 'Patriarchy'. Calcutta, Stree Publications.
- Jagger, Alison. (1983) 'Feminist Politics and Human Nature'. U.K, Harvester Press.
- John, Mary (
- John, Mary(2008) 'Women studies in India: A Reader', Peguin, New Delhi
- Lerner, Gerda. (1986) 'Creation of Patriarchy'. New York. Oxford University Press.

Reference Books

- Banarjee, Sikata. (2007) 'Ghadially, Rehana. (ed.) 'Urban Women in Contemporary India: A Reader'. New Delhi, Sage.
- Chakravarti, Uma. (1988) 'Beyond the Altekarian Paradigm: Towards a New Understanding of Gender Relations in Early Indian History', Social Scientist, Volume 16, No. 8.
- Desai, Neera & Thakkar, Usha. (2001) 'Women in Indian Society'. New Delhi: National Book Trust.
- Gandhi, Nandita & Shah, Nandita. (1991) 'Contemporary Women's Movement in India'. Delhi, Zubaan.
- Gupta, A and Sinha Smita, (2005) 'Empowerment of women: Language and Other Facets', Mangal Deep, New Delhi.
- Jayawardene, Kumari. (1986) 'Feminism and Nationalism in the Third World'. London, Zed Books and Conclusion.
- Nayak, Smita (2016) (eds.) ' Combating Violence Against Women: A Reality in the Making', Kalpaz, Gyan Books Pvt, Ltd, New Delhi
- Nayak, Smita (2016) (eds.) 'Gender Dynamics: The Emerging Frontiers', Research India Publications, New Delhi.
- Nayak, Smita, (2016), 'Whither Women: A Shift from Endowment to Empowerment', Edupedia, New Delhi.
- Rege, Sharmila. (2003) (ed.) 'The Sociology of Gender: The Challenge of Feminist Sociological Knowledge'. New Delhi, Sage.
- Rowbotham, Shiela. (1993) 'Women in Movements', New York and London, Routledge.
- Sangari, Kumkum & Chakravarty, Uma.(1999) (eds.) 'From Myths to Markets: Essays on Gender'. Delhi, Manohar.
- Sarkar, Tanika & Butalia, Urvashi. (1995) (eds.) 'Women and the Hindu Right'. Delhi, Kali for Women.

Generic Elective Paper II

GOVERNANCE: ISSUES AND CHALLENGES

Objectives: This paper deals with concepts and different dimensions of governance highlighting the major debates in the contemporary times. There is a need to understand the importance of the concept of governance in the context of a globalizing world, environment, administration, development. The essence of governance is explored through the various good governance initiatives introduced in India.

UNIT-I: Government and governance: concepts

(i) Governance: Meaning, Nature and Types
(ii) Role of State in the Era of Globalisation: State, Market and Civil Society

UNIT-II : Good Governance

i) Good Governance
ii) Sustainable Development and Governance

UNIT-III: Local Governance

(i) Democratic Decentralization: Institutions of Local Governance (PRIs),
(ii) People' Participation in Local Governance & Deepening Democracy

UNIT-IV : Good Governance Initiatives In India

i) Public Service Guarantee Acts & Electronic Governance
ii) Citizens Charter & Right to Information, Corporate Social Responsibility
iii)

Text Books

- A Baviskar, ((1995) The Belly of the River: Tribal Conflict Over Development in the Narmada Valley', Delhi, Oxford University Press.
- A. Parel (2000) (ed) 'Gandhi, Freedom and Self-Rule', New Delhi, Lexington Books.
- B. Parekh, (1997) 'Gandhi: A Brief Insight', Delhi, Sterling Publishing Company.
- B. Parekh, (1999) 'Colonialism, Tradition and Reform: An Analysis of Gandhi's Political Discourse', New Delhi, Sage Publication.
- D. Hardiman, (2003) 'Gandhi in his Time and Ours'. Delhi, Oxford University Press.

Reference Books

- R Iyer, (ed) (1993) 'The Essential Writings of Mahatma Gandhi', New Delhi, Oxford University Press.
- R. Ramashray, (1984) 'Self and Society: A Study in Gandhian Thought', New Delhi, Sage Publication.

GANDHI AND THE CONTEMPORARY WORLD

Introduction: Locating Gandhi in a global frame, the course seeks to elaborate Gandhian thought and examine its practical implications. It will introduce students to key instances of Gandhi's continuing influence right up to the contemporary period and enable them to critically evaluate his legacy.

UNIT-I-

i) Theories: Satyagraha, Ahimsa

UNIT-II-

i) Swaraj, Swadeshi

UNIT-III-

i) Relevance Gandhi: Gandhi & Environment, Gandhi & Women, Gandhi & Social Harmony

UNIT-IV-

- Gandhi & Global Peace: Gandhian Philosophy in Contemporary World

Text Books

- B. C. Smith (2007), 'Good Governance and Development', Palgrave.
- B. Chakrabarty and M. Bhattacharya, (1998) (eds.) 'The Governance Discourse'. New Delhi, Oxford University Press.
- B. Nayar (1995) (ed.), 'Globalization and Politics in India', Delhi, Oxford University Press.
- Neera Chandhoke, (1995) 'State and Civil Society Explorations In Political Theory', Sage Publishers.
- Panda, Smita Mishra (2008), 'Engendering Governance Institutions: State, Market and Civil Society', Sage Publications.
- Surendra Munshi and Biju Paul Abraham (2004) (eds.), 'Good Governance, Democratic Societies and Globalisation', Sage.
- United Nation Development Programme, (1997) 'Reconceptualising Governance', New York.
- World Bank Report, (1992) 'Governance and Development'.

Reference Books
- Burns H Weston and David Bollier (2013), 'Green Governance: Ecological Survival, Human Rights, and the Law of the Commons', Cambridge University Press.
- Emilio F. Moran, (2010) 'Environmental Social Science: Human - Environment interactions and Sustainability', Wiley-Blackwell.
- Pardeep. Sachdeva, (2011) 'Local Government in India', Pearson Publishers, New Delhi.

- Pranab Bardhan and Dilip Mookherjee (2006), 'Decentralization And Local Governance In Developing Countries: A Comparative Perspective', MIT Press.
- T.R. Raghunandan (2013), 'Decentralization and Local Governments: The Indian Experience, Readings on The Economy, Polity and Society', Orient Blackswan.
- D. Crowther (2008), 'Corporate Social Responsibility', Deep and Deep Publishers, New Delhi.

Generic Elective Paper IV

UNITED NATIONS AND GLOBAL CONFLICTS

Introduction: This course provides a comprehensive introduction to the most important multilateral political organization in international relations. It provides a detailed account of the organizational structure and the political processes of the UN, and how it has evolved since 1945, especially in terms of dealing with the major global conflicts. The course imparts a critical understanding of the UN's performance until now and the imperatives as well as processes of reforming the organization in the context of the contemporary global system.

UNIT-I : The United Nations

i) An Historical Overview of the United Nations.
ii) Principles and Objectives

UNIT-II

i) Structures and Functions**:** General Assembly, Security Council, Economic and Social Council,.

ii) The International Court of Justice, The Specialized Agencies (International Labour Organisation (IOL), United Nations Educational, Scientific and Cultural Organisation (UNESCO), World Health Organisation (WHO), UN Programmes Funds: United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), United Nations High Commissioner for Refugees (UNHCR)
iii) Peace Keeping, Peace Making and Enforcement, Peace Building and Responsibility to Protect
iv) Millennium Development Goals.

UNIT-III   Major Global Conflicts since the Second World war

i) Korean war
ii) Vietnam War
iii) Afghanistan War
iv) Balkans Serbia and Bosnia

UNIT-IV
Assessment of the United Nations as an International Organisation: Imperatives of Reforms and the Process of Reforms

Text Books

- Basu, Rumki (2014) 'United Nations: Structure and Functions of an international organization', New Delhi, Sterling Publishers
- Baylis, J. and Smith, S. (2008) (eds.) 'The Globalization of World Politics: An Introduction to International Relations'. 4th edn. Oxford, Oxford University Press.
- Gareis, S.B. and Varwick, J. (2005) 'The United Nations: an introduction'. Basingstoke, Palgrave.
- Goldstein, J. and Pevehouse, J.C. (2006) 'International Relations'. 6th edn. New Delhi, Pearson.
- Saxena, J.N. (1986) et.al. 'United Nations for a Better Worl', New Delhi, Lancers.
- White, B. et al. (eds.) (2005) 'Issues in World Politics', 3rd edn. New York, Macmillan.
- Whittaker, D.J. (1997) 'United Nations in the Contemporary World', London, Routledge.

Reference Books

- Armstrong, D., Lloyd, L. and Redmond, J. (2004) 'International Organisations in World Politics'. 3rd edn. New York, Palgrave, Macmillan.
- Calvocoressi, P. (2001) 'World Politics: 1945-2000', 3rd edn. Harlow, Pearson Education.
- Moore, J.A. Jr. and Pubantz, J. (2008) 'The new United Nations', Delhi, Pearson Education.
- United Nations Department of Public Information. (2008) 'The United Nations Today'. New York, UN.

Course structure of UG Political Science Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Introduction To Political Theory	06	100
II	DSC-II	Indian Government And Politics	06	100
III	DSC-III	Comparative Government And Politics	06	100
IV	DSC-IV	Introduction To International Relations	06	100
V	DSE-I	Administration And Public Policy: Concepts And Theories	06	100
VI	DSE-II	Democracy And Governance	06	100

				30	600

POLITICAL SCIENCE Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers

 Marks per paper - Midterm : 20 marks, End term : 80 marks, Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 50 hours + 10 hours tutorial

Discipline Specific Core Paper I

INTRODUCTION TO POLITICAL THEORY

Course Objective: This course aims to introduce certain key aspects of conceptual analysis in political theory and the skills required to engage in debates surrounding the application of the concepts.

Unit-I Political Theory: Definition and Approaches: Normative, Historical, Behavioural and Post Behavioural, Relevance (14 lectures)

Unit-II Concepts: Democracy, Liberty, Equality, Justice

Unit-III Rights, Gender, Citizenship, Civil Society and State

Unit-IV Debates in Political Theory:
  (i)   Grounds of Political Obligation
  (ii)   Protective discrimination and Equality

Text Books

- Bhargava, R. and Ashok Acharya (2008) '*Political Theory: An Introduction.* New Delhi: Pearson Longman.
- Vinod, M.J and Deshpande, Meena (2013) 'Contemporary Political Theory', PHI, New Delhi
- Verma, S. P. (1996) 'Modern Political Theory', Vikash Publishing, 3rd Reprint, New Delhi.
- Ramaswamy, Sushila (2010), 'Political Theory: Ideas and Concepts', PHI Learning, New Delhi
- Bellamy, R. (1993), (ed.) 'Theories and Concepts of Politics'. New York: Manchester University Press.
- Marsh, D. and Stoker, G. (eds.) 'Theory and Methods in Political Science'. London: Macmillan.

- Heywood, Andrew (2016) (Reprint) 'Political Theory: An Introduction', Palgrave, UK.

Reference Books

- Kukathas, Ch. and Gaus, G. F. (2004) (eds.) 'Handbook of Political Theory'. New Delhi, Sage.
- Vincent, A. (2004) 'The Nature of Political Theory'. New York: Oxford University Press.
- Mckinnon, C. (ed.) (2008) 'Issues in Political Theory', New York: Oxford University Press.
- Arblaster, A. (1994) 'Democracy', (2nd Edition), Buckingham: Open University Press.
- Parekh, B. (2000), 'Rethinking Multiculturalism: Cultural Diversity and Political Theory', Macmillan Press, London.

Discipline Specific Core Paper II

INDIAN GOVERNMENT AND POLITICS

Unit-I Historical Development of Indian Constitution and formation and working of the Constituent Assembly

Unit-II Indian Constitution: Basic features, Preamble, Fundamental Rights and Directive Principles

Unit-III Institutional Functioning: President, Prime Minister, Parliament and Judiciary

Unit-IV (i) Parties and Party systems in India
  (ii) Recent trends in Federalism in India

Text Books

1. Abbas, H., Kumar, R. & Alam, M. A. (2011) *Indian Government and Politics.* New Delhi: Pearson, 2011.
2. Austin, G. (1999) *Indian Constitution: Corner Stone of a Nation.* New Delhi: Oxford University Press.
3. Austin, G. (2004) *Working of a Democratic Constitution of India.* New Delhi: Oxford University Press.
4. Chakravarty, B. & Pandey, K. P. (2006) *Indian Government and Politics.* New Delhi: Sage.
5. Chandhoke, N. & Priyadarshi, P. (eds.) (2009) *Contemporary India: Economy, Society, Politics.* New Delhi: Pearson.
6. Jayal, N. G. & Maheta, P. B. (eds.) (2010) *Oxford Companion to Indian Politics.* New Delhi: Oxford University Press.

Reference Books:

7. Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) *India After Independence.* New Delhi: Penguin.
8. Menon, N. and Nigam, A. (2007) *Power and Contestation: India Since 1989.* London: Zed Book.
9. Singh, M.P. & Saxena, R. (2008) *Indian Politics: Contemporary Issues and Concerns.* New

Delhi: PHI Learning.
Vanaik, A. & Bhargava, R. (eds.) (2010) *Understanding Contemporary India: Critical Perspectives.* New Delhi: Orient Blackswan.

Discipline Specific Core Paper III

COMPARATIVE GOVERNMENT AND POLITICS

Unit-I The nature, scope and methods of comparative political analysis

Unit-II Comparing Regimes: Authoritarian and Democratic

Unit-III Classifications of political systems:
(i)   Parliamentary and Presidential: UK and USA
(ii)   Federal and Unitary: Canada and China

Unit-IV

Party Systems: one-party, two-party and multi-party systems: China, UK, and India

Text Books

● Ann L. G. (ed.) (2002) Handbook *of Federal Countries.* Montreal & Kingston: McGill☐Queen's University Press.
● Bara, J & Pennington, M. (eds.). (2009) *Comparative Politics.* New Delhi: Sage.
● D. Caramani. (ed.) (2008) *Comparative Politics.* Oxford: Oxford University Press.
● Dhillon, Michael. (2009) *Contemporary China: An Introduction.* London, New York: Routledge, 2009.
● Hague, R and Harrop, M. (2004) *Comparative Government and Politics: An Introduction.* London: Palgrave McMillan, pp. 268☐290.
● Newton, K. and Deth, Jan W. V. (2010) *Foundations of Comparative Politics: Democracies of the Modern World.* Cambridge: Cambridge University Press.
● O'Neil, P. (2009) *Essentials of Comparative Politics.* (Third Edition). New York: WW. Norton & Company, Inc.
● Palekar, S.A. (2009) *Comparative Government and Politics.* New Delhi: PHI Learning Pvt. Ltd. (EightEdition). London: Palgrave McMillan.
● Rekha Saxena. (ed.) (2002) *Mapping Canadian Federalism for India.* New Delhi: Konark Publisher, Pvt., pp. 115☐129.

Reference Books:

● Bara, J. (2009) 'Methods for Comparative Analysis', in Bara, J. & Pennington, M. (eds.) *Comparative Politics.* New Delhi: Sage, pp. 40☐65.
● Blondel, J. (1996) 'Then and Now: Comparative Politics', *Political Studies. Vol. 47, Issue 1,* pp. 152☐160
● Chandhoke, N. (1996) 'Limits of Comparative Political Analysis', *Economic and Political*

Weekly. vol. 31, No. 4, (January 27), pp. PE 2□PE8.

- Ishiyama, J.T. and Breuning, M. (eds.) (2011) *21st Century Political Science: A Reference Book.* Los Angeles: Sage, pp. 150□158.
- Mair, P. (2008) 'Democracy', in Carmani, D. (ed.) *Comparative Politics.* Oxford: Oxford University Press, pp. 108□132.
- Watts, D. (2003) *Understanding US/UK Government and Politics.* Manchester: Manchester University Press, pp. 1□25; 66□105; 106□138.

Discipline Specific Core Paper IV

INTRODUCTION TO INTERNATIONAL RELATIONS

Course Objective: This Course is designed to give students a sense of some important theoretical approaches to understand international relations; a history from 1945 onwards to the present; and an outline of the evolution of Indian foreign policy since independence and its possible future trajectory.

Unit-I Approaches to International Relations

    (a)Classical Realism
    (b)   Liberalism and Neo-Liberalism
    (c)Feminist Perspective

Unit-II Cold War and Post-Cold:
    (i) Origin and Phases
    (ii)Post Cold- War Era and Emerging Centres of Power (European Union, China, Russia and Japan)

Unit-III India's Foreign Policy: Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic)

Unit-IV (i) India's Policy of Non-alignment
    (ii) India: An Emerging Power

Text Books

- Appadorai and Rajan, M. S. (eds.) (1985) *India's Foreign Policy and Relations.* New Delhi: South Asian Publishers.
- Art, R. J. and Jervis, R. (eds.) (1999) *International Political Enduring: Concepts and Contemporary Issues.*5th Edition. New York: Longman, pp. 7□14; 29□49; 119□126.
- Basu, Rumki (ed)(2012) *International Politics: Concepts theories and Issues*, New Delhi, Sage Publications India Pvt Ltd.
- Baylis, J. and Smith, S. (eds.) (2011) *The Globalization of World Politics: An Introduction to International Relations.* Fifth Edition. Oxford: Oxford University Press.
- Ganguly, S. (ed.) (2009) *India's Foreign Policy: Retrospect and Prospect.* New Delhi: Oxford University Press.
- Goldstein, J. and Pevehouse, J.C. (2009) *International Relations.* New Delhi: Pearson.

- Indian Foreign Service Institute. (1997, 1998) *India's Foreign Policy: An Agenda for the 21st Century* Vols. 1 & 2, New Delhi: Konark Publishers.
- Vanaik, A. (1995) *India in a Changing World: Problems, Limits and Successes of Its Foreign Policy.* New Delhi: Orient Longman.

Reference Books
- Jackson, R. and Sorenson, G. (2008) *Introduction to International Relations: Theories and Approaches*. New York: Oxford University Press.
- Mewmillians, W.C. and Piotrowski, H. (2001) *The World Since 1945: A History of International Relations*.Fifth edition. London: Lynne Rienner Publishers.
- Smith, M., Little, R. and Shackleton, M. (eds.) (1981) *Perspectives on World Politics.* London: Croom Helm.
- Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post☐Cold War Era.* Columbia University Press.
- Wenger, A. and Zimmermann, D. (eds.) (2003) *International Relations: From the Cold World War to the Globalized World.* London: Lynne Rienner.
- William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co.

Discipline Specific Elective Paper I

ADMINISTRATION AND PUBLIC POLICY: CONCEPTS AND THEORIES

Topics:

Unit-I   Public administration: Meaning, scope and significance of the subject, Public and Private Administration, Major Approaches, (16 lectures)

Unit-II Administrative Theories: The Classical Theory, Scientific Management, the Human - Relation theory, and Rational Decision-Making. (16 lectures)

Unit-III Understanding public policy: (i) concept and theories, relevance.

Unit-IV Policy formulation, implementation and evaluation. (14 lectures)
    Development Administration, New Public Management.

Readings:
Text Books
Topic 1. Public administration as a discipline
- Awasthi, A. and Maheshwari, S. (2003) *Public Administration.* Agra: Laxmi Narain Agarwal, pp. 3☐12.
- Basu, Rumki, (2014) Public Administration, Concepts and Theories, Delhi Sterling Publishers
- Henry, N. (2003) Public Administration and Public Affairs. New Delhi: Prentice Hall, pp. 1☐52.

Topic 2. Administrative theories

- Bhattacharya, M. and Chakrabarty, B. (2005) (eds.) Public *Administration: A Reader*. Delhi: Oxford University Press.

- *Frontiers in Organization & Management.* New York: Praeger.
- Henry, N. (2003) Public Administration and Public Affairs. New Delhi: Prentice Hall, pp. 53□74.
- Benson, J. K. (ed.) (1977) *Organizational Analysis: Critique and Innovation*. Beverly Hills: Sage.
- Bhattacharya, M. and Chakrabarty, B. (eds.) (2005) Public *Administration: A Reader*. Delhi: Oxford University Press, pp. 88□100.

Topic 3. Development administration
- Bhattacharya, M. (2001) *New Horizons in Public Administration*. New Delhi: Jawahar.

Topic 4. Understanding public policy

- Dror, Y. (1983) *Public Policy Making Re-examined.* Oxford: Transaction Publication.
- Dye, T.R. (1975) *Understanding Public Policy.* New Jersey: Prentice Hall.

<u>**Reference Books:**</u>

- Bernard, C. (1938) *The Functions of Executive.* Cambridge: Harvard University Press.
- Gant, G.F. (1979) *Development Administration: Concepts, Goals, Methods*. Madison: University of Wisconsin Press.
- Mooney, J. (1954) *The Principles of Organization*. New York: Harper & Row.
- Siffin, W. (eds.), *Approaches to Development Politics* . New York: McGraw□Hill.
- Simon, H. (1967) *Administrative Behavior: A Study of Decision Making Process in Administrative Organization.* New York: Macmillan.
- Wiedner, E. (ed.) (1970) *Development Administration in Asia.* Durham: Duke University Press.

<div align="center">

Discipline Specific Elective Paper II

DEMOCRACY AND GOVERNANCE

</div>

Course Objective: This Paper tries to explain the institutional aspects of democracy and how institutions function within a constitutional framework. It further delves into how democracy as a model of governance can be complimented by institution building.

Unit-I
Structure and Process of Governance: Parliament, Party Politics and Electoral behaviour, Federalism, The Supreme Court and Judicial Activism, Units of Local Governance (Grassroots Democracy)

Unit-II
Ideas, Interests and Institutions in Public Policy:
a. Contextual Orientation of Policy Design
b. Institutions of Policy Making

Unit-III
Regulatory Institutions –

(i) SEBI, TRAI, Competition Commission Of India
(ii)Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.

Unit-IV
Dynamics of Civil Society: New Social Movements and Various interests, Role of NGO's, Understanding the political significance of Media and Popular Culture.

Text Books
- Agarwal B, Environmental Management, Equity and Eco-feminism: Debating India's Experience, Journal of Pesant Studies, Vol. 25, No. 4, pp. 55□95.
- Atul Kohli (ed.), (2001)The Success of India's Democracy, Cambridge University Press,
- Corbridge, Stuart and John Harris, (2000) Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy OUP.
- Basu Rumki et, al(ed) (2010)Democracy and good governance: Reinventing the Public service Delivery System in India, New Delhi, Bloomsbury India, 2015
- Baxi, Upendra and Bhikhu Parekh, (ed.) (1994)Crisis and Change in Contemporary India, New Delhi, Sage.
- Bidyut Chakrabarty, (2003) Public Administration: A Reader, Oxford University Press, New Delhi.
- Kothari, Rajini,(1970) Politics in India, Delhi, Orient Longma,.
- Mackie. Gerry, (2003) Democracy Defended, New York, Cambridge University Press,.
- Mahajan, Gurpreet (ed.) (2000) Democracy, Difference and Social Justice, New Delhi, Oxford University Press.
- Menon, Nivedita, (ed.) (2001) Gender and Politics in India, New Delhi, Oxford University Press.
- Mohanty, Manoranjan (1998) Peoples Rights: Social Movements and the State in the Third World, Sage, New Delhi,.
- Brass. Paul, (1990) Politics in India since Independence, Hyderabad, Orient Longman.

Reference Books
- Fuller, C.J. (ed.) (1997)Caste Today, Oxford University Press
- Jenkins. Rob, (2004) Regional Reflections: Comparative Politics Across India's States, New Delhi, OUP,.
- Joseph E. Stiglitz,(2003) Globalisation and its Discontents, WW Norton Press.
- Pankaj Sharma, (2004) E□Governance: The New Age Governance, APH Publishers
- S. Laurel Weldon, (2011) When Protest Makes Policy: How Social Movements Represent Disadvantaged Groups, Michigan Publishers.
- Shah. Ghanshyam, [ed.], (2002) Social Movements and The State, Sage Publication,
- Smitu Kothari, (1993) Social Movements and the Redefinition of Democracy, Boulder, Westview.
- Su H. Lee,(2010) Debating New Social Movements: Culture, Identity, and Social Fragmentation , Rawat Publishers, New Delhi
- Sury, M.M, (2003) India: A Decade of Economic Reforms: 1991 –2001, New Delhi, New Century Publication.
- Thomas R. Dye, (1984) Understating Public Policy, Prentice Hall NJ.
- Vasu Deva, E□Governance In India : A Reality, Commonwealth Publishers,2005
- Y. Dror, Public Policy Making Re-examined, Leonard Hill Books, Bedfordshire, 1974.

1) READING GANDHI

Course objective: Locating Gandhi in a global frame, the course seeks to elaborate Gandhian thought and examine its practical implications. It will introduce students to key instances of Gandhi's continuing influence right up to the contemporary period and enable them to critically evaluate his legacy.

Unit-I- Theories: Satyagraha, Ahimsa

Unit-II- Swaraj, Swadeshi

Unit-III- Relevance Gandhi: Gandhi & Environment, Gandhi & Women, Gandhi and Social Harmony

Unit-IV- Gandhi and Global Peace: Gandhian Philosophy in Contemporary World

Text Books

- A. Parel (ed) (2000) Gandhi*, Freedom and Self-Rule*, New Delhi: Lexington Books.
- A. Parel (ed.) (1997) *Gandhi, Hind Swaraj and Other Writings* Cambridge: Cambridge University Press.
- B. Parekh, (1999) *Colonialism, Tradition and Reform: An Analysis of Gandhi's Political Discourse*, New Delhi: Sage Publication.
- Brown. J, and A Parel (eds) (2011) *Cambridge Companion to Gandhi*, Cambridge University Press.
- D. Dalton, (2000) A. Parel (ed) *Gandhi, Freedom and Self-Rule*, New Delhi: Lexington Books.
- H. Coward (ed) (2003) *Indian Critiques of Gandhi,* New York: State University of New York Press.
- R. Iyer, (2001) *The Moral and Political Thought of Mahatma Gandhi*, New Delhi: Oxford University Press. pp. 344-358.
- R. Mukharjee, (ed) (1995), *The Penguin Gandhi Reader*, New Delhi: Penguin.

Reference Books

- B Parekh, (1997) *Gandhi: A Brief Insight,* Delhi: Sterling Publishing Company.
- Brown, J. (2008) *Gandhi and Civil Disobedience: The Mahatma in Indian Politics*, Cambridge: Cambridge University Press.
- Chatterjee. P, (1986) *Nationalist Thought and the Colonial World: A derivative discourse?* Delhi: Zed Books.
- D. Dalton, (1996) *Mahatma Gandhi: Selected Political Writings*, USA: Hackett Publishing.
- D. Hardiman, (1981) *Peasant Nationalists of Gujarat: Kheda District, 1917-1934*, Delhi: Oxford University Press.
- D. Hardiman, (2003) *Gandhi in his Time and Ours*. Delhi: Oxford University Press.
- Dirks, (2001), '*Castes of Mind: Colonialism and the making of Modern India*, Princeton: Princeton University Press.
- Gandhi, (1941) 'Chapter 1, 2, 9, 15, and 16', in *Constructive Programme: Its Meaning and Place*, Ahmedabad: Navjivan Trust.

- R Iyer, (ed) (1993) *The Essential Writings of Mahatma Gandhi*, New Delhi: Oxford University Press.
- R. Ramashray, (1984) *Self and Society: A Study in Gandhian Thought*, New Delhi: Sage Publication.
- S. Sarkar, (1982) *Modern India 1885-1947*, New Delhi: Macmillan.
- Taneja, (2005) Gandhi Women and the National Movement 1920-1947, New Delhi: Haranand Publishers.
- Terchek, (1998) *Gandhi: Struggling for Autonomy*, USA: Rowman and Littlefield Publishers.
- Weber, (2006) 'Gandhi is dead, Long live Gandhi- The Post Gandhi Gandhian Movement in India', in *Gandhi, Gandhism and the Gandhians*, New Delhi: Roli.

Generic Elective

2) HUMAN RIGHTS GENDER AND ENVIRONMENT

Course Objective: This course aims at enabling the students to understand the issues concerning the rights of citizens in general and the marginalized groups in particular, and assess the institutional and policy measures which have been taken in response to the demands of various movements. Conceptual dimensions, international trends and the Indian experience form the contents of the course.

Expected Learning Outcome: The study of the course will equip the students with theoretical and conceptual understanding of socio – economic and political problems of marginalized groups in society such as women, dalits, minorities and adivasis and repercussions of contemporary developments on globalization on them.

Unit-I Understanding Social Inequality

   i.   Caste, Gender, Ethnicity and Class as distinct categories and their interconnection.
   ii.   Globalisation and its impact on workers, peasants, dalits, adivasis and women.

Unit-II Human Rights
   i.   Human Rights: Various Meanings
   ii.   UN Declarations and Covenants
   iii.   Human Rights and Citizenship Rights
   iv.   Human Rights and the Indian Constitution
   v. Human Rights, Laws and Institutions in India; the role of the National Human Rights Commission.
   vi. Human Rights of Marginalized Groups: Dalits, Adivasis, Women, Minorities and Unorganized Workers.
   vii. Consumer Rights: The Consumer Protection Act and Grievance Redressal mechanisms.
   viii.   Human Rights Movement in India.

Unit-III Gender
   i.   Analysing Structures of Patriarchy
   ii.   Gender, Culture and History

iii.   Economic Development and Women
iv.   The issue of Women's Political Participation and Representation in India
v.   Laws, Institutions and Women's Rights in India
vi.   Women's Movements in India

Unit-IV Environment
i.   Environmental and Sustainable Development
ii.   UN Environment Programme: Rio, Johannesburg and after.
iii.   Issues of Industrial Pollution, Global Warming and threats to Bio – diversity
iv.   Environment Policy in India
v.   Environmental Movement in India

Text Books

- Agarwal, Anil and Sunita Narain (1991), *Global Warming and Unequal World: A Case of Environmental Colonialism*, Centre for Science and Environment, Delhi.
- Baxi, Upendra (2002), *The Future of Human Rights*, Oxford University Press, Delhi.
- Beteille, Andre (2003), *Antinomies of Society: Essays on Ideology and Institutions*, Oxford University Press, Delhi.
- Geetha, V. (2002) *Gender*, Stree Publications, Kolkata.
- Ghanshyam Shah, (1991) *Social Movements in India*, Sage Publications, Delhi.
- Gonsalves, Colin (2011) Kaliyug: The decline of human rights law in the period of globalization Human Rights Law Network, New Delhi.
- Guha, Ramachandra and Madhav Gadgil, (1993) *Environmental History of India*, University of California Press, Berkeley.
- Haragopal, G. (1997) *The Political Economy of Human Rights*, Himachal Publishing House, Mumbai.
- Menon, Nivedita (ed) (2000) *Gender and Politics in India*, Oxford University Press, Delhi.
- Patel, Sujata et al (eds) (2003) *Gender and Caste: Issues in Contemporary Indian Feminism*, Kali for Women, Delhi.
- Sen, Amartya, (1999) Development as Freedom New Delhi, OUP.
- Shah, Nandita and Nandita Gandhi (1992) *Issues at Stake: Theory and Practice in the Contemporary Women's Movement in India*, Kali for Women, Delhi.

Optional for SECC II paper

Total Marks- 100

Skill Enhancement Courses (SECC Option-I)

LEGISLATIVE PRACTICES AND PROCEDURES

Introduction : To acquaint the student broadly with the legislative process in India at various levels, introduce them to the requirements of peoples' representatives and provide elementary skills to be part of a legislative support team and expose them to real life legislative work. These will be, to understand complex policy issues, draft new legislation, track and analyze ongoing bills, make speeches and floor statements, write articles and press releases, attend legislative meetings, conduct meetings with various stakeholders, monitor media and public developments, manage constituent relations and handle inter-office communications. It will also deepen their understanding and appreciation of the political process and indicate the possibilities of making it work for democracy.

Unit-I

Powers and Functions of People's Representatives at different tiers of Governance

 i) Members of Parliament, State Legislative Assemblies
 ii) Representatives of Rural & Urban local self-government from Zilla Parishad, Municipal Corporation to Panchayat/ Ward

Unit-II :Supporting the Legislative Process and the Legislative Committees

  i) Legislative Procedure: How a Bill becomes law, Role of the Standing Committee in reviewing a Bill
  ii) Types of Committees; Role of Committees in reviewing Government Finances, policy, programmes and legislation

Unit-III : Reading the Budget Document

  i) Overview of the Budget Process, Role of Parliament in Parliament in reviewing the Union Budget
  ii) Railway Budget, Examination of Demands for Grants of Ministries, Working of Ministries

Unit –IV : Support in Media monitoring and Communication

  i) Types of Media and their significance for Legislators
  ii) Basics of Communication in Print and Electronic Media

Text Books

1. D. Kapur and P. Mehta, (2006) 'The Indian Parliament as an Institution of Accountability', *Democracy, Governance and Human Rights,* Programme Paper Number 23, United Nations Research Institute for Social Development.
2. Government of India, (Ministry of Parliamentary Affairs) (2009), *Subordinate Legislation,*
3. Government of India, (Ministry of Parliamentary Affairs), (2009) *Legislation, Parliamentary Procedure.*
4. P. Mehta, 'India's Unlikely Democracy: The Rise of Judicial Sovereignty', *Journal of Democracy,* Vol. 18(2), pp.70-83.
5. Sanyal, (2011) *Strengthening Parliamentary Committees* PRS, Centre for Policy Research, New Delhi.

Reference Books

6. DelCelestine, (2011) *How to Read the Union Budget* PRS, Centre for Policy Research, New Delhi.
7. B. Jalan, (2007) *India's Politics,* New Delhi: Penguin.
8. G. Rose, (2005) **'**How to Be a Media Darling: There's No getting Away From It', *State Legislatures*, Vol. 31(3).
9. N. Jayal and P. Mehta (eds), (2010)*The Oxford Companion to Politics in India,* Oxford University Press: New Delhi,
10. R. Guha, (2007), *India After Gandhi*, Macmillan: New Delhi.

Skill Enhancement Courses (SECC Option-II)

PEACE AND CONFLICT RESOLUTION

Introduction: The objective of an undergraduate application course for common students in Peace and Conflict Studies will cover in-depth knowledge of conflict analysis, conflict resolution, conflict prevention, as well as the historical and cultural context of organized violence, Peace and Conflict Resolution addresses the sources of war, social oppression and valence and the challenges of promoting peace and justice internationally and domestically. It also introduces more equitable, cooperative and non-violent methods that can be used to transform unjust, violent or oppressive world situations. This course provides students with an overview of the Peace and Conflict Studies discipline, including key concepts and related theories. The course is designed to familarise students with the historical background of various peace movements, to analyse principles used to resolve conflict and to provide a view of how peace and conflict resolution are being pursued today. The course will also cover extensive understanding of current research and development within the field of peace and conflict studies and perspective of the environment, gender, migration and ethnicity.

Unit-I International Peace and Conflict Resolution: Sources of War

i) Sources of War: International and Domestic Issues and Trends

ii) What is Conflict: Introduction to International Conflict Resolution

Unit-II International Conflict Resolution Theories:

i) Models developed by Johan Galtung, Joseph Montville,

ii) Models developed by Morton Deutsch, William Zartman, Levy Jack.

Unit-III Conflict Resolution

i) Background of various Peace Movement and Concepts,

ii) Principles used to resolve conflict**.**

Unit-IV Cross-border Relationship

i) Migration, International rules and regulations, normative concept and political decisions.

ii) Current perspective of peace and conflict resolution.

Text Books

1. Bidwai, Praful and Achin Vanaik (eds.)(1999), South Asia on a short fuse: Nuclear politics and the future of global disarmament, New Delhi: OUP.

2. Carr, Edward H.,(1994) "Realism and Idealism," Richard Betts (ed), Conflict After the Cold War, Boston: Simon & Schuster.

3. Deutsch, Morton,(1973) The Resolution of Conflict: Constructive and Destructive Processes, New Haven, Yale University Press.

4. Ghosh, Partha S.(1989), Cooperation and conflict in South Asia, New Delhi: Manohar.

Reference Books

5. Kriesberg, Louis (1998), Constructive Conflicts: From Escalation to Resolution, Rowman & Littlefield, Maryland. Banerjee, A.K. (ed.)(1998), Security issues in South Asia: Domestic and external sources of threats to security, Calcutta: Minerva.

6. Levy, Jack, (1995)"Contending Theories of International Conflict: A Levels-of-Analysis Approach" in Crocker et al, Managing Global Chaos, USIP.

7. Starkey, Boyer, and Wilkenfield, (1999) Negotiating a Complex World. Rowman & Littlefield, Maryland.

8. Waltz, Kenneth N., (1994)"Structural Causes and Economic Effects," Richard Betts (ed), Conflict After the Cold War, Boston: Simon & Schuster.

<u>**Training Component of the UG Syllabus in Political Science**</u>

The present Syllabus in Political Science requires special training for the teachers of undergraduate teaching. The training modules will update their knowledge and help them to deliver quality inputs to the students.

Themes on which inputs for teachers are to be developed:

I. <u>**Understanding Political Theory**</u>
- Theorizing the Political
- Theories of Feminism
- Modernism and Post Modernism

II. <u>**Constitutional Government and Democracy in India**</u>
- Recent trends in Federalism

III. <u>**Political Theory-Concepts and Debates**</u>
- Egalitarianism: Special Exclusion and Affirmative Action
- Procedural, Distributive and Global Justice
- Cultural Relativism and Multiculturalism

IV. <u>**Political Process in India**</u>
- Recent trends in Indian Party System
- Role of Caste, Class, Gender and Religion in Voting Behaviour
- Electoral Reforms-Recent Debates
- Secularism and Communalism Debates
- Politicisation of Caste

V. <u>**Introduction to Comparative Governments and Politics**</u>
- Going beyond Euro-centrism
- Capitalism: Meaning and development
- Globalization: features and impact
- Rise and decline of Communism as a ruling Ideology
- Decolonization meaning and context

VI. <u>**Introduction to Public Administration**</u>
- Public Policy
- New public Administration
- New Public Management
- New Public Service Approach
- Good governance
- Feminist perspective

VII. <u>**Perspective on International Relations**</u>

- Development of International Relations; Emergence of International State System
- Nationalization and Power
- National Interest-Key Development of International Relations
- Power, Conservations of International Relations
- Classical Realism and Neo-realism, Liberalism and Neo- liberalism, Marxist Approach, Feminist Perspective , Euro-centricism and Perspective from Global South
- World War-I causes and consequences, Significance of Bolshevik Revolution
- Rise of Fascism and Nazism, World War-II cause and consequences
- Cold war evolution and different phrases, Disintegration of USSR
- Emergence of Third World War and End of Cold War

VII. Political Processes and Institutions in Comparative Perspective
- New Institutionalism: meaning, background, significance
- Nation-State-meaning and Evolution in West Europe
- Nation and State Debates in Post colonial context
- Democratization in Post-Authoritarian Countries
- Democratization in Post-Communist Countries
- Federalism: meaning, evolution and features

IX. Public Policy and Administration in India
- Public Policy Process in India
- Concept and Significance of Budget, Budget cycle in India
- Various Approaches and Types of Budgeting
- Public Service Delivery System
- Redressal of Public Grievances: RTI, Lokpal, Citizens' Charter and e-Governance

X. Global Politics
- Proliferation of Nuclear Weapons
- International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments
- Political Debates on Sovereignty and Territoriality
- Cultural and Technological Dimension
- Global Resistances (Global Social Movements and NGOs)
- Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change
- Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs
- Understanding Globalization and its Alternative Perspectives
- Migration & Human Security
- Global Shifts: Power and Governance

XI. Western Political Philosophy
- Hegel
- Marx

XII. Indian Political Philosophy
- Brahmanic and Shramanic
- Islamic and Syncretic

- Abul Fazal-Monarchy
- Kabir: Syncretism

XIII. Contemporary Political philosophy
- Antonio Gramsci
- John Rawls

XIV. Modern Indian Political Thought
- Pandita Ramabai: Gender, Critique of Orthodoxy
- Tagore Critique of Nationalism
- Savarkar: Hindutwa-A Critical Assessment
- Lohia: Socialism,
- J.P.Narayan: Total Revolution

Generic Elective (Interdisciplinary): 4

1. Feminism: Theory and Practice
- Feminist theorizing of the sex/gender distinction; Public Man and Private Woman
- Radical feminism and Eco-feminism
- Women's participation in anti-colonial and national liberation movements with special focus on India
- Traditional Historiography and Feminist critiques; Social Reforms Movement and position of women in India, History of Women's struggle in Post- Independent India
- Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights
- Understanding Woman's Work and Labour – Sexual Division of Labour, Productive and Reproductive labour, Visible - invisible work – Unpaid (reproductive and care), Underpaid and Paid work,- Methods of computing women's work , Female headed households

II. Gandhi and The Contemporary World
- Relevance Gandhi: Gandhi and Environment, Gandhi and Women, Gandhi and Social Harmony
- Gandhi and Global Peace: Gandhian Philosophy in Contemporary World

III. Governance: Issues and Challenges
- Role of State in the Era of Globalization: State, Market and Civil Society
- Good Governance
- Sustainable Development and Governance
- People' Participation in Local Governance and Deepening Democracy
- Public Service Guarantee Acts and Electronic Governance
- Citizens Charter and Right to Information, Corporate Social Responsibility

DISCIPLINE SPECIFIC ELECTIVE -4 (DSE)

I. Human Rights in a Comparative Perspective
- Rights in National Constitutions: South Africa

- International Refugee Law, International Humanitarian Law

II. **Development Process and Social Movements in Contemporary India**
- Welfare State, Development and the role of Planning Commission
- Development in the era of Liberalization and Reforms
- Industrial Development and its impact on organized and unorganized labour
- Agricultural Development and Agrarian Crisis, Land Reforms and Green Revolution,
- Social Movements: Meaning and Approaches, New Social Movements
- Women's Movement, Environmental Movements
- Dalit Movement, Tribal Movement,
- Leftwing Extremism: Issues and Challenges

III. **India's Foreign Policy in a Changing World**
- India's Foreign Policy: Postcolonial Perspective
- India and South Asia: SAARC, Look East Policy, Act East Policy
- India as an emerging Global Power, Myth and Reality
- India in the Contemporary World

IV. **Women, Power and Politics**
- Gender, Power and Politics
- WID (Women in Development), WAD (Women and Development), GAD (Gender and Development
- Women and Work (Visible and Invisible)

Ability Enhancement (Skill Based)-2

1. **Legislative Practices and Procedures**
- Types of Media and their significance for Legislators
- Basics of Communication in Print and Electronic Media

2. **Peace and Conflict Resolution**
- What is Conflict: Introduction to International Conflict Resolution
- Models developed by Johan Galtung, Joseph Montville,
- Models developed by Morton Deutsch, William Zartman, Levy Jack.
- Background of various Peace Movement and Concepts,
- Principles used to resolve conflict.
- Migration, International rules and regulations, normative concept and political decisions.
- Current perspective of peace and conflict resolution.

Training Component of the UG Syllabus in Political Science (Pass)

The present Syllabus in Political Science requires special training for the teachers of undergraduate teaching. The training modules will update their knowledge and help them to deliver quality inputs to the students.

Themes on which inputs for teachers are to be developed:

I- <u>Introduction to Political Theory</u>

- Definition and Approaches: Normative, Historical, Behavioural and Post Behavioural, Relevance
- Debates in Political Theory: Protective discrimination and Equality.

II- <u>COMPARATIVE GOVERNMENT AND POLITICS</u>

- Comparing Regimes: Authoritarian and Democratic

IV- <u>INTRODUCTION TO INTERNATIONAL RELATIONS</u>

- Approaches to International Relations**:** Classical Realism, Liberalism and Neo-Liberalism Feminist Perspective
- Cold War and Post-Cold: Phases, Post Cold- War Era and Emerging Centres of Power European Union, China, Russia and Japan

SKILL ENHACEMENT COMPUYSLORY COURSE-II

QUANTITATIVE AND LOGICAL THINKING

(SPECIAL COURSE)

ODISHA STATE HIGHER EDUCATION COUNCIL

BHUBANESWAR

STATE MODEL SYLLABUS FOR UNDER GRADUATE
COURSE IN SKILL ENHANCEMENT
COURSE (II)
(Bachelor of Arts/Sc/Com Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

FOREWARD

The Higher Education system has undergone a paradigm shift in Odisha with the introduction of Choice Based Credit System (CBCS) in the academic year 2015-16 as per the University Grant Commission regulations. Initially it was adopted in all Autonomous colleges and from 2016-17, in all the colleges of Odisha. CBCS offers students the liberty to choose from list of available courses under the domains of Ability Enhancement, Skill Enhancement and General Elective. This book on Quantitative and Logical Thinking aims to engage the students more creatively to improve their critical thinking skills. This paper will be taught under Skill Enhancement Compulsory Course (SECC).

The main intent of this paper is to strengthen the quantitative & logical thinking of Under Graduate students, majority of who are set to enter the job market with high hopes. Needless to say, a good command over Quantitative Aptitude and Logical Thinking is one skill which various companies expect from their prospective employees. The course content is developed with the help of faculties from Ravenshaw University, Rama Devi University and other experienced Mathematics faculties keeping in mind the diverse background of students of Odisha. We would like to acknowledge their vital contribution and members of the World Bank project in Higher Education for the development of this book. We hope the students find merit in using this book not just as a course study material but as a life time companion in improving his / her critical thinking skills. Any suggestions for improving the content are most welcome. The same can be emailed to oshec.hed@gmail.com

Vice Chairperson

Bhubaneswar   OSHEC

Table of Contents

QUANTITATIVE AND LOGICAL THINKING (SPECIAL COURSE)

I.   QUANTITATIVE APTITUDE & DATA INTERPRETATION

Unit – 1: Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots and Cube roots, Surds and Indices, Problems on Numbers, Divisibility

<u>**Definitions:**</u>

- <u>Whole numbers</u>:

All positive numbers including 0 are called whole numbers.

> For Example - 0, 1, 2, 3 ...

- <u>Prime numbers</u>:

A number that is divisible only by itself and 1 is called a prime number.

> For Example – 2, 3, 5, 7, …..
> > ❖ Prime numbers are whole numbers.
> > ❖ The smallest prime number is 2.

- <u>Co-prime / Relatively prime/ Mutually prime</u>:

Two numbers *a* and *b* (not both necessarily prime) are said to be co-prime, relatively prime or mutually prime if the only positive integer that divides both of them is 1.

> For Example- 15 and 22 are co-prime because the only common divisor is 1.

- <u>Integers:</u>

All the positive and negative numbers including 0 are called integers.

> For Example- -3, -2, -1, 0, 1, 2, 3 ...

- <u>Rational numbers</u>:

The set of numbers which can be written in the form of (p/q) are called rational numbers .

> For Example -   115/4, 0, 26/5 , -22/9...

- <u>Irrational numbers:</u>

The set of numbers which cannot be written in the form of (p/q) are called irrational numbers.

For Example - π, $\sqrt{2}$, $\sqrt[3]{3}$...

- Real numbers:

Real numbers contains the set of Whole numbers, integers, rational and irrational number.

For Example: 1, -2, 0, π, $\sqrt{2}$....

Basic formulae

1. $(a+b)^2 = a^2 + b^2 + 2ab$
2. $(a-b)^2 = a^2 + b^2 - 2ab$
3. $(a+b)^2 - (a-b)^2 = 4ab$
4. $(a+b)^2 + (a-b)^2 = 2(a^2+b^2)$
5. $(a^2-b^2) = (a+b)(a-b)$
6. $(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab+bc+ca)$
7. $(a^3+b^3) = (a+b)(a^2-ab+b^2)$
8. $(a^3-b^3) = (a-b)(a^2+ab+b^2)$
9. $(a^3+b^3+c^3-3abc) = (a+b+c)(a^2+b^2+c^2-ab-bc-ca)$

Solved examples:

1. If one-third of one-fourth of a number is 15, then three-tenth of that number is:

   Solution:

   Let the number be x.

   Then, $\dfrac{1}{3}$ of $\dfrac{1}{4}$ of $x = 15$ ▬ $x = 15 \times 12 = 180$.

   So, required number = $\left| \dfrac{3}{10} \times 180 \right| = 54$.

2. The sum of two numbers is 25 and their difference is 13. Find their product.

   Solution:
   Let the numbers be x and y.
   Then, $x + y = 25$ and $x - y = 13$.
   $4xy = (x + y)^2 - (x - y)^2$

$= (25)^2 - (13)^2$

$= (625 - 169)$

$= 456$

$\blacksquare$ $xy = 114$.

3. The difference between a two-digit number and the number obtained by interchanging the positions of its digits is 36. What is the difference between the two digits of that number?

Solution:

Let the ten's digit be x and unit's digit be y.
Then, $(10x + y) - (10y + x) = 36$
   $\Rightarrow$ $9(x - y) = 36$
   $\Rightarrow$ $x - y = 4$.

4. The difference between a two-digit number and the number obtained by interchanging the its is 36. What are the digits of the number if the ratio between the digits of the number is 1 : 2 ?

Solution:

Since the number is greater than the number obtained on reversing the digits, so the ten's digit is greater than the unit's digit.

Let ten's and unit's digits be $2x$ and x respectively.
Then, $([10 \times 2x] + x) - (10x + 2x) = 36$
   $\Rightarrow$ $9x = 36$
   $\Rightarrow$ $x = 4$.
   $\blacksquare$ One digit is 4 and the other digit is $2 \times 4 = 8$

5. The product of two numbers is 18 and the sum of their squares is 45. The sum of the numbers is:

Solution:

Let the numbers be x and y.
Then, $xy = 18$ and $x^2 + y^2 = 45$.
$\blacksquare$ $(x + y)^2 = x^2 + y^2 + 2xy = 45 + (2 \times 18) = 81$
$\blacksquare$ $x + y = \sqrt{81} = 9$.

Divisibility rules

Divisibility by 2:

A number is divisible by 2 if the last digit is even. i.e., if the last digit is 0 or 2 or 4 or 6 or 8.
Ex: 454 is divisible by 2 , 455 is not divisible by 2.

Divisibility by 3:

A number is divisible by 3 if the sum of the digits is divisible by 3.
Ex: 459 is divisible by 3 as the sum of the digits, 4+5+9=18 is divisible by 3.

Divisibility by 4:

A number is divisible by 4 if the number formed by the last two digits is divisible by 4.
Ex: 324 is divisible by 4 as 24 is divisible by 4.

Divisibility by 5:

A number is divisible by 5 if the last digit is either 0 or 5.
Ex: 555 is divisible by 5

Divisibility by 6:

A number is divisible by 6 if it is divisible by both 2 and 3.
Ex: 528 is divisible by 6 as 528 is divisible by both 2 & 3.

Divisibility by 8:

A number is divisible by 8 if the number formed by the last three digits is divisible by 8.
Ex: 8168 is divisible by 8 as 168 is divisible by 8.

Divisibility by 9:

A number is divisible by 9 if the sum of the digits is divisible by 9.
Ex: 981 is divisible by 9 as the number formed by the sum of the digits i.e. 18(9+8+1=18) is divisible by 9.

Divisibility by 10:

A number is divisible by 10 if the last digit is 0.
Ex: 100 is divisible by 10.

Divisibility by 11:

To find out if a number is divisible by 11, find the sum of the odd numbered digits and the sum of the even numbered digits.

Now subtract the lower number obtained from the bigger number obtained.

If the number we get is 0 or divisible by 11, the original number is also divisible by 11.

Ex: 121 is divisible by 11. (Sum of the digits in the even place is 2 & sum of the digits in the odd places is 1+1=2.Now 2-2 =0 is divisible by 11.)

Solved examples:

1. Find the least value of * for which the number 8550*1 is divisible by 3.

   Solution:

   Let the required number be a.
   Now 8+5+5+0+a+1 = 19+a

   Hence the least number is 2.

2. Find the least value of * for which the number 13*1 is divisible by 11.

   Solution:

   Let the required number be x.
   Now sum of digits at odd places –sum of digits at even places
   $$= (1+3)-(1+x)$$
   $$= (3-x), \text{ should be divisible by 11.}$$
   Hence the least value of x is 3.

3. Is 7248 divisible (i) by 4, (ii) by 2 and (iii) by 8?

   Solution:

   (i) The number 7248 has 48 on its extreme right side which is exactly divisible by 4. When we divide 48 by 4 we get 12.

Therefore, 7248 is divisible by 4.

(ii) The number 7248 has 8 on its unit place which is an even number so, 7248 is divisible by 2.

(iii) 7248 is divisible by 8 as 7248 has 248 at its hundred place, tens place and unit place which is exactly divisible by 8.

4. A number is divisible by 4 and 12. Is it necessary that it will be divisible by 48? Give an example in support of you answer.

Solution:

$48 = 4 \times 12$ but 4 and 12 are not co-prime.

Therefore, it is not necessary that the number will be divisible by 48.

Let us consider the number 72 for an example

$72 \div 4 = 18$, so 72 is divisible by 4.

$72 \div 12 = 6$, so 72 is divisible by 12.

But 72 is not divisible by 48.

5. Without actual division, find if 235932 is divisible (i) by 4 and (ii) 8.

Solution:

(i)The number formed by the last two digits on the extreme right side of 235932 is 32

$32 \div 4 = 8$, i.e. 32 is divisible by 4.

Therefore, 235932 is divisible by 4.

(ii) The number formed by the last three digits on the extreme right side of 235932 is 932

But 932 is not divisible by 8. Therefore, 235932 is not divisible by 8.

Square roots

Steps of Long Division Method for Finding Square Roots:

Step I: Group the digits in pairs, starting with the digit in the units place.

Step II: Think of the largest number whose square is equal to or just less than the first group. Take this number as the divisor and also as the quotient.

Step III: Subtract the product of the divisor and the quotient from the first group and bring down the next group to the right of the remainder. This becomes the new dividend.

Step IV: Now, the new divisor is obtained by taking two times the quotient and annexing with it a suitable digit which is also taken as the next digit of the quotient, chosen in such a way that the product of the new divisor and this digit is equal to or just less than the new dividend.

Step V: Repeat steps (2), (3) and (4) till all the groups have been taken up. Now, the quotient so obtained is the required square root of the given number.

Solved examples:

1. Find out √16384.

   Solution:

   Marking group and using the long-division method,

Therefore, √16384 = 128.

2. Find out √66049.

   Solution:

   Marking group and using the long-division method,

   Therefore, √66049 = 257

Surds & Indices

Definitions:

- Index

  An **index** (plural: **indices**) is the power, or exponent, of a number. E.g a^5 has an **index** of 5.

- Surd

  A **surd** is an irrational number that can be expressed with roots.

  E.g. Let *a* be rational number and *n* be a positive integer such that $(a)^{(1/n)} = \sqrt[n]{a}$, Then a is called a surd of order n.

Laws of Indices:

1. $a^m \times a^n = a^{m+n}$
2. $(a^m)^n = a^{mn}$
3. $(ab)^n = a^n b^n$

4. $\dfrac{a^m}{a^n} = a^{m-n}$

5. $a^0 = 1$

6. $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$

7. $a^{-n} = \dfrac{1}{a^n}$

Laws of Surds:

1. $\sqrt[n]{a} = a^{(1/n)}$

2. ▮

3. $\sqrt[n]{\dfrac{a}{b}} = \left(\dfrac{a}{b}\right)^{\frac{1}{n}}$

Solved examples:

1. Divide 12 by $3\sqrt{2}$.

   Solution:

   $\dfrac{12}{3\sqrt{2}} = \dfrac{4}{\sqrt{2}} = \dfrac{4\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}} = 2\sqrt{2}$.

2. Simplify $(125)^{-2/3}$.

   Solution:

   $(125)^{-2/3} \quad = (5\times5\times5)^{-2/3} = (5)^{3\times\frac{-2}{3}}$

   $\qquad\qquad\quad = 5^{-2} = \dfrac{1}{5^2}$

   $\qquad\qquad\quad = \dfrac{1}{25}$

3. $15^4 \times 15^x = 15^6$ Find the value of x.

   Solution:
   $15^4 \times 15^x = 15^6$

$\Rightarrow$ $15^x = \dfrac{15^6}{15^4}$

$\Rightarrow$ $15^x = 15^2$

$\Rightarrow$ $x = 2$

4. If $2^a = 64$, then find the value of 2^{a-3}.

   Solution:

   We have $2^a = 64$ (Since the LHS contains a power of 2 so the RHS must be expressed in terms of some power of 2)

   $\Rightarrow$ $2^a = 2^6$

   $\Rightarrow$ $a = 6$

   $2^{a-3} = 2^{6-3} = 2^3 = 8$.

Unit -2: Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simple interest, Ratio and Proportion, Mixture

Definitions:

Percentage is a fraction whose denominator is always 100. x percentage is represented by

$$x \% = \frac{x}{100}$$

Example - $25 \% = \frac{25}{100} = \frac{1}{4}$

Formulae:

1. To express $\frac{x}{y}$ as a percentage

   We know that $\frac{x}{y} = \left(\frac{x}{y} \times 100\right) \%$

   E.g.- $\frac{1}{4} = \left(\frac{1}{4} \times 100\right) \% = 25\%$

2. If A is R % more than B , then B is less than A by $\left(\frac{R}{R+100} \times 100\right) \%$.

3. If A is R % less than B , then B is more than A by $\left(\frac{R}{100-R} \times 100\right) \%$.

4. If the price of a commodity increases by R % , then reduction in consumption as not to increase the expenditure is $\left(\frac{R}{R+100} \times 100\right) \%$.

5. If the price of a commodity decreases by R % , then increase in consumption as not to decrease the expenditure is $\left(\frac{R}{100-R} \times 100\right) \%$.

6. Results on Population : Let the population of a town be P now and suppose increases at the rate of R % per annum , then :

   i)   Population after n years $= P\left(1 + \frac{R}{100}\right)^n$.

ii)   Population n years ago $= \dfrac{P}{\left(1+ \frac{R}{100}\right)^{n}}$

7. **Results on Depreciation:** Let the present value of a machine be P . Suppose it depreciates at the rate of R % per annum , then :

i)   Value of machine after n years $= P\left(1 - \frac{R}{100}\right)^{n}$

ii)   Value of machine n years ago $= \dfrac{P}{\left(1- \frac{R}{100}\right)^{n}}$

8. To remember :

$\dfrac{1}{2} = 50\%$ $\qquad\qquad$ $\dfrac{1}{3} = 33\dfrac{1}{3}\%$

$\dfrac{1}{4} = 25\%$ $\qquad\qquad$ $\dfrac{1}{5} = 20\%$

$\dfrac{1}{6} = 16\dfrac{2}{3}\%$ $\qquad\qquad$ $\dfrac{1}{7} = 14\dfrac{2}{7}\%$

$\dfrac{1}{8} = 12\dfrac{1}{2}\%$ $\qquad\qquad$ $\dfrac{1}{9} = 11\dfrac{1}{9}\%$

$\dfrac{1}{10} = 10\%$ $\qquad\qquad$ $\dfrac{1}{11} = 9\dfrac{1}{11}\%$

$\dfrac{1}{12} = 8\dfrac{1}{3}\%$ $\qquad\qquad$ $\dfrac{1}{13} = 7\dfrac{9}{13}\%$

Solved examples:

1. Find 8 % of 625.
   Solution : $\dfrac{8}{100} \times 625 = 50.$

2. Ram's salary is increased from Rs. 24,000 to Rs. 30,000. Find the increased % .

   Solution :
   Increase in salary = Rs.30,000 – Rs.24,000 = Rs. 6000
   % Increase = $\dfrac{6000}{24000} \times 100 = 25\%$.

3. In an election, candidate A got 75% of the total valid votes. If 15% of the total votes were declared invalid and the total numbers of votes is 560000, find the number of valid vote polled in favor of candidate.

   Solution:

   Given that 15% of the total votes were invalid. So we have,

Total number of valid votes = 85 % of 560000

$$= \frac{85}{100} \times 560000$$

$$= \frac{47600000}{100}$$

$$= 476000$$

Percentage of votes polled in favor of candidate A = 75 %

Therefore, the number of valid votes polled in favors of candidate A = 75 % of 476000

$$= \frac{75}{100} \times 476000$$

$$= \frac{35700000}{100}$$

$$= 357000$$

4. Rama had Rs.2100 left after spending 30 % of the money he took for shopping. How much money did he take along with him?

Solution:

Let the money Rama took along with him be 100%.

Given that he spent 30 % of the money for shopping. So money left with him is 70% of the money.

But money left with him = Rs. 2100

Therefore 70%= Rs. 2100

⇨ 100% = Rs 2100× $\frac{100}{70}$

⇨ 100% = Rs 3000

Therefore, the money he took for shopping is Rs 3000.

5. A shopkeeper bought 600 oranges and 400 bananas. He found 15% of oranges and 8% of bananas were rotten. Find the percentage of fruits in good condition.

Solution:

Total number of fruits shopkeeper bought = 600 + 400 = 1000

Given that 15% of oranges and 8% of bananas were rotten. So he had 85% of oranges & 92 % of bananas in good condition.

Number of oranges in good condition = 85% of 600

$$= \frac{85}{100} \times 600$$

$$= 510$$

Number of bananas in good condition= 92 % of 400

$$= \frac{92}{100} \times 400$$

$$= 368$$

Therefore Number of fruits in good condition = 510+ 368 = 878

Therefore Percentage of fruits in good condition = ($\frac{878}{1000} \times 100$)%

$$= 87.8\%$$

PROFIT & LOSS

Definitions:

- Cost Price: The price at which an article is purchased is called its cost price and it is denoted by CP.

- Selling Price: The price at which an article is sold is called its selling price and denoted by SP.

- Profit (P) :If SP is greater than CP, then seller is said to have a profit.

- Loss (L) : If SP is less than CP , then seller is said to have a loss.

- Marked price: MRP of an article is known as marked price or labeled price and denoted by MP.

- Discount : Discount is a percentage of the MP.

  * Profit and loss are always counted on CP.

* Discount is always carried on MP.

Formulae:

1. P $= SP - CP$

2. L $= CP - SP$

3. P % $= \dfrac{P}{CP} \times 100$

4. L % $= \dfrac{L}{CP} \times 100$

5. SP $= \dfrac{100 + P\ \%}{100} \times CP$

6. SP $= \dfrac{100 - L\ \%}{100} \times CP$

7. CP $= \dfrac{100}{100 + P\ \%} \times SP$

8. CP $= \dfrac{100}{100 - L\%} \times SP$

9. Discount (D) $= MP - SP$

10. Discount % $= \dfrac{Discount}{MP} \times 100$

11. SP $= \dfrac{100 - D\ \%}{100} \times MP$

Solved examples:

1. A person purchased an article for Rs. 80 and sold it for Rs.120. Find his % of profit.

   Solution :

   CP of the article $=$ Rs. 80

   SP of the article $=$ Rs. 120

   Profit $= SP - CP$

   $= $ Rs. 120 $-$ Rs. 80 $=$ Rs. 40

   Profit % $= \dfrac{40}{80} \times 100 = 50\ \%$.

2. By selling a fan for Rs 649, Anil earns a profit of 18%. Find its cost price.

Solution:

S.P. of the fan = Rs 649, profit = 18%

Therefore, Rs 649 = $(1 + \frac{18}{100})$ of C.P.

$\Rightarrow$ Rs 649 = $\frac{118}{100}$of C.P.

$\Rightarrow$ C.P. = Rs $(649 \times \frac{100}{118})$ = Rs 550

Hence the cost price of the fan = Rs 550.

3. Sammy sold his dining table set at a loss of 20%. If he had sold it for Rs. 800 more, he would have received a profit of 5%. Find the cost price.

Solution :

Let the cost price be Rs. 100

So when C.P = 100 , loss of 20% means

S.P = 100 – 20 = 80

Profit of 5% means S.P = 100 + 5 = 105

The difference of two S.P = 105 - 80 = 25

If the difference is 25, C.P = Rs100

If the difference is Rs 800 , C.P = (100 / 25) x 800

C.P = Rs 3200

4. The cost of 11 pencils is equal to the selling price of 10 pencils. Find the loss or profit percent, whatever may be the cost of 1 pencil.

Solution:

The cost price of 11 pencils = S.P of 10 pencils

Let C.P of 1 pencil is Rs.1.

C.P of 10 pencils = Rs. 10

S.P of 10 pencils = C.P of 11 pencils = Rs. 11

Profit on 10 pencils = 11 – 10 = Rs. 1

Profit % = ($\frac{1}{10}$) x 100 = 10 %.

5. A person sold an article at a profit of 12 %. If he had sold it Rs. 4 more, he would have gained 20 %. What is the cost price?

Solution:

Let the CP of an article be Rs x. Then,

112 % of x + 4 = 120 % of x

⇨   120 % of x - 112 % of x = 4

  ⇨   8 % of x = 4

  ⇨ $\frac{8}{100}$ × x = 4

  ⇨ x = 4 × $\frac{100}{8}$ = 50.

<div align="center">

DISCOUNT

</div>

Solved examples:

1. If the Marked Price of an article is Rs 1000, then what is the Selling Price at a discount rate of 20%?

Solution:

Given MP of an article= Rs. 1000

D%=20

So SP= 1000× $\frac{80}{100}$ = 800.

2. Find the selling price of an article after two successive discount 10% & 20% if the marked price is Rs. 2500.

Solution:

Given MP of an article = Rs. 2500

  $SP = \frac{100 - D\,\%}{100} \times MP$

So after first discount 10%, SP = $\frac{100-10}{100} \times 2500 = Rs.\,2250$

Now the new MP is = Rs. 2250

After 20% successive discount SP = $\frac{100-20}{100} \times 2250 = Rs.\,1800$

3. If the marked price of an article is 13% more than CP and a shopkeeper allows a discount of 10%. Find the profit/ loss percentage?

Solution:

Let CP of the article be Rs. 100.

Then MP = 113% of 100 = 113

Discount = 10%

SP = $113 \times \frac{90}{100}$

= 101.7

P = $SP - CP = 101.7 - 100 = 1.7$

% P = $\frac{P}{CP} \times 100 = \frac{1.7}{100} \times 100 = 1.7\,\%$

4. After getting two successive discounts, a shirt with MRP Rs. 500 is available at Rs.420. If the first discount is 12.5% then find out the percentage of second discount.

Solution:

Let the second discount be x %.

Thus, $(100 - x)\%$ of 87.5% of 500 = 420

⇨ $\frac{100-x}{100} \times \frac{87.5}{100} \times 500 = 420$

⇨ 100 - x = 96

⇨ x = 4 %.

5. At what % above the CP must an article be marked so as to gain 17 % allowing 10 % discount?

Solution:

Let CP of the article be 100.

Then SP = 117

Let MP of the article be x. Now,

90 % of x = 117

$$\Rightarrow \frac{90}{100} \times x = 117$$

$$\Rightarrow x = 117 \times \frac{100}{90} = 130.$$

So, MP = 30 % above CP.

SIMPLE INTEREST

Definition :

- Principal (P): The money borrowed or lent out for a certain period is called principal.

- Interest (I): Extra money paid for using other 's money is called interest.

- Simple Interest (S.I) : If the interest on the money borrowed is paid uniformly , then it is called simple interest.

Formulae :

1. S.I $= \frac{P \times R \times T}{100}$

   Where , P = principal

   R = rate percent per annum

   T = time period (Number of years)

2. Amount (A) = P + S.I

Conversions

1. Case I : If S.I , R and T are known ,

   $P = \dfrac{S.I \times 100}{R \times T}$

2. Case II : If S.I , P and T are known ,

   $R = \dfrac{S.I \times 100}{P \times T}$

3. Case III : If S.I , P and R are known ,

   $T = \dfrac{S.I \times 100}{P \times R}$

Solved examples:

1. Find S.I on Rs 2000 at the rate of interest 10 % p.a. for 2 years .

   Solution:

   $S.I = \dfrac{P \times R \times T}{100}$

   $\quad = \dfrac{2000 \times 10 \times 2}{100}$

   $\quad = $ Rs. 400

2. Find S.I and the amount on Rs. 4000 at a rate of interest 5 % for 6 months.

   Solution:

   Here, P = Rs. 4000 , R = 5 % , T = 6 months $= \dfrac{6}{12}$ years $= \dfrac{1}{2}$ year

   $S.I = \dfrac{P \times R \times T}{100}$

   $\quad = \dfrac{4000 \times 5 \times 1}{100 \times 2} = $ Rs. 100

   Amount = P + S.I

   $\qquad = $ Rs. 4000 + Rs. 100 = Rs. 4100

3. In what time will Rs. 3100 amount to Rs. 6200 at 4 % p.a ?

   Solution :

Here , P = Rs. 3100 , R = 4 % , A = Rs. 6200

So, Interest = Rs. 6200 – Rs. 3100 = Rs. 3100

$$T = \frac{3100 \times 100}{3100 \times 4} = 25 \text{ years}$$

4. A sum of money put at S.I doubles itself in 8 years . In how many years it will become five times ?

Solution :

Let Principal be P. Then, Amount = 2 P

$\Rightarrow$ S.I = 2P - P = P

Using, S.I $= \frac{P \times R \times T}{100}$

$\Rightarrow$ P $= \frac{P \times R \times 8}{100}$

$\Rightarrow$ R $= \frac{100}{8}$-

Again Principal = P

$\Rightarrow$ Amount = 5 P

$\Rightarrow$ S.I = 5 P – P = 4 P

Again using, S.I $= \frac{P \times R \times T}{100}$

$\Rightarrow$ 4 P $= \frac{P \times \frac{100}{8} \times T}{100}$

$\Rightarrow$ T = 4 $\times$ 8 = 32 years.

5. If S.I is $\frac{1}{4}$ th of the principal and the number of years is equal to rate of interest , then find the rate percent p.a.?

Solution :

Let Principal = P

$\Rightarrow$ S.I $= \frac{1}{4}$ P

Let Rate of interest be x .

As per the question, Time = rate of interest = x .

$$\text{S.I} = \frac{P \times R \times T}{100}$$

$$\Rightarrow \frac{1}{4} P = \frac{P \times x \times x}{100}$$

$$\Rightarrow x^2 = \frac{100}{4} = 25$$

$$\Rightarrow x = 5$$

RATIO AND PROPORTION

Definition:

- Ratio: The ratio of two quantities a and b in the same units is the fraction $\frac{a}{b}$ and we write it as a : b. In the ratio a : b , a is the first term or antecedent and b is the second term or consequent.

  Example - In the ratio 5 : 9 , 5 is the antecedent and 9 is the consequent.

- Proportion: The equality of two ratios is called proportion.

  If a : b = c : d , then **a, b , c** and **d** are in proportion and can also be written as a : b : : c : d

Solved examples:

1. Divide 240 into two parts in the ratio 2 : 3.

   Solution –

   Let the first part be 2x and the second part be 3x.

   Now, 2x + 3x = 240

   $$\Rightarrow 5x = 240$$

   $$\Rightarrow x = 48$$

   So 2x = 2 × 48 = 96 and 3x = 3 × 48 = 144.

2. Find three numbers in the ratio 1 : 3 : 5 so that the sum of their squares is equal to 315.

Solution –

Let the numbers be x , 3x , 5x.

Now, we have

$$x^2 + (3x)^2 + (5x)^2 = 315$$

$\Rightarrow$ $x^2 + 9x^2 + 25x^2 = 315$

$\Rightarrow$ $35x^2 = 315$

$\Rightarrow$ $x^2 = 9$

$\Rightarrow$ $x = 3$

$\Rightarrow$ $3x = 9$ & $5x = 15$

■ The required numbers are 3, 9 and 15.

3. A mixture contains milk and water in the ratio 5 : 4. If 5 litres of water is added to the mixture, the ratio becomes 5 : 6 . Find the quantity of milk in the given mixture.

Solution –

Let the quantity of milk and water be 5x and 4x litres respectively. Then, $\frac{5x}{4x+5} = \frac{5}{6}$

$\Rightarrow$ 30x = 20x + 25

$\Rightarrow$ 10x = 25

$\Rightarrow$ x = 2.5 litres

$\Rightarrow$ 5x = 5 × 2.5 = 12.5 litres

Thus, the quantity of milk in the given mixture is 12.5 litres.

4. The sides of a triangle are in the ratio $\frac{1}{2}$: $\frac{1}{3}$: $\frac{1}{4}$ and its perimeter is 78 cm. Find the length of the sides of the triangle.

Solution –

Let the sides of the triangle be $a = \frac{1}{2}x$, $b = \frac{1}{3}x$, $c = \frac{1}{4}x$

Given, Perimeter of the triangle is 78 cm.

$\Rightarrow \frac{1}{2}x + \frac{1}{3}x + \frac{1}{4}x = 78$

$\Rightarrow \frac{13}{12}x = 78$

$\Rightarrow x = 72$ cm

$\Rightarrow a = 36$ cm , $b = 24$ cm and $c = 18$ cm .

MIXTURE & ALLIGATION

Definition:

- Alligation: It is a rule that enables us to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of desired price.

- CP of the mixture: It is the cost price of a unit quantity of mixture.

- It is a modified form of finding the weighted average. If 2 ingredients are mixed in a ratio and the cost price of the unit quantity of the mixture, called the cost of mixture per kg is given then,

$\Rightarrow \quad Q_c \times (m - c) = Q_d \times (d - m)$

- Here 'd' is the cost of dearer ingredient, 'm' is the cost of mixture per kg and 'c' is the cost of cheaper ingredient. Q_c & Q_d are the quantity of the cheaper and dearer ingredient respectively.

Solved examples:

1. The cost of Type 1 material is Rs. 15 per kg and Type 2 material is Rs.20 per kg. If both Type 1 and Type 2 are mixed in the ratio of 2 : 3, then what is the price per kg of the mixed variety of material?

   Solution –

Cost Price (CP) of Type 1 material is Rs. 15 per kg
Cost Price (CP) of Type 2 material is Rs. 20 per kg

Type 1 and Type 2 are mixed in the ratio of 2 : 3.

Hence Cost Price (CP) of the resultant mixture

$$= \frac{(15 \times 2) + (20 \times 3)}{(2 + 3)} = \frac{90}{5} = 18$$

Price per kg of the mixed variety of material = Rs.18.

2. A mixture of 30 litres of milk and water contains 30% of water. The new mixture is formed by adding 10 lit of water. What is the percentage of water in the new mixture?

Solution -

Quantity of water in the 30 litre mixture $= \frac{30}{100} \times 30 = 9$ litre
After adding 10 litre of water, quantity of water becomes 19 litre and total quantity becomes 40 litre.
Percentage of water $= \frac{19}{40} \times 100 = 47.5\%$

3. Tea worth of Rs. 135/kg & Rs. 126/kg are mixed with a third variety in the ratio 1: 1 : 2. If the mixture is worth Rs. 153 per kg, the price of the third variety per kg will be ?

Solution –

Let the price of the third variety of tea be Rs. x.

Given that Tea worth of Rs. 135/kg , Rs. 126/kg &Rs. x/kg are mixed in the ratio 1: 1 : 2 and the mixture is worth Rs. 153 per kg

Now we have, $\frac{135 \times 1 + 126 \times 1 + x \times 2}{1 + 1 + 2} = 153$

$\Rightarrow \frac{135 + 126 + 2x}{4} = 153$

$\Rightarrow 261 + 2x = 153 \times 4 = 612$

$\Rightarrow 2x = 612 - 261 = 351$

⇨ x = 175.50

Hence, price of the third variety = Rs.175.50 per kg.

4. A merchant has 1000 kg of sugar part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. The Quantity sold at 18% profit is?

Solution –

By the rule of alligation:

$$Q_c \times (m- c) = Q_d \times (d- m)$$

$$⇨ \frac{Q_c}{Q_d} = \frac{(d- m)}{(m- c)} = \frac{18-14}{14 -8} = \frac{4}{6} = \frac{2}{3}$$

So, ratio of cheaper quantity and dearer quantity = 2 : 3

Quantity of dearer part $= \frac{3}{5} \times 1000 = 600$ Kg

5. A mixture of 150 litres of wine and water contains 20% water. How much more water should be added so that water becomes 25% of the new mixture?

Solution –

Number of litres of water in 150 litres of the mixture = 20% of $150 = \frac{20}{100} \times 150 = 30$ litres

Let us assume that another 'P' litre of water is added to the mixture to make water 25% of the new mixture. So, the total amount of water becomes (30 + P) and the total volume of the mixture becomes (150 + P)

Thus, (30 + P) = 25% of (150 + P)

$$⇨ 30 + P = \frac{25}{100} \times (150 + P)$$
$$⇨ 30 + P = \frac{(150 + P)}{4}$$
$$⇨ 120 + 4P = 150 + P$$

$\Rightarrow$ 4P – P = 30

$\Rightarrow$ 3 P = 30

We get P = 10 litres.

Unit- 3: Time and Work, Pipes and Cisterns, Basic concepts of Time, Distance and Speed ; relationship among them

- Work done is dependent on factors like number of persons working, number of days, number of hours working per day etc.,If M1 persons working D1 days can complete W1 amount of work   and M2 persons working D_2 days can complete W_2 amount of work   , then we have a general formula in the relationship of

$$\frac{M_1 D_1}{W_1} = \frac{M_2 D_2}{W_2}$$

$$\Rightarrow M_1 D_1 W_2 = M_2 D_2 W_1$$

- If we include the working hours (say, T_1 and T_2) for the two groups and efficiency (say, E_1 and E_2) of the persons in two groups , then the relationship is

$$\frac{M_1 D_1 T_1 E_1}{W_1} = \frac{M_2 D_2 T_2 E_2}{W_2}$$

$$\Rightarrow M_1 D_1 W_2 T_1 E_1 = M_2 D_2 W_1 T_2 E_2$$

Important Formulae

1. Work from days
If A can do a piece of work in n days, then A's 1 day's work $= \frac{1}{n}$

2. Days from Work
If A's 1 day's work $= \frac{1}{n}$, then A can finish the work in n days.

3. Ratio

a) If A is thrice as good a workman as B, then ,

    i.   Ratio of work done by A and B =3:1.

    ii.   Ratio of times taken by A and B to finish a work =1:3

b) If A is x times as good a workman as B, then he will take $(\frac{1}{x})^{th}$ of the time by B to do the same work.

1. A and B can do a piece of work in 'x' days and 'y' days respectively, then working together, they will take $\left(\frac{xy}{x+y}\right)$ days to finish the work and in one day, they will finish $\left(\frac{x+y}{xy}\right)^{th}$ part of work.

Solved examples:

1. A can do piece of work in 30 days while B alone can do it in 40 days. In how many days can A and B working together do it?

    Solution –

    A′s one day's work = $\frac{1}{30}$

    B′ s one day's work = $\frac{1}{40}$

    (A+B)′s one day's work = $\frac{1}{30}$ + $\frac{1}{40}$ = $\frac{4+3}{120}$ = $\frac{7}{120}$

    Number of days required for A and B to finish the work = $\frac{1}{7/120}$ = $\frac{120}{7}$ = $17\frac{1}{7}$ days.

    This can also be calculated by using the formula as…

2. To complete a piece of work A and B take 8 days, B and C 12 days. A, B and C take 6 days. A and C will take **:**

    Solution –

    Given (A+B)'s one day's work = $\frac{1}{8}$

    (B+C)'s one day's work = $\frac{1}{12}$

(A+B+C)'s 1 day's work $= \dfrac{1}{6}$

Work done by A, alone = (A+B+C)'s 1 day's work - (B+C)'s one day's work

$$= \dfrac{1}{6} - \dfrac{1}{12}$$

$$= \dfrac{1}{12}$$

Work done by C, alone = (A+B+C)'s 1 day's work - (A+B)'s one day's work

$$= \dfrac{1}{6} - \dfrac{1}{8}$$

$$= \dfrac{1}{24}$$

(A+C)'s one day's work $= \dfrac{1}{12} + \dfrac{1}{24} = \dfrac{1}{8}$

■ (A+C) will take 8 days to complete the work together.

3. A and B can do a piece of work in 45 days and 40 days respectively. They began to do the work together but A leaves after some days and then B completed the remaining work in another 23 days. The number of days after which A left the work was?

Solution –

(A+B)'s 1 day's work $= \dfrac{1}{45} + \dfrac{1}{40} = \dfrac{17}{360}$

Work done by B in 23 days $= 1 \times \dfrac{23}{40} = \dfrac{23}{40}$

Remaining work $= 1 - \dfrac{23}{40} = \dfrac{17}{40}$

Now, $\dfrac{17}{360}$ work was done by (A+B) in 1 day.

$\dfrac{17}{40}$ Work was done by (A+B) in $1 \times \dfrac{360}{17} \times \dfrac{17}{40} = 9$ days

■ A left after 9 days.

4. A and B undertake to do a piece of work for Rs 600. A alone can do it in 6 days while B alone can do it in 8 days. With the help of C, they can finish it in 3 days, Find the share of C in Rs?

Solution –

A's one day's work $= \dfrac{1}{6}$

B's one day's work $= \dfrac{1}{8}$

(A+ B + C)'s one day's work $= \dfrac{1}{3}$

$\Rightarrow$ C's one day's work, $= \left(\dfrac{1}{3}\right) - \left(\dfrac{1}{6} + \dfrac{1}{8}\right)$

$= \dfrac{1}{24}$

Therefore, A : B : C = Ratio of their one day's work

$= \dfrac{1}{6} : \dfrac{1}{8} : \dfrac{1}{24}$

C's share for 3 days $= \dfrac{1}{24} \times 3 \times 600 = $ Rs. 75

5. A can build up a structure in 8 days and B can break it in 3 days. A has worked for 4 days and then B joined to work with A for another 2 days only. In how many days will A alone build up the remaining part of the structure?

Solution –

A can build the structure in 8 days.

Fraction of structure built in a day by A $= \dfrac{1}{8}$

Similarly, fraction of structure broken by B in a day $= \dfrac{1}{3}$

Amount of work done by A in 4 days $= \dfrac{4}{8} = \dfrac{1}{2}$

Now, both A and B together for 2 days.

Amount of work done by A in 2 days $= \dfrac{2}{8} = \dfrac{1}{4}$

Amount of structure broken by B in 2 days $= \dfrac{2}{3}$

Fraction of structure built $= \left(\dfrac{1}{2} + \dfrac{1}{4}\right) - \dfrac{2}{3} = \dfrac{1}{12}$

Fraction of structure still to be built $= 1 - \dfrac{1}{12} = \dfrac{11}{12}$

If A takes x days to build up the remaining structure, then $\dfrac{x}{8} = \dfrac{11}{12}$

$\Rightarrow$ x = 22/3 days.

PIPES AND CISTERN

A pipe is connected to a tank or cistern. It is used to fill or empty the tank; accordingly, it is called an inlet or an outlet.

- Inlet pipe: A pipe which is connected to fill a tank is known as an inlet pipe.
- Outlet pipe: A pipe which is connected to empty a tank is known as an outlet pipe.

Important Formulae

1. If an inlet connected to a tank fills it in x hours, part of the tank filled in one hour is $= \frac{1}{x}$

2. If an outlet connected to a tank empties it in y hours, part of the tank emptied in one hour is $= \frac{1}{y}$

3. An inlet can fill a tank in x hours and an outlet can empty the same tank in y hours. If both the pipes are opened at the same time and $y > x$, the net part of the tank filled in one hour is given by;

$$= \left(\frac{1}{x} - \frac{1}{y}\right)$$

4. An inlet can fill a tank in x hours and another inlet can fill the same tank in y hours. If both the inlets are opened at the same time, the net part of the tank filled in one hour is given by;

$$= \left(\frac{1}{x} + \frac{1}{y}\right)$$

Solved examples:

1. Two pipes A and B can fill a tank in 12 and 24 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank?

    Solution –

    Part filled by pipe A in 1 minute $= \frac{1}{12}$

    Part filled by pipe B in 1 minute $= \frac{1}{24}$

    Part filled by pipe A and pipe B in 1 minute

    $= \frac{1}{12} + \frac{1}{24} = \frac{1}{8}$

    ■ Both the pipe together can fill the tank in 8 minutes.

2. Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in:

    Solution –

Pipes A and B can fill the tank in 5 and 6 hours respectively. Therefore,

part filled by pipe A in 1 hour $= \frac{1}{5}$

part filled by pipe B in 1 hour $= \frac{1}{6}$

Pipe C can empty the tank in 12 hours. Therefore,

part emptied by pipe C in 1 hour $= \frac{1}{12}$

Net part filled by Pipes A,B,C together in 1 hour,

$$\Rightarrow \quad \frac{1}{5} + \frac{1}{6} - \frac{1}{12} = \frac{17}{60}$$

This is a positive number. This means rate of filling is greater than rate of emptying and so the tank can be filled in some hours.

■ The tank can be filled in $\frac{60}{17} = 3\frac{9}{17}$ hours.

3. Two pipes A and B can fill a cistern in $37\frac{1}{2}$ minutes and 45 minutes respectively. Both pipes are opened. The cistern will be filled in just half an hour, if pipe B is turned off after what time?

Solution –

Pipe A alone can fill the cistern in $37\frac{1}{2} = \frac{75}{2}$ minutes.

B was closed after some minutes but A was open for 30 minutes.

Since A was open for 30 minutes, part of the cistern filled by pipe A $= \frac{2}{75} \times 30 = \frac{4}{5}$

So the remaining $= 1 - \frac{4}{5} = \frac{1}{5}$ part is filled by pipe B.

Pipe B can fill the cistern in 45 minutes. So, time required to fill $\frac{1}{5}$ part

$$= \frac{45}{5} = 9 \text{ minutes.}$$

■ Pipe B is turned off after 9 minutes.

4. A water tank is two-fifth full. Pipe A can fill a tank in 12 minutes and pipe B can empty it in 6 minutes. If both the pipes are open, how long will it take to empty or fill the tank completely?

Solution –

Since pipe B is faster than pipe A, the tank will be emptied.

Part filled by pipe A in 1 minute $= \frac{1}{12}$

Part emptied by pipe B in 1 minute $= \frac{1}{6}$

Net part emptied by pipe A and B in 1 minute $= \frac{1}{6} - \frac{1}{12} = \frac{1}{12}$

So in 12 minutes, they will empty a full tank.

Time taken to empty $\frac{2}{5}$ of the tank $= \frac{2}{5} \times 12 = 4.8$ min.

5. Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is:

Solution –

A, B, C together can fill a tank in 6 hours.

⇨ Part filled by pipes A,B,C together in 1 hr $= \frac{1}{6}$

All these pipes are open for only 2 hours and then C is closed.

Part filled by pipes A,B,C together in these 2 hours $= \frac{2}{6} = \frac{1}{3}$

Remaining part $= 1 - \frac{1}{3} = \frac{2}{3}$

This remaining part of $\frac{2}{3}$ is filled by pipes A and B in 7 hours.

Therefore, part filled by pipes A and B in 1 hr $= \frac{\left(\frac{2}{3}\right)}{7} = \frac{2}{21}$

Part filled by pipe C in 1 hr

$$= \frac{1}{6} - \frac{2}{21} \quad = \frac{3}{42} = \frac{1}{14}$$

▮ C alone can fill the tank in 14 hours.

TIME , DISTANCE AND SPEED

Relationship between Speed, Distance and Time –

1. Speed $= \frac{Distance}{Time}$
2. Distance $=$ Speed $\times$ Time
3. Time $= \frac{Distance}{Speed}$

When using these equations, it is important to keep the units straight. For instance, if the rate of the problem is given in kilometres per hour (kmph), then the time needs to be in hours , and the distance in kilometres. If the time is given in minutes, you will need to divide by 60 to convert it to hours before you can use the equation to find the distance in kilometres.

- **Convert kilometres per hour (km/hr) to metres per second (m/s)**

$$\boxed{x \text{ km / hr } = \left(x \times \frac{1000}{3600}\right) \text{ m / s} = \left(x \times \frac{5}{18}\right) \text{ m / s}}$$

- **Convert metres per second (m/s) to kilometres per hour (km/hr)**

$$\boxed{x \text{ m / s } = \left(x \times \frac{3600}{1000}\right) \text{ km / hr} = \left(x \times \frac{18}{5}\right) \text{ km / hr}}$$

❖ **Average Speed**

If an object covers a certain distance at x kmph and an equal distance at y kmph, the average speed of the whole journey $= \frac{2xy}{x+y}$ km / hr

❖ If the ratio of the speeds of A and B is $a : b$, then, the ratio of the time taken by them to cover the same distance is

$$\frac{1}{a} : \frac{1}{b} = b : a$$

❖ **Relative Speed**

- If two objects are moving in the same direction at v_1 m/s and v_2 m/s respectively where $v_1 > v_2$, then their relative speed = $(v_1 - v_2)$ m / s

- If two objects are moving in opposite directions at v_1 m/s and v_2 m/s respectively, then their relative speed = $(v_1 + v_2)$ m/s

Solved examples:

1. a) Express speed of 72 km / hr in m / s .
   b) Express speed of 25 m / s in km / hr .

   Solution –

   a) 72 km / hr = $\left(72 \times \frac{5}{18}\right)$ m / s = 20 m / s

   b) 25 m / s = $\left(25 \times \frac{18}{5}\right)$ km / hr = 90 km / hr

2. A person crosses a 600 metre long street in 5 minutes. What is his speed in km per hour?

   Solution –

   Distance = 600 metre = 0.6 km

   Time = 5 minutes = $\frac{1}{12}$ hour

   Speed = $\frac{Distance}{Time}$ = $\frac{0.6}{1/12}$ = 7.2 km/hr.

3. A man completes a journey in 10 hours. He travels first half of the journey at the rate of 21km/hr and second half at the rate of 24 km/hr. Find the total journey in km.

   Solution –

   Average Speed = $\frac{2 \, x \, y}{x+y}$

   $$= \frac{2 \times 21 \times 24}{21 + 24} \text{ km / hr} = 22.4 \text{ km / hr}$$

   Total distance = 22.4×10=224 km.

4. In covering a distance of 30 km, Arun takes 2 hours more than Anil. If Arun doubles his speed, then he would take 1 hour less than Anil. What is Arun's speed?

Solution –

Let speed of Arun = x kmph,
speed of Anil = y kmph
distance   = 30 km

We know that Time $= \dfrac{Distance}{Speed}$ Hence,

$\dfrac{30}{x} - \dfrac{30}{y} = 2 \cdots(1)$

$\dfrac{30}{y} - \dfrac{30}{2x} = 1 \cdots(2)$

Adding (1)and (2)

$\dfrac{30}{x} - \dfrac{30}{2x} = 3$

$\Rightarrow \dfrac{30}{2x} = 3$

$\Rightarrow \dfrac{15}{x} = 3$

$\Rightarrow \dfrac{5}{x} = 1$

$\Rightarrow x = 5$

■ Arun's speed = 5 kmph.

5. A man travelled a distance of 61 km in 9 hours. He travelled partly on foot at 4 km/hr and partly on bicycle at 9 km/hr. What is the distance travelled on foot?

Solution-

Let the time in which he travelled on foot = x hr
Then the time in which he travelled on bicycle = (9−x) hr

Distance = speed × time

$\Rightarrow$ 4x + 9(9−x) = 61

$\Rightarrow$ 4x + 81− 9x = 61

$\Rightarrow$ 5x = 20

$\Rightarrow$ x = 4

■ Distance travelled on foot = 4x = 16 km.

Unit – 4: Concept of Angles, Different Polygons like triangles, rectangle, square, right angled triangle, Pythagorean Theorem, Perimeter and Area of Triangles, Rectangles, Circles

Concept of Angle

In plane geometry, an **angle** is the figure formed by two rays, called the *sides* of the angle, sharing common endpoint, called the vertex of the angle.

- Angles smaller than 90°are called **acute angles.**
- An angle equal to 90° is called a **right angle.**
- Angles larger than a right angle and smaller than 180° are called **obtuse angles**.

Triangle

A **triangle** is a polygon with three edges and three vertices. The sum of the 3 angles of a triangle is 180°.

Types of triangle:

1. An **equilateral triangle** has all sides the same length. An equilateral triangle is also a regular polygon with all angles measuring 60°.
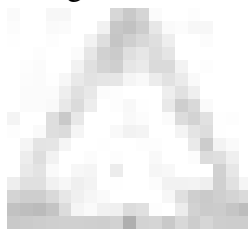
2. An **isosceles triangle** has two sides of equal length. An isosceles triangle also has two angles of the same measure, namely the angles opposite to the two sides of the same length.

3. A **scalene triangle** has all its sides of different lengths. Equivalently, it has all angles of different measure.

4. A **right triangle** (or right-angled triangle) has one of its interior angles measuring 90° (a right angle). The side opposite to the right angle is the hypotenuse, the longest side of the triangle.

Perimeter and area

Let the length of the three sides of a triangle be a , b , c. Then,
- Perimeter of the triangle $= a + b + c$
- Area of the triangle $= \frac{1}{2} \times base \times height$
- Area $= \sqrt{s\,(s-a)(s-b)(s-c)}$ (if all the sides are given)
  Where $s = \frac{1}{2}(a + b + c)$

❖ Let the side of an equilateral triangle be a . Then ,
➤ Perimeter of equilateral the triangle $= 3\,a$
➤ Area of the equilateral triangle $= \frac{\sqrt{3}}{4} \times a^2$

Pythagorean Theorem

It states that the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.

$$a^2 + b^2 = c^2$$
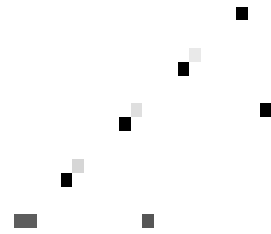
Solved examples:

1. Find the perimeter of the triangle having length of the sides 5 cm, 8 cm, 7 cm.

   Solution:
   Let a , b, c be the length of the sides of the given triangle.
   So a = 5 cm, b = 8 cm, c = 7 cm.
   Perimeter of the triangle = (a + b + c) cm
   $$= (5 + 8 + 7) \text{ cm}$$
   $$= 20 \text{ cm}.$$
   Perimeter of the given triangle is 20 cm.

2. Find the area of the triangle whose sides measure 13 cm , 14 cm , 15 cm.

   Solution –
   Let a = 13 cm , b = 14 cm , c = 15 cm.
   Then $s = \frac{1}{2}(a + b + c)$
   $$= \frac{1}{2}(13 + 14 + 15) = 21 \text{ cm}.$$
   Area of the triangle = $\sqrt{s(s-a)(s-b)(s-c)} = \sqrt{21(21-13)(21-14)(21-15)}$
   $$= \sqrt{21 \times 8 \times 7 \times 6}$$
   $$= 84 \text{ cm}^2$$
   Area of the triangle is 84 cm².

3. Let the perimeter of an equilateral triangle be 27 cm. Then find the length of its sides.

   Solution:

   Given perimeter of the equilateral triangle = 27 cm

   Let a be the length of the side of the equilateral triangle.

$\Rightarrow$ 3 a = 27

$\Rightarrow$ a = $\frac{27}{3}$ = 9 cm

◼ Length of the side of the equilateral triangle is 9 cm.

4. Find the area of the equilateral triangle having sides of length 8 cm.

Solution:

Given length of the side of the equilateral triangle = 8 cm

Area of the triangle = $\frac{\sqrt{3}}{4}$ × a^2

$= \frac{\sqrt{3}}{4}$ × $(8)^2$

$= 16\sqrt{3}\ cm^2$

◼ Area of the given equilateral triangle is $16\sqrt{3}\ cm^2$.

5. Find the length of the hypotenuse of the right angled triangle when the length of the base and the perpendicular are 5 cm and 12 cm respectively.

Solution:

Given length of the base (b) = 5 cm
length of the perpendicular (a) = 12 cm

Using Pythagorean theorem, $a^2 + b^2 = c^2$

$\Rightarrow$ $c^2 = 5^2 + 12^2$
$\Rightarrow$ $c^2 = 25 + 144$
$\Rightarrow$ $c^2 = 169$
$\Rightarrow$ c = 13 cm
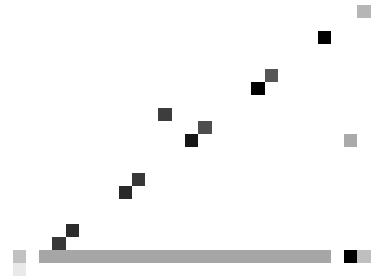
◼ Length of hypotenuse of the triangle is 13 cm.

6. The base of a triangular field is three times its altitude. If the cost of cultivating the field at Rs. 24.68 per hectare be Rs.333.18, find its base and height.

Solution –

Area of the field $= \frac{total\ cost}{rate} = \frac{333.18}{24.68}$ = 13.5 hectares [1 hectare = 100m × 100m]

$= (13.5 \times 10000)\ m^2 = 135000\ m^2$

Let altitude = x metres and base = 3x metres.

Then, $\frac{1}{2} \times 3x \times x = 135000$

$\Rightarrow x^2 = 90000$

$\Rightarrow x = 300$ metres

Thus, base $= 900$ metres and altitude $= 300$ metres.

7. The altitude drawn to the base of the isosceles triangle is 8 cm and the perimeter is 32 cm. Find the area of the triangle.

Solution:

Let ABC be a isosceles triangle and AD be its altitude.
Let AB = AC = x cm. Then BC = (32 − (AB + AC))
$\qquad\qquad\qquad\qquad$ = (32 − 2x) cm

Since in an isosceles triangle the altitude bisects the base, so we have BD = CD = (16 − x) cm

In triangle ADC , AD^2 + BD^2 = AB^2

$\Rightarrow x^2 = 8^2 + (16 - x)^2$

$\Rightarrow x^2 = 64 + 256 + x^2 - 32x$

$\Rightarrow 32x = 320$

$\Rightarrow x = 10$

So BC = (32 − 2x) =(32 − 20) = 12 cm

Now Area of the triangle $= \frac{1}{2} \times base \times height$

$\qquad\qquad = \frac{1}{2} \times 12 \times 8$

$\qquad\qquad = 48$ cm^2

■ Area of the triangle is 48 cm^2.

Rectangle

A **rectangle** is a quadrilateral with four right angles. In a rectangle both pairs of opposite sides are parallel and equal in length. The sum of the angles of a rectangle is $360°$.

Perimeter and area

If a rectangle has length l and width b,

- it has perimeter P = $2\,(l + b)$
- it has area A = $l \times b$

Solved examples:

1. Find the area and the perimeter of a rectangle having length 12 cm and breadth 10cm.

   Solution –

   Given Length of the rectangle = 12 cm

   Breadth of the rectangle = 10 cm

   Perimeter = $2\,(l + b)$ = $2\,(12 + 10)$

   = 44 cm.

   Area = $l \times b$ = $12 \times 10 = 120\ cm^2$.

   Area and perimeter of the triangle are 120 cm^2 & 44 cm respectively.

2. A field is in the form of a rectangle having its sides in the ratio 2 : 3. The area of the field is 1.5 hectares. Find the length and breadth of the field.

   Solution:

   Let length = 2x and breadth = 3x metres.

   Area = 1.5 hectares = 1.5×10000 m^2 = 15000 m^2. [1 hectare = 100m × 100m]

   $\Rightarrow 2x \times 3x = 15000$

   $\Rightarrow 6\,x^2 = 15000$

   $\Rightarrow x^2 = 2500$

   $\Rightarrow x = 50$ metres

Length = 2x = 100 metres and breadth = 3x = 150 metres.

█ The length and breadth of the rectangle is 100 m & 150 cm respectively.

3. If three angles of a quadrilateral are 50°, 75° and 80°, then find the remaining angle of the quadrilateral.

Solution:

Given three angle of the quadrilateral are 50°, 75° and 80°.

We know that the sum of the angles of a quadrilateral is 360°.

Hence the remaining angle = $360° - (50° + 75° + 80°)$

$$= 360° - 205°$$

$$= 155°$$

4. Let one side and a diagonal of a rectangle be 6 cm & 10 cm respectively, then find the area of the rectangle.

Solution:

Given breadth of the rectangle = 6 cm

Length of the diagonal = 10 cm

Δ ABD is a right angle triangle. So we have $BD^2 = AD^2 + AB^2$

$\Rightarrow 10^2 = AD^2 + 6^2$

$\Rightarrow 100 = AD^2 + 36$

$\Rightarrow AD^2 = 64$

$\Rightarrow AD = 8$ cm

Area of ABCD = $AD \times AB$

$$= 6 \times 8 = 48 \ cm^2$$

█ Area of the given rectangle is 48 cm².

5. The length of a rectangle is 8 cm and the width is 5 cm. If the length is greater by 2 cm, what should the width be so that the new rectangle has the same area as the first one?

Solution:

Given length of the rectangle = 8 cm

Breadth of the rectangle = 5 cm

So area of the rectangle = $l \times b$ = $8 \times 5 = 40cm^2$

If the length is increased by 2 cm, then the new length of the rectangle = 10 cm.

Area = $l \times b$

⇨ $40 = 10 \times b$

⇨ b = 4 cm.

The new width of the rectangle is 4 cm.

Square

A **square** is a regular quadrilateral, which means that it has four equal sides and four equal angles (i.e.$90°$).
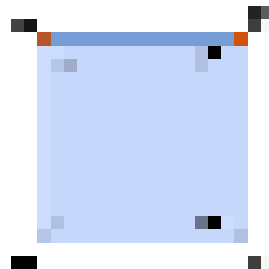
Perimeter and area

- The perimeter of a square whose four sides have length l is $P = 4\,l$
- And the area $A = l^2$

Solved examples:

1. Find the area and the perimeter of the square having sides 6 cm.

Solution:

Given length of the side $l = 6\ cm$

So perimeter P = $4\ l$

$$= 4 \times 6 = 24\ cm$$

Area $A = l^2$

⇨ A = $6^2 = 36$ cm²

■ Perimeter and area of the given square is 24 cm & 36 cm² respectively.

2. Find the perimeter of the square whose area is 100 cm².

Solution:

Let the sides of the square be a cm.

Given area of the square = 100 cm².

⇨ $a^2 = 100$

⇨ $a = 10\ cm$.

Perimeter = $4 \times a = 4 \times 10 = 40\ cm$

■ Perimeter of the square is 40 cm.

3. Find the length of the diagonal of the square having sides 9 cm.

Solution:

Let ABCD be a square having sides 9 cm.

Δ ABD is a right angle triangle. So we have $BD^2 = AD^2 + AB^2$

⇨ $BD^2 = 9^2 + 9^2$

⇨ $BD^2 = 162$

⇨ $BD = 9\sqrt{2}$ cm

■ Length of the diagonal is $9\sqrt{2}$ cm.

❖ If a is the length of the side of a square, then its diagonal = $a\sqrt{2}$
❖ If d is the length of the diagonal of a square ,then the length of its

sides = $\frac{d}{\sqrt{2}}$

4. Find the area of a square whose diagonal is 4 cm.

Solution:

Given length of the diagonal of a square = 4 cm

$\quad$ Length of its sides $= \frac{d}{\sqrt{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2}\ cm$

Area of the square $= 2\sqrt{2} \times 2\sqrt{2} = 8\ cm^2$

■ Area of the square is 8 cm².

❖ Area of square $= \frac{1}{2}(d)^2$ (if length of the diagonal is given)

---

5. The perimeter of a square courtyard is 100 m. find the cost of cementing it at the rate of Rs. 5 per m².

Solution:

Perimeter of square courtyard = 100 m

Therefore, side of the square courtyard $= \frac{100}{4} = 25$ m

Therefore, area of square courtyard = (25 × 25) m² = 625 m²

For 1 m², the cost of cementing = Rs. 5

For 625 m², the cost of cementing = 625 × 5 = Rs. 3125

Circle

A **circle** is a simple closed shape. It is the set of all points in a plane that are at a given distance from a given point, the centre; equivalently it is the curve traced out by a point that moves so that its distance from centre is constant.

- A circle has a total of **360 degrees** all the way around the center,
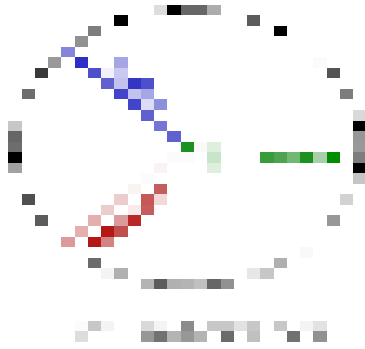
Perimeter and area

Let the radius of a circle be r. Then,

- Perimeter/Circumference of the circle $= 2\pi r$
- Area of the circle $= \pi r^2$

Solved examples:

1. Find the circumference of a circle having radius 21cm.

   Solution:

   Given r = 21 cm

   Circumference $= 2\pi r$

   $$= 2 \times \frac{22}{7} \times 21$$

   $$= 132 \text{ cm}.$$

   Circumference of the circle is 132 cm.

2. Find the area of the circle having radius 7 cm.

   Solution:

   Given radius of the circle (r) = 7 cm

   Area $= \pi r^2$

   $$= \frac{22}{7} \times 7^2 = 154 \text{ cm}^2.$$

■ Area of the circle is 154 cm^2.

3. A wheel makes 200 revolutions in covering a distance of 44 km. Find the radius of the wheel.

Solution:
Distance covered in 200 revolutions = 44 km = $(44 \times 1000)\ m$ = 44000 m

⇨ Distance covered in 1 revolution = $\frac{44000}{200}$ $= 220\ m$

Distance covered in 1 revolution = perimeter of the wheel

⇨ $2\pi r = 220$

⇨ $2 \times \frac{22}{7} \times r = 220$

⇨ $r = 220 \times \frac{7}{22} \times \frac{1}{2}$

⇨ $r = 35\ cm.$

■ Radius of the wheel is 35 cm.

4. Two concentric circles form a ring. The inner and the outer circumference of the ring are 132 cm & 176 cm respectively. Then find the width of the ring.

Solution:

Let R and r be the radii of the outer and inner circles respectively.
According to the question, for the outer circle, $2\pi R = 176\ cm$

⇨ $2 \times \frac{22}{7} \times R = 176$

⇨ R = $176 \times \frac{7}{22} \times \frac{1}{2}$

⇨ R = 28 cm

Similarly for the inner circle, $2\pi r = 132$

⇨ $2 \times \frac{22}{7} \times r = 132$

⇨ $r = 132 \times \frac{7}{22} \times \frac{1}{2}$

⇨ $r = 21\ cm$

■ Width of the ring = R – r = 28 cm – 21 cm = 7 cm.

5. If the radius of a circle is decreased by 50%, then find the % decrease in area.

Solution:
Let the radius of a circle = r cm
So area of the circle = πr^2
Now if the radius decreases by 50% the new radius (R) = 50% of r

$$= \frac{50}{100} \times r = \frac{r}{2}$$

The new area = $\pi R^2 = \pi \left(\frac{r}{2}\right)^2 = \frac{\pi r^2}{4}$

Decrease in area = $\frac{change\ in\ area}{original\ area} \times 100 = \frac{\pi r^2 - \frac{\pi r^2}{4}}{\pi r^2} \times 100 = \frac{\frac{3\pi r^2}{4}}{\pi r^2} \times 100 = 75\%$

■ Decrease in area = 75%.

Unit – 5: Raw and Grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events and Sample Space, Probability

Data analysis is an important aspect of almost every competitive exam today. Usually, a table or a bar diagram or a pie chart or a sub-divided bar diagram or a graph is given and candidates are asked questions that test their ability to analyze the data given in those forms.

Raw data

Raw data or primary data are collected directly related to their object of study (statistical units). When people are the subject of an investigation, we may choose the form of a survey, an observation or an experiment.

Examples:

Let us consider the marks secured by 20 students of a class (total mark 500)

453	301	220	485	211
420	143	388	357	229
98	448	429	190	150

| 490 | 324 | 256 | 373 | 389 |

This is called raw data i.e. not processed; only gathered.

Grouped data

Grouped data are data formed by aggregating individual observations of a variable into groups, so that a frequency distribution of these groups serves as a convenient means of summarizing or analyzing the data.

Example:

One way of arranging the above data is as below

Marks	Number of students
0 – 100	1
100- 200	3
200 - 300	4
300 – 400	6
400 - 500	6

This is called grouping of data i.e. arranging data in a particular way.

Bar Graphs

A **bar graph** (also called bar chart) is a graphical display of data using bars of different heights.

We can use bar graphs to show the relative sizes of many things, such as what type of car people have, how many customers a shop has on different days and so on.

Solved examples:

1. Study the following graph and answer the questions.
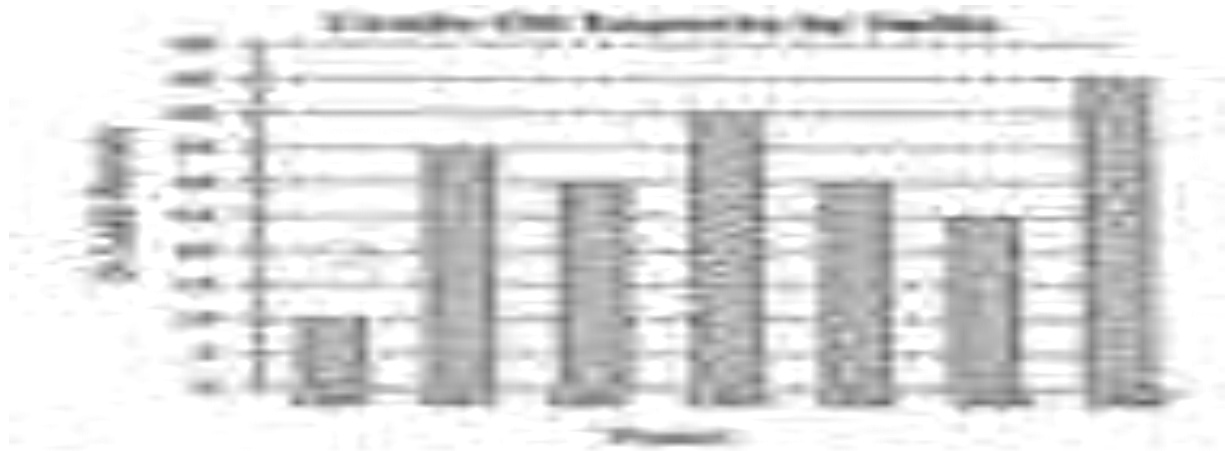
QA. From the graph calculate the sum of crude oil imports in the years 1991 & 1996.

   Solution: Crude oil import in the year 1991 = 35 lakh barrels

   Crude oil import in the year 1996 = 45 lakh barrels

   Sum = 35 + 45 = 80 lakh barrels.

QB. Calculate the average crude oil imports by India during 1990 – 1996.

   Solution: sum of crude oil imports during 1990 – 1996 = 10 + 35 + 30 + 40 + 30 + 25 + 45

   = 215 lakh barrels.

   Hence, average = $\frac{215}{7}$ = 30.71 lakh barrels.

QC. In which year(s) the crude oil import was greater than average import?

   Solution:

   From above we have average = 30.71 lakh barrels

   Hence, in the years 1991, 1993, 1996 the crude oil import was greater than the average.

2. The following bar graph shows the population of two states A & B in lakhs.

   Answer the following questions based on the data given below.

   Population of two states (in lakhs) over the years
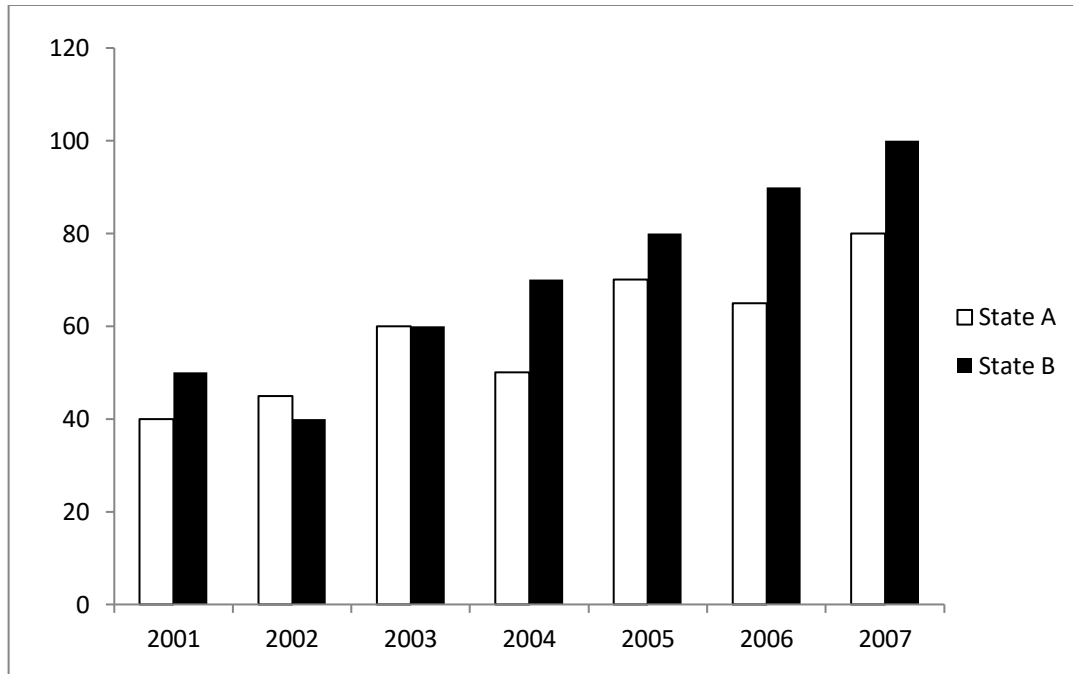
Number of years

Q A: Approximately, what is the average population of state A for all the given years?

Solution:

Total population of State A = 410 Lakhs

Average Population of State A $= \dfrac{\text{Total population of State A}}{\text{Number of Years}} = \dfrac{40+45+60+50+70+65+80}{7}$

$= \dfrac{410}{7} = 58.57$ Lakhs

Therefore, The approx average population of State A is 59 Lakhs.

Q B: What is the ratio of the total population of state A for the years 2001, 2002 and 2003 together to the population of state B for 2005, 2006 and 2007 together?

Solution:

As we need to find ratio, State A (2001 + 2002 + 2003) : State B(2005 + 2006 +2007)

$= (40 + 45 + 60) : (80+ 90+100)$

$= 145: 270 = 29:54$

Therefore the ratio of number of people in the state A (2001 + 2002 + 2003) to the number of people in the state B (2005 + 2006+ 2007) is 29 : 54.

Q C: What is the percentage rise in population of state B from the year 2003 to 2004?

   Solution:

   As we need to find the percentage rise in the population,

   Percentage change = $\frac{\text{change in value}}{\text{reference value}} \times 100$

   So, Percentage Increase = $\frac{70-60}{60} \times 100$

   $= \frac{10}{60} \times 100 = 16.66\%$

   Therefore, there has been a rise in 16.66% of population during the year 2003 and 2004 in State B.

3. The bar graph given below shows the foreign exchange reserves of a country (in million US $) from 1991 - 1992 to 1998 - 1999.

Foreign Exchange Reserves Of a Country. (in million US $)

Years
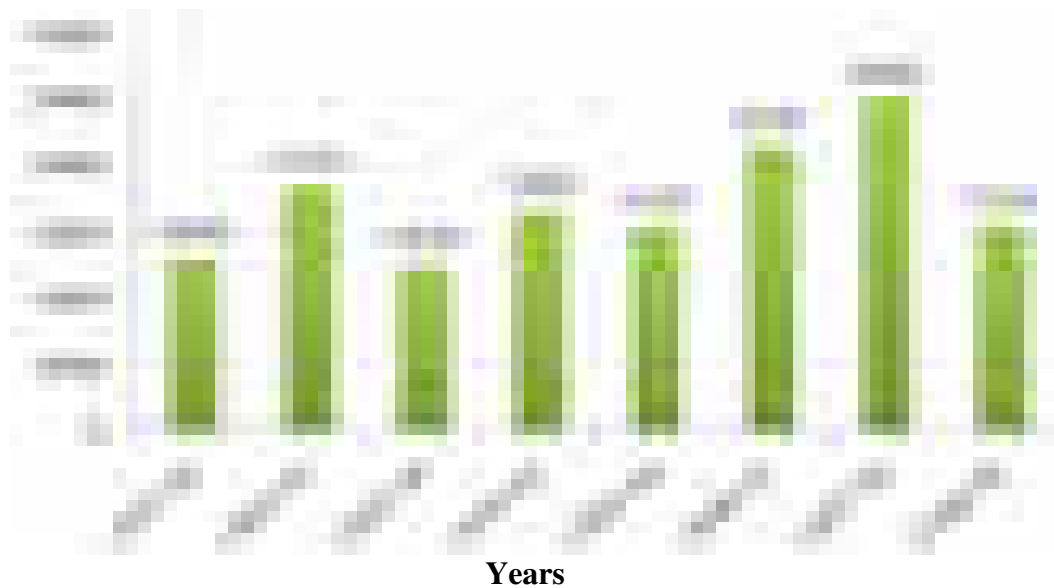
Q A. Calculate the average foreign reserves of the country from 1991 - 1992 to 1998 – 1999.

   Solution:

   Sum of foreign reserves of the country = (2640 + 3720 + 2520 + 3360 + 3120 + 4320 + 5040 + 3120) million US $.

   ` = 27840 million US $.

Hence, average $= \frac{sum}{8} = \frac{27840}{8} = 3480$ million US \$.

Q B. The foreign exchange reserves in 1997-98 were how many times that in 1994-95?

Solution:

Required ratio $= = \frac{\text{foreign exchange reserves in } 1997-98}{\text{foreign exchange reserves in } 1994-95} = \frac{5040}{3360} = 1.5$.

Q C. What was the percentage increase in the foreign exchange reserves in 1997-98 over 1993-94?

Solution:

Foreign exchange reserves in 1997 - 1998 = 5040 million US \$.

Foreign exchange reserves in 1993 - 1994 = 2520 million US \$.
Increase = (5040 – 2520) = 2520 million US \$.

Percentage increase $= \left(\frac{2520}{2520} \times 100 \right) \% = 100\%$.

Pie chart

A pie is a baked dish which is round in shape. A pie chart or pie graph is a special chart that uses "pie slices" to show relative sizes of data. The chart is divided into sectors, where each sector shows the relative size of each value.

Solved examples:

1. The following pie-chart shows the percentage distribution of the expenditure incurred in publishing a book. Study the pie-chart and the answer the questions based on it.

Various Expenditures (in percentage) Incurred in Publishing a Book
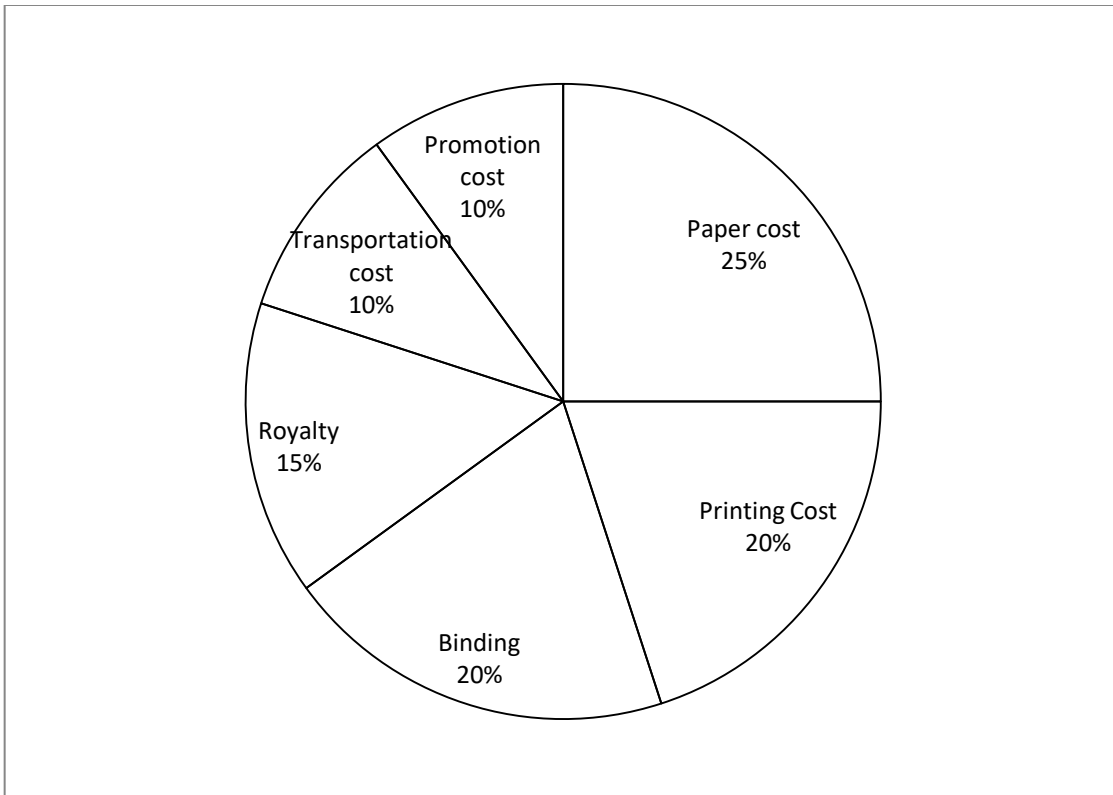
QA. If for a certain quantity of books, the publisher has to pay Rs. 30,600 as printing cost then, what will be amount of royalty to be paid for these books?

Solution:

Given that the printing cost = Rs. 30,600

Let the royalty to be paid be Rs. x.

So we can write, $\frac{20\% \ of \ total \ cost}{15\% \ of \ total \ cost} = \frac{30,600}{x}$

⇨ $20 \times x = 15 \times 30,600$

⇨ $x = \frac{15 \times 30,600}{20} = Rs. \ 22,950$

Hence royalty to be paid = Rs. 22,950

Q B. Promotion cost on the book is less than the paper cost by what percentage?

Solution:

Promotion cost of book = 10% of C.P.

paper cost on book = 25% of C.P.

Difference = (25% of C.P.) - (10% of C.P) = 15% of C.P.

Percentage difference $= \left(\frac{\text{Difference}}{paper\ cost} \times 100 \right) \%$

$$= \left(\frac{15\ \%\ of\ C.P}{25\%\ of\ C.P.} \times 100 \right) \% = 60\% \ .$$

QC . If the total cost of printing a certain quantity of books is Rs.2,50,000. Then find the sum of its transportation cost, promotion cost and binding cost.

Solution:

Given that the total cost = Rs.2,50,000

Sum = (10 % of total cost) + (10 % of total cost) + (20 % of total cost)

$$= (\ 10\% + 10\% + 20\%)\ of\ 2,50,000$$

$$= \frac{40}{100} \times 2,50,000$$

$$= Rs.\ 1,00,000$$

2. The following pie chart shows the amount of subscriptions generated for India bonds for different categories of investors.
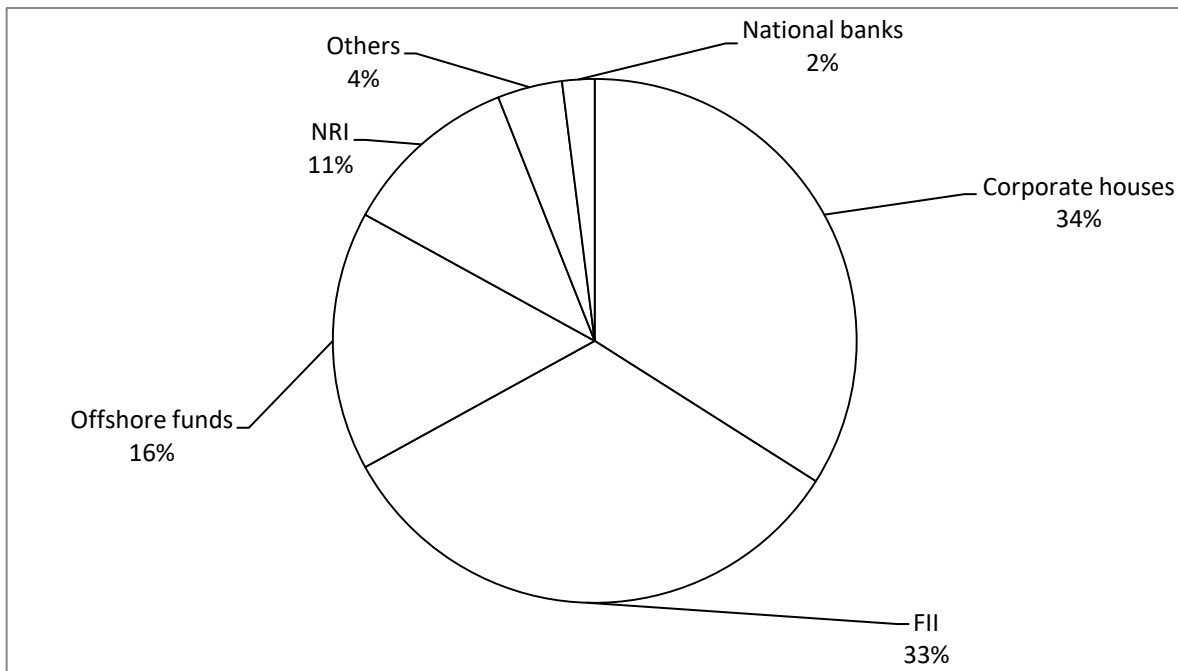
Q A. If the investments by NRIs are Rs 1100 crore, then the investment by corporate houses and FIIs together is:

Solution:

Let the investment by corporate houses and FIIs together is be x.

So we can write, $\dfrac{11\% \ of \ total \ \text{investments}}{34 \ \% \ of \ total \ \text{investments}+ \ 33\% \ of \ total \ \text{investments}} = \dfrac{1100}{x}$

$\Rightarrow \ \dfrac{11}{34+33} = \dfrac{1100}{x}$

$\Rightarrow \ x = \dfrac{1100 \ \times 67}{11} = 6700 \ crore$

The investment by corporate houses & FII is = 6700 crore.

Q B. What is the approximate ratio of investment flows into India Bonds from NRIs to corporate houses?

Solution:

Investment flows into India Bonds from NRIs = 11%

Investment flows into India Bonds from corporate houses = 34%

Required ratio = 11 : 34 = 1: 3(approx.)

QC. In the corporate sector, how many degrees should be there in the central angle?

Solution:

From the above pie chart we have corporate sector = 34% of total subscriptions

As we know a circle has a total of 360 degrees.

So, 100 % of total subscriptions = 360°

$\Rightarrow$ 1 % of total subscriptions = 3.6°
$\Rightarrow$ 34% of total subscriptions = 34 × 3.6 = 122.4°.

3. The following pie charts Figures (a) and (b) give the information about the distribution of weight in the human body according to different kinds of components. Study the pie charts carefully and answer the question given.
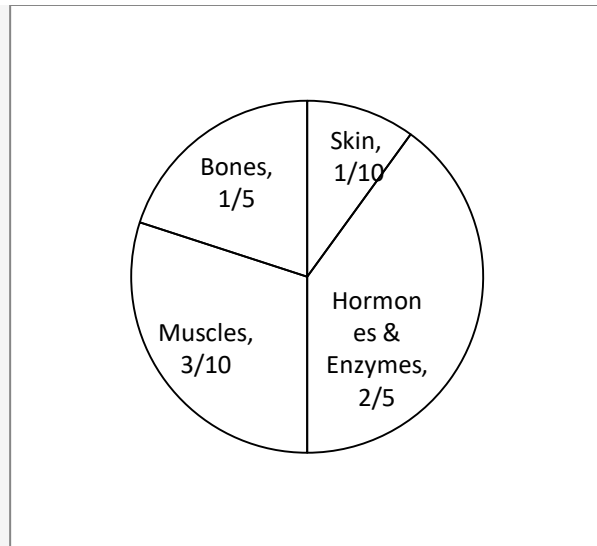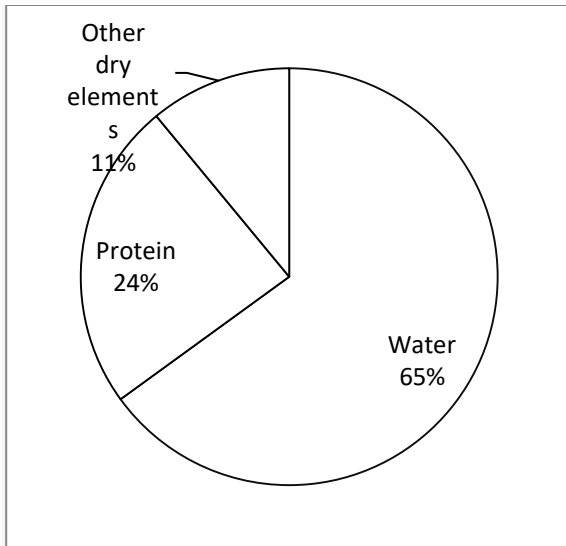
QA. What percentage of proteins of the human body is equivalent to the weight of its skin?

Solution:

Proteins contribute 24% of human weight.

Skin contributes $= \frac{1}{10} \times 100 = 10\%$ of human weight.
Let's say weight of human body is 100 kg.

⇨ Weight of proteins = 24% of 100 kg = 24 kg and

Weight of skin = 10% of 100 kg = 10kg

Now 10 kg is equivalent to $\frac{10}{24} \times 100\% = 41.66\%$.

So 41.66% of proteins of the human body is equivalent to the weight of its skin.

Q B. If the skin weighs 12 kg, then find the weight of water.

Solution:

Let the weight of water be x kg.

Given that skin weighs 12 kg

⇨ $\frac{\frac{1}{10} \text{ of total body weight}}{\frac{65}{100} \text{ of total body weight}} = \frac{12}{x}$

⇨ $x = 12 \times \frac{65}{100} \times 10 = 78 \, kg.$

Now weight of water = 78 kg.

QC. If the total weight of the body is 47 kg, then find out the difference between weight of bones and other dry elements.

> **Solution**:
>
> Given total weight of the body is 47 kg
>
> Weight of bones $= \frac{1}{5} \times 47 = 9.4$ kg
>
> Weight of dry elements $= \frac{11}{100} \times 47 = 5.17$ kg.
>
> Difference $= 9.4$ kg $- 5.17$ kg $= 4.23$ kg

Mean, Median & Mode

Mean:

Mean is basically the average found by adding all data values and dividing by the number of data values.

The mean (m) of a sample of n values $x_1, x_2, x_3, x_4, \ldots x_n$, is

$$m = \frac{x_1 + x_2 + x_3 + x_4 + \ldots + x_n}{n}$$

Examples:

1. Find the mean of 5, 11,16,10,18.

   Solution:

   $$\text{Mean (m)} = \frac{x_1 + x_2 + x_3 + x_4 + \ldots + x_n}{n} = \frac{5+11+16+10+18}{5} = \frac{60}{5} = 12$$

2. Find the mean of 1.2, 3.15, 4.19, 4.22, 5.75, 1.90.

   Solution:

   $$m = \frac{x_1 + x_2 + x_3 + x_4 + \ldots + x_n}{n} = \frac{1.2+3.15+4.19+4.22+5.75+1.90}{6} = 3.4$$

3. Find the mean of first five multiples of 8.

   Solution:

   The first five multiples of 8 are 8, 16, 24, 32, and 40.

   $$\text{Mean} = \frac{8+16+24+32+40}{5} = \frac{120}{5} = 24.$$

4. There are two sections A and B of a class, consisting of 25 and 32 students' respectively. If the average weight of section A is 45kg and that of section B is 43kg, find the average weight of the whole class.

   Solution:

   Average weight of 25 students of section A = 45 kg

⇨ Total weight of 25 students of section A = 45 × 25 = 1125 kg

Average weight of 32 students of section B = 43 kg

⇨ Total weight of 32 students of section A = 43 × 32 = 1376 kg

Now average weight of whole class $= \dfrac{total\ weight}{total\ no\ of\ students} = \dfrac{1125+1376}{25+32} = \dfrac{2501}{57} = 43.87$ kg.

5. The mean of 25 numbers is 48. If two numbers, 15 and 17 are discarded, then find the mean of the remaining numbers.

   Solution:

   Average of 25 numbers = 48

   ⇨ Sum = 48 × 25 = 1200

   If 15 and 17 are discarded then new sum = 1200 – (15 + 17) =1168

   New mean $= \dfrac{1168}{23} = 50.78$.

Median:

Median is the middle value for a set of data that has been arranged in order of smallest to largest.

To find median of **n** no. of values first we have to arrange the given values in ascending order.

Median = the value in $\left(\dfrac{n+1}{2}\right)$th place   (if n is odd)

$= \dfrac{\text{the value in } \left(\dfrac{n}{2}\right)\text{th place} + \text{the value in } \left(\dfrac{n}{2}+ 1\right)\text{th place}}{2}$ (if n is even)

Solved examples:

1. Find the median for the following data.

   96, 37, 14, 35, 55, 110, 24

   Solution:

   Arranging the above data we have,

   14, 24, 35, 37, 55, 96,110

   Here n= 7(odd)

   So, median = the value in $\left(\dfrac{n+1}{2}\right)$th place = the value in 4th place = 37.

2. Find the median for the following data set:

140, 27, 38, 23, 69, 121, 15, 52.

Solution:

Arranging the above data we have,

15, 23, 27, 38, 52, 69, 121, 140

Here n= 8(even)

So median $= \dfrac{\text{the value in } \left(\frac{n}{2}\right)\text{th place} + \text{the value in } \left(\frac{n}{2}+1\right)\text{th place}}{2}$

$\qquad = \dfrac{38+52}{2} = 45.$

3. Find the median for the following data set:
36, 53, 1.2, 3.9, 47,12.6

Solution:

Arranging the above data we have,

1.2, 3.9, 12.6, 36, 47, 53

Here n=6(even)

So, median $= \dfrac{\text{the value in } \left(\frac{n}{2}\right)\text{th place} + \text{the value in } \left(\frac{n}{2}+1\right)\text{th place}}{2}$

$\qquad = \dfrac{12.6+36}{2} = 24.3.$

4. Find the median for a set containing squares of all the even numbers between 1 to 20.

Solution:

We need to find median of squares of the set (2, 4, 6, 8, 10, 12, 14, 16, 18)

Here n = 9 (odd)

So desired value is square of 5th value $= 10^2 = 100$

5. Find the median $\dfrac{3}{5}, \dfrac{1}{2}, \dfrac{12}{13}, \dfrac{6}{5}, \dfrac{1}{6}, \dfrac{7}{9}.$

Solution:

Now to arrange the above fractions in ascending order first we have to a common multiple of all the denominators.

So the common multiple of 5, 2, 13, 5, 6, 9 is 1170

$$\frac{3}{5} = \frac{3 \times 234}{5 \times 234} = \frac{702}{1170}$$

$$\frac{1}{2} = \frac{1 \times 585}{2 \times 585} = \frac{585}{1170}$$

$$\frac{12}{13} = \frac{12 \times 90}{13 \times 90} = \frac{1080}{1170}$$

$$\frac{6}{5} = \frac{6 \times 234}{5 \times 234} = \frac{1404}{1170}$$

$$\frac{1}{6} = \frac{1 \times 195}{6 \times 195} = \frac{195}{1170}$$

$$\frac{7}{9} = \frac{7 \times 130}{9 \times 130} = \frac{910}{1170}$$

Now arranging the above data according to the above values we have,

$$\frac{1}{6}, \frac{1}{2}, \frac{3}{5}, \frac{7}{9}, \frac{12}{13}, \frac{6}{5}$$

So median $= \dfrac{\text{the value in } \left(\frac{n}{2}\right)\text{th place} + \text{the value in } \left(\frac{n}{2}+1\right)\text{th place}}{2}$

$$= \frac{\frac{3}{5}+\frac{7}{9}}{2} = \frac{31}{45}.$$

Mode

Mode is the most frequent value in a data set. There can be no mode, one mode or multiple modes in a data set.

Solved examples:

1. Find the mode of the following set of scores.

   4, 2, 8, 9, 2, 7,2,11

   Solution:

   Mode = 2,since it occurs 3 times in the given data set, which is more than any other value.

2. Find the mode of the following data set.

   53, 23, 18, 23, 23, 96, 84, 53, 107, 88, 53.

   Solution:

   Mode = 53 and 23 (both occurs most frequently i.e. 3 times)

3. The following frequency table shows the marks obtained by students in a quiz. Given that 3 marks is the only mode, what is the least value for x?

Marks	1	2	3	4	5	6
Number of students	15	13	x	9	7	3

   Solution:

   Given that 3 is the only mode of the data set.

   ⇨ x is at least 16 (if x is less than 16 then 3 will not be the mode)

4. Find the mode of the following data set.

   1020, 962, 321, 1020, 420, 786, 962, 420, 962, 333,469,656.

   Solution:

   1020, 962,420 are the modes. (Each occurs most frequently i.e. 2 times)

5. A marathon race was completed by 5 participants. What is the mode of times taken by them? (given in hours)

   2.7 , 8.3, 3.5, 5.1, 4.9

   Solution:

   Ordering the data in ascending order we get,

   2.7, 3.5, 4.9, 5.1, 8.3

   Since each value occurs only once in the data set, there is no mode for this set of data.

Probability

Probability is a measurement of uncertainty.

- Random experiment:

  A random experiment is an experiment or a process for which the outcome cannot be predicted with certainty and the process repeatedly occurs under homogeneous conditions.

- Outcome:

An **outcome** is a result of a random experiment.

- Sample space(S):

The set of all possible outcomes is called the **sample space**.

- Event(E):

In **probability** theory, an **event** is a set of outcomes of an experiment (a subset of the sample space).

Example

➢ Rolling a dice is a random experiment.

Here the number of possible outcomes 6.

Sample space = $\{1, 2, 3, 4, 5, 6\}$

Getting an even number is an event.

Probability of an event = $\dfrac{\text{total no of elments in the event set (n(E))}}{\text{total no.of elements in the sample space(n(S))}}$

- ❖ **Points to remember**
  - $P(S) = 1$
  - $0 \leq P(E) \leq 1$

Solved examples:

1. Find the probability of getting an odd no. when a dice is thrown?

Solution:

Here   S= {1,2,3,4,5,6}

E= {1,3,5}

P (getting an odd number)= $\frac{n(E)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

2. A coin is tossed twice .find the probability of getting at least one head.

Solution:

Here S = $\{HH, HT, TH, TT\}$

E= $\{HT, TH, HH\}$

P (getting at least one head)= $\frac{n(E)}{n(S)} = \frac{3}{4}$

3. A number a is chosen at random from the numbers 4, 6, 1, 92, 32, 56, 98, 11, 55. What is the probability that a < 50.

Solution:

Here S= $\{4, 6, 1, 92, 32, 56, 98, 11, 55\}$

E = $\{4, 6, 1, 32, 11\}$

P (choosing a < 50)= $\frac{n(E)}{n(S)} = \frac{5}{9}$.

4. Two dice are thrown simultaneously. Find the probability of getting a sum greater than or equal to 8 on adding the two faces.

Solution:

Here   S ={(1,1)(1,2)(1,3)(1,4)(1,5)(1,6)

(2,1)(2,2)(2,3)(2,4)(2,5)(2,6)

(3,1)(3,2)(3,3)(3,4)(3,5)(3,6)

(4,1)(4,2)(4,3)(4,4)(4,5)(4,6)

(5,1)(5,2)(5,3)(5,4)(5,5)(5,6)

(6,1)(6,2)(6,3)(6,4)(6,5)(6,6)}

E = {(2,6)(3,5)(3,6)(4,4)(4,5)(4,6)(5,3)(5,4)(5,5)(5,6)(6,2)(6,3)(6,4)(6,5)(6,6) }

P (getting a sum greater than or equal to 8) = $\frac{n(E)}{n(S)} = \frac{15}{36}$

5. Tickets numbered 1 to 25 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is multiple of 3 or 5?

Solution:

Here S = {1, 2, 3,…………, 24, 25}

E = Event of getting a multiple of 3 or 5 = {3, 6, 9, 12, 15, 18, 21, 24, 5, 10, 20, 25}

$P(E) = \frac{n(E)}{n(S)} = \frac{12}{25}$.

II. LOGICAL REASONING

Unit - 1 : Analogy basing on kinds of relationships, Simple Analogy; Pattern and Series of Numbers, Letters, Figures. Coding-Decoding of Numbers, Letters, Symbols (Figures), Blood relations

1. <u>Analogy</u>

Definition : An analogy compares the relationship between two things or ideas to highlight some point of similarity. It is a way to clarify an idea or an unfamiliar concept by comparing it to something familiar.

Look at this example:

NOTE :

- The example given above asks you to identify the relationship between pairs of words.
- To answer this question, you must first decode the symbols. The colon (:) stands for the phrase "is related to," and the double colon (::) can be read as "in the same way that." Thus, you would read the above example like this: "Appalling is to pleasing in the same way that interesting is to…"
- To figure out the missing word, you need to identify the relationship between the first two elements precisely as possible, and choose a word that will make the final pair have a parallel relationship.
- Most accurately, you might describe the relationship between appalling and pleasing as "appalling is an antonym of pleasing."
- Now read the first word of the second pair, supplying the same relationship: "interesting is an antonym of…"
- The only word that fits this blank adequately is "boring," the opposite of 'interesting'. The other three options do not fit the blank as they are the synonyms of interesting.
- In the example above, the relationship between the words in the first pair is compared to the relationship of words in the second pair. This is what we call an analogy is.

For example - **butterflies : swarm :: fish : school**

You can read this analogy as:

Butterflies are to swarm as fishes are to school.

In this example, swarm is the specific term for a group of butterflies. Similarly, school is the specific term for a group of fish.

Both the pairs of words in the analogy illustrate the same relationship.

KINDS OF RELATIONSHIPS

1. Instrument and measurement
- Ex-Barometer : Pressure   - Barometer is an instrument used to measure pressure.
- Some more examples -
- Thermometer : Temperature
- Odometer   : Speed
- Scale   : Length
- Balance   :Weight
- Rain gauge   : Rain

2. Quantity and Unit -
- Ex- Length : Metre   - Metre is the commonly used unit of length.
- Some more examples –
- Mass : Kilogram
- Force : Newton
- Volume : Litre
- Time : Hour
- Temperature : Degrees

3. Individual and group -
- Ex – Sailors : Crew   - A group of sailors is called a crew.
- Some more examples –
- Cattle : Herd
- Flowers : Bouquet
- Grapes : Bunch
- Singer : Chorus
- Man : Crowd

4. Animal and young one –
- Ex – Horse : Pony   - Pony is the young one of horse.
- Some more examples –
- Cat : Kitten
- Sheep : Lamb
- Cow : Calf
- Dog : Puppy
- Man : Child

5. Male and female –
- Ex- Horse : Mare   -   Mare is the female horse.
- Some more examples –
- Dog : Bitch
- Son : Daughter
- Lion : Lioness
- Gentleman : Lady
- Nephew : Niece

6. Individual and class –
- Ex – Lizard : Reptile - Lizard belongs to the class of reptiles.
- Some more examples
- Man : Mammal
- Ostrich : Bird
- Butterfly : Insect
- Snake : Reptile
- Whale : Mammal

7. Individual and dwelling places
- Ex – Dog : Kennel - A dog lives in a kennel.
- Some more examples –
- Bee : Apiary
- Cattle : Shed
- Lion : Den
- Poultry : Farm
- Fish : Aquarium

8. Study and topics –
- Ex – Ornithology : Birds - Ornithology is the study of birds
- Some more examples –
- Botany : Plants
- Entomology : Insects
- Zoology : Animals
- Oology : Eggs
- Virology : Viruses

9. Worker and tool –
- Ex – Carpenter : Saw - Saw is a tool used by the carpenter.
- Some more examples –
- Woodcutter : axe
- Tailor : needle
- Soldier : gun
- Doctor : stethoscope
- Farmer : plough

10. Tool and action –
- Ex- Needle : Sew - A needle is used for sewing
- Some more examples –
- Knife : cut
- Pen : write
- Spoon : feed
- Gun : shoot

- Axe : grind

11. Worker and working place-
- Ex – Chef : Kitchen   - A chef works in a kitchen
- Some more examples –
- Farmer : field
- Warrior : battlefield
- Teacher : school
- Doctor : hospital
- Clerk : office

12. Worker and product –
- Ex – Mason : Wall - A mason builds a wall.
- Some more examples –
- Farmer : crop
- Hunter : prey
- Carpenter : furniture
- Author : book
- Butcher : meat

13. Product and Raw Material-
- Ex-Prism: Glass- Prism is made of glass.
- Some more examples –
- Butter : Milk
- Wall : Brick
- Furniture : Wood
- Shoes : Leather
- Oil : Seed

14. Part and whole relationship –
- Ex- Pen : Nib - Nib is a part of a pen
- Some more examples –
- Pencil : lead
- House : keychain

- Fan : blade
- Class : student
- Room : Window

15. Word and Intensity -
- Ex- Anger: Rage- Rage is of higher intensity than anger.
- Some more examples –
- Wish: Desire
- Kindle: Burn
- Sink: Drown
- Quarrel: War
- Error: Blunder

16. Word and Synonym –
- Ex- Abode : Dwelling – Abode means the same as dwelling. Thus, dwelling is the synonym of abode.
- Some more examples –
- Ban : Prohibition
- Assign : Allot
- Vacant : Empty
- House : Home
- Flaw : Defect

17. Word and Antonym-
- Ex- Attack : Defend – Defend means the opposite of attack. Thus, Defend is the antonym of Attack
- Some more examples –
- Advance : Retreat
- Cruel : kind
- Best : Worst
- Fresh : Stale
- Ignore : Notice

Examples –

In the following questions, find out the RELATION between given two words in capital letter and pick up one word proportionately from the options that bear the same relation.

1. Day: Night **::** _____ **:** _____
   (1) Half : Full   (2) Tall : Fat
   (3) East : West   (4) Food : Vegetable
   Answer   -   East : West (Opposite To Each Other).

2. Distance: Mile **::** _____ **:** _____
   (1) Weight : Scale   (2) Fame : Television
   (3) Field : Plough   (4) Liquid: Litre
   Answer   -   Liquid : Litre (2nd one is the unit of 1st one).

3. Ring: Finger :: Shoe : _____
   (1) Socks   (2) Case
   (3) Foot   (4) Market
   Answer -   Foot (2nd one is the body part in which the 1st one is worn)

4. Court: Justice :: School **:** _____
   (1) Teacher   (2) Education
   (3) Student   (4) Discipline
   Answer   **-**   Education (The thing that is imparted in the institution).

5. Mouse: Cat :: Worm **:** _____
   (1) Trap   (2) Bird
   (3) Paw   (4) Grab
   Answer   - Bird (Prey : Predator)

2. **SERIES**

➤ **NUMBER SERIES** –
   A series of numbers which follow a certain pattern throughout.
Case I –
Finding the difference between the terms in the given series –

Ex 1 : Which number would replace ' ? ' in the series : 7 , 12 , 19 , ? , 39
a) 29 b) 28 c) 26 d) 24

Solution - Difference between 7 and 12 = 5

Difference between 12 and 19 = 7

Note – Here the difference increases by 2 , so the next difference should be 9.

Thus, answer = 19 + 9 = 28.

Ex 2 : Which is the number that comes next in the sequence : 0 , 6 , 24 , 60 , 120 , 210 ?

a) 240   b) 290   c) 336   d) 504

Solution – Pattern of the series ; $1^3 - 1$, $2^3 - 2$, $3^3 - 3$, $4^3 - 4$, 5^3 - 5 , 6^3 - 6

Next number $7^3 - 7 = 343 - 7 = 336$

Hence, the answer is 336.

Ex 3 : Which is the number that comes next in the following sequence : 4 , 6 , 12 , 14 , 28 , 30 , ?

a) 32   b) 60   c) 62   d) 64

Solution – The given sequence is the series 4, 4+2 (=6), 6*2 (=12), 12+2, 14*2, 28+2…

So pattern followed is +2,*2,+2,*2, …..

So, next number is 30*2

Hence, answer = 60

Ex 4 : Find out the missing number in the following sequence : 1 , 3 , 7 , ? , 21

a) 10   b) 11   c) 12   d) 13

Solution - Pattern followed is + 2 , + 4 , …..

Missing number = 7 + 6 = 13

Hence, answer = 13.

Ex 5 : Which fraction comes in the sequence $\frac{1}{2}, \frac{3}{4}, \frac{5}{8}, \frac{7}{16}$, ?

a) $\frac{9}{32}$ b) $\frac{10}{17}$ c) $\frac{11}{34}$ d) $\frac{12}{35}$

Solution- The numerators of the fractions in the series have a difference of 2. The denominators of the fractions form the series 2,4,8,16 i.e 2^1, 2^2, 2^3, 2^4…So the numerator of the next fraction will be 7+2=9 and denominator will be 2^5=32.

Answer = $\frac{9}{32}$

Elementary Idea of Progressions

1. **Arithmetic Progression (A.P)-** The progression of the form a, a+d, a+2d…..is known as AP with first term= a and common difference = d

    Ex 1- 3, 6, 9, 12…… is an AP with a=3, d=6-3=3

    In an AP we have n*th* term= a + (n-1)d

    Ex 2- In the series 357, 363,369,….,What will be the 10th term ?

        a) 405   b) 411   c) 413   d) 417

    Solution- The given series is an A.P in which a=357, d=6

        10th term = a+(10-1)d

              = a+9d

              = $(357+9 \times 6)$

              = 357+54

              = 411

    Ex3- How many terms are there in the series 201, 208, 215, …, 369 ?

    A) 23   b) 24   c) 25   d)26

    Solution- The given series in an AP in which a=201, d=7

        Let the number of terms be n.

       $369=201+ (n-1) \times 7$

    ⇨ 369=201+7n-7

    ⇨ 168=7n-7

    ⇨ 7n= 175

    ⇨ n = 25

    Answer = 25

2. **Geometric Progression (G.P)-** The progression of the form a,ar,ar^2, ar^3,…..is known as GP with first term = a and common ratio= r

    Ex 1- 1,5, 25, 125, …. is a GP with a = 1 and $r = \frac{5}{1} = \frac{25}{5}$ =………= 5

    In a GP we have n*th* term= ar^{n-1}

    Ex 2- In the series 7,14,28,…. What will be the 10th term?

        a) 1792   b) 2456   c) 3584   d) 4096

    Solution- Clearly, 7*2=14, 14*2=28,…..and so on

       In the given series of GP a=7, r =2

       10th term = ar$^{(10-1)}$

              = ar^9

              = 7×2^9

              =7×512

              = 3584

Answer= 3584

Ex 3- Find the number of terns in GP 6, 12 ,24, …….., 1536 ?

    a) 7   b)9   c)8   d)10

Solution- $a_1 = 6$ $a_2 = 12$ $a_n = 1536$

$r = \dfrac{a2}{a1} = \dfrac{12}{6} = 2$

Now we have, $1536 = ar^{n-1}$

⇨ $1536 = 6 \times 2^{n-1}$

⇨ $256 = 2^{n-1}$

⇨ $2^8 = 2^{n-1}$

⇨ $8 = n-1$

⇨ $n = 9$.

➢ **LETTER SERIES**

In this series, only letters are available which follow a certain pattern throughout.

Position of Letters
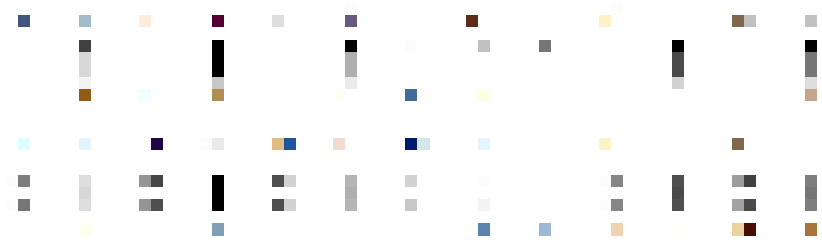
Quick tricks :

1. Starting point of the series is called left end and end point of the series is called right end.

2. To solve the question easily we should break the series in combination of 5-5 elements – ABCDE / FGHIJ / KLMNO / PQRST / UVWXY / Z - it will help in counting the letters.

3. There are some key words which help in remembering the place values of the letters. Once the candidate knows the position of alphabets, he requires to learn time management.

TABLE OF 3
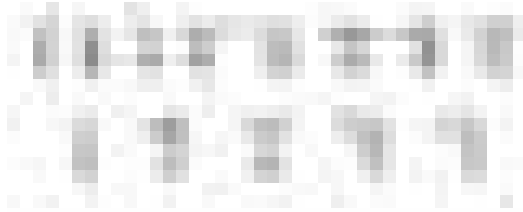
TABLE OF 5

Words given above are the arrangement of alphabets having position multiples of 3 in first line and 5 in second line.

4. The opposite letters

A ↔ Z (**AZ**ad)   F ↔ U (**FU**ll)   K ↔ P (**K**an**P**ur)
B ↔ Y (**B**o**Y**)   G ↔ T (**G T** road)   L ↔ O (**LO**ve)
C ↔ X (Cru**X**)   H ↔ S (**H**igh **S**chool)   M ↔ N (**M**a**N**)
D ↔ W (**D**e**W**)   I ↔ R   (**I**ndian **R**ailway)
E ↔ V (**EV**en)   J ↔ Q   (**J**ungle **Q**ueen)

Examples –

1. Solve the series : JAF, JEF, JIF, JOF, ?

a) PIG   b) PET   c) JUF   d) POT

Solution –
The middle letters which are vowels have an increasing trend of A, E, I, O, U and remaining letters have been retained as it is. So answer would be **JUF.**

2. Solve the series - WXCD, UVEF, STGH, QRIJ?

a) OPKL   b) AYBZ   c) JIRQ   d) LRMS

Solution –
The last two letters of every word is in ascending order and the first two letters are in descending order.

OP precedes QR and KL succeeds IJ.

Answer - **OPKL**

3. In the word EMASCULATE let the place value of the letters according to English alphabets be written in descending order then which number is 4th from the left end?

a. 13   b.14   c.12   d.1

Solution –

E   M   A   S   C   U   L   A   T   E

5   13   1   19   3   21   12   1   20   5

Descending order -

21   20   19   **13**   12   5   5   3   1   1

So, answer is 13 , 4th from left end.

4. If only each of the vowels in the word IMPOSE is changed to the next letter in the English alphabet then which of the following will be the fifth letter from the left end ?

a) P   b) J   c) F   d) S

Solution -

I   M   P   O   S   E

J   M   P   P   **S**   F

So, the answer is S

➢ **FIGURE SERIES**

Definition – In a figure series, there is a sequence of figures depicting a change step by step. Either one of these figures is out of order and has to be omitted or figure has to be selected from a separate set of figures which would continue the series.

There are two directions mostly used in the figures – i) clockwise direction ii) anti – clockwise direction. A clockwise direction movement will be as in a square boundary.
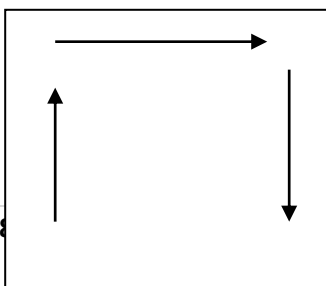
Fig - A clockwise direction movement in a square boundary.
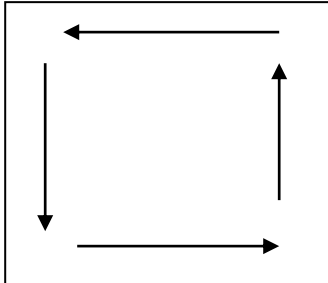
Fig – An anticlockwise direction movement in a square boundary.

Note – In a square boundary means a square box.

Four Figure series –

In this case , the series or sequence is indicated by four problem figures and it is required to select a figure from amongst the answer figures which would be fifth figure to continue the series.

Examples –

1. Find the figure that will replace the question mark
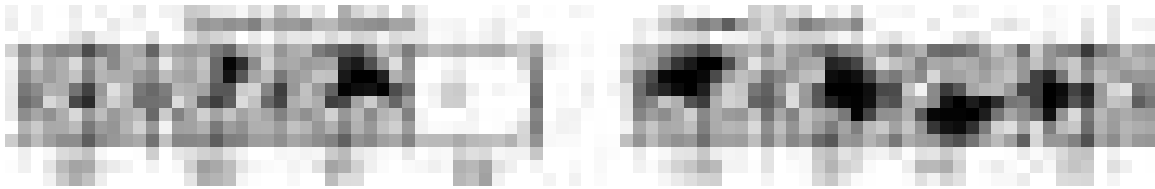
Answer - Option (2)

The sequence of this series is that the circle has been divided into various sectors which are getting shaded in clockwise direction by adding a cord each time.

2. Which figure can be placed in place of question mark?
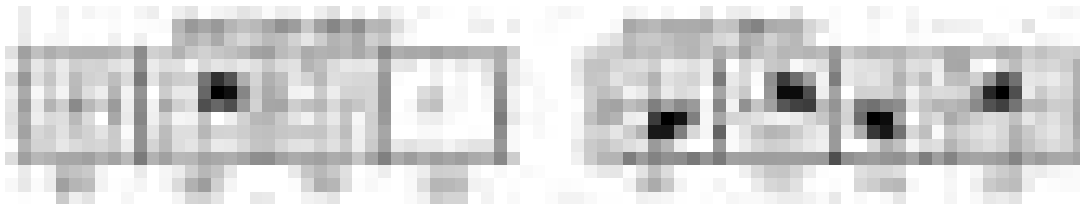
Answer – Option (2)

Figure (a) and (b) are related to each other by getting shade of upper right side quarter therefore in this way figure (2) will make pair with figure (c).

3. Find the similar figure as that of the question figure.
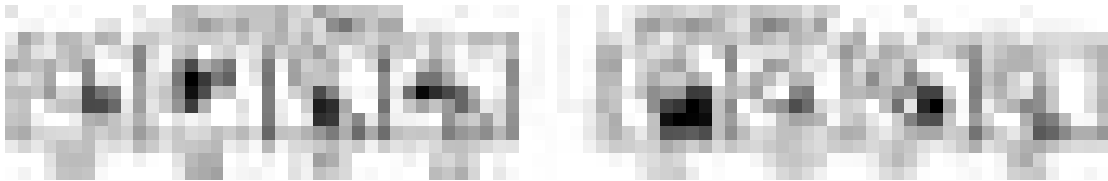
Answer – Figure (3)

In question figure all blocks consist of two figures touching each other and half of any of them is shaded. The sequence in the question figure also shows that in the odd number blocks, top figure is empty and bottom is shaded while in the even number blocks top figure is shaded while the bottom one is empty. Hence figure (3) is same as question figure.

4. If the figures continue to change in the same order what should the fifth figure be?"

Solution: You will see two different things happening here. The number of circles is increasing 1, 2, 3, 4, so that the next figure would have 5 circles. But note that the square is also turning. First the point is up, then the flat side, then again the point is up, and then again the flat side. In the next place, therefore, the point should be up. But in figure C there are 6 circles inside the rectangle.

Answer: So none of the figure is correct.

5. Continue the series :

Answer – D .

Sol: Here the arrow in the circle goes on rotating in clockwise direction at an angle of 45° each time. Hence the answer would be (d).

Five figure series:

In this case , the series or sequence is indicated by five problem figures and it is required to select a figure from amongst the answer figures which would be sixth figure to continue the series.

Examples –

1. Select a figure from amongst the answer Figures which will continue the same series as established by the five Problem Figures.

Problem Figures: Answer Figures:

(A)   (B)   (C)   (D)   (E)   (1)   (2)   (3)   (4)   (5)

Answer: Option **(4)**
      In one step, the existing element enlarges and a new element appears inside this element. In the next step, the outer element is lost.

2. Select a figure from amongst the Answer Figures which will continue the same series as established by the five Problem Figures.

Problem Figures: Answer Figures:

(A)   (B)   (C)   (D)   (E)   (1)   (2)   (3)   (4)   (5)
Answer : Option **(1)**
In each step, the dot moves one space clockwise and the arrow moves two spaces clockwise.

3. Select a figure from amongst the Answer Figures which will continue the same series as established by the five Problem Figures.

Problem Figures: Answer Figures:

(A)   (B)   (C)   (D)   (E)   (1)   (2)   (3)   (4)   (5)

Answer - Option **(3)**

The pin rotates 45º clockwise and 90º clockwise alternately and moves one space (each space is equal to half-a-side of the square) and two spaces clockwise alternately. The arrow rotates 90º anti clockwise and 45º anti clockwise alternately and moves two spaces and one space.

4. Select a figure from amongst the Answer Figures which will continue the same series as established by the five Problem Figures.

Problem Figures: Answer Figures:

(A)   (B)   (C)   (D)   (E)   (1)   (2)   (3)   (4)   (5)

Answer - Option **(3)**

In each step, the pin rotates 90º clockwise and the arrow rotates 90º anti clockwise.

5. Select a figure from amongst the Answer Figures which will continue the same series as established by the five Problem Figures.

Problem Figures: Answer Figures:

(A)   (B)   (C)   (D)   (E)   (1)   (2)   (3)   (4)   (5)

Answer – Option **(2)**

In one step, the figure gets laterally inverted and one line segment is lost from the upper end of the RHS portion of the figure. In the next step, the figure gets laterally inverted and one line segment is lost from the upper end of the LHS portion of the figure.

\

3. **CODING & DECODING**

- **Coding** is a process in which a word, a number, or a series of combination of words and numbers is expressed in a particular code or pattern based on various rules. You have to answer the questions based on these set of rules.
- **Decoding** is the process of (interpreting) deciphering the coded pattern and reverting it to its original form from the given codes. Hence, you are required to understand the logic behind the coding pattern and then apply this logic to find answers.

LETTER CODING:

Here letters are assigned codes according to a set pattern or rule concerning the movement or reordering / rearranging of letters and you need to detect this rule to decode a massage. Sometimes, specific codes are assigned to particular letters without any set pattern. Observe a few examples to know the various reordering or rearranging techniques.

Ex-1

In a code language if TRAINS is coded as RTIASN, how PISTOL will be coded in the same language?
(a) SITLOP
(b) IPSTLO
(c) SIPTLO
(d) IPTSLO

Solution: (Answer – d)

If we compare the basic word {TRAINS} with the coded word {RTIASN}, we would see that the letters used in the word are same as in the basic word but their order of placement has been changed. Letter T at first position of the basic word has been placed at second position in the coded word and the letter R at the second position has been placed in the first position.
It means that in this question, letters of the basic word have been interchanged i.e. first letter with second, third with the fourth and so on. And thus we get the coded word. So PISTOL will be coded as IPTSLO. Hence option (d) is the answer.

Ex-2

In a certain code, TEACHER is written as VGCEJGT. How is CHILDREN written in that code?
(a) EJKNEGTP   (b) EGKNFITP (c) EJKNFGTO (d) EJKNFTGP

Solution: (Answer- d)

Each alphabet in the word "TEACHER " is moved two steps forward to obtain the corresponding alphabet of the code.
T E A C H E R

V G C E J G T
(Each alphabet is increasing by 2)
Similarly, we have
C H I L D R E N
E J K N F T G P

Ex-3

In a certain code language, the word ROAD is written as WTFI. Following the same rule of coding, what should be the word for the code GJFY?

(a) REAP (b) TAKE (c) BEAT (d) LATE

Solution: (Answer- c)

Each alphabet of the word is five steps behind the corresponding alphabet of the given code word.

Hence, BEAT is coded as GJFY.

Ex-4

If 'tee see pee' means 'drink fruit juice'; 'see kee lee' means 'juice is sweet' and 'lee ree mee' means 'he is intelligent', which word in that language means 'sweet'?
(a) see
(b) kee
(c) lee
(d) pee

Solution: (Answer b)

In the first and second statement, the common word is 'juice' and the common code word is 'see'. So, 'see' means 'juice'.
In the second and third statements, the common word is 'is' and the common code is 'lee'. So 'lee' means 'is'. Thus in the second statement, the remaining word 'sweet' is coded as 'kee'. Hence the answer is choice (b).

NUMBER CODING:

Numerical code is given or value is assigned to a word. Here the only way to relate the alphabets & numbers is by associating the positions of the letters in the English alphabet. Sometimes any mathematical operation like addition or subtraction can be performed using the position of the letters. Direct coding questions can also be asked.

Ex-1 If PAINT is coded as 74128 and EXCEL is coded as 93596, then how would you encode ACCEPT?

(a) 455978
(b) 547978
(c) 554978
(d) 735961

Solution: (Answer- a)

In the given code the alphabets have been coded as follows:

P A I N T E X C E L
7 4 1 2 8 9 3 5 9 6

So, in ACCEPT, A is coded as 4, C as 5, E as 9, P as 7 and T as 8. Hence the correct code is 455978 and therefore the answer is Choice (a).

Ex-2 If DELHI is coded as 73541 and CALCUTTA as 82589662, how can CALICUT be coded ?

     a. 5279431
     b. 5978213
     c. 8251896
     d. 8543691

Solution.(Answer: c)

`The alphabets are coded as follows :

D	E	L	H	I	C	A	U	T
7	3	5	4	1	8	2	9	6

So, in CALICUT,
C is coded as 8,
A as 2,
L as 5,
I as 1,
U as 9   and
T as 6.
Thus, the code for CALICUT is 8251896.

Ex-3 If in a certain code, TWENTY is written as 863985 and ELEVEN is written as 323039, how is TWELVE written in that code ?

a) 863203
b) 863584
c) 863903
d) 863063

Solution (Answer: a)

The alphabets are coded as shown :

T	W	E	N	Y	L	V
8	6	3	9	5	2	0

So, In TWELVE ,

T is coded as 8,

W as 6,

E as 3,

L as 2,

V as 0.

Thus, the code for TWELVE is 863203.

Ex-4 In a certain code 'MISSIONS' is written as 'MSIISNOS'. How is 'ONLINE' written in that code?

1. OLNNIE

2. ONILEN

3. NOILEN

4. LNOENI

5. ONNLIE

Solution: Answer - Option 1

Explanation: First and last letter remain same. The others interchange their positions in pair of two.

So, NL become LN and IN become NI so code of ONLINE will be OLNNIE.

SYMBOL CODING

Directions (Q1-5): In each of the following questions, there is a group of letters followed by four combinations of digits/symbols (A), (B), (C) and (D). You have to find out which of the combinations correctly represents the group of letters based on the following digits/symbol coding system and the conditions those follow and mark the number of that combination as the answer. If none of the combinations is correctly represents the group of letters then mark (E).

Letter:	L	H	U	B	E	P	N	A	K	I	R	S	T	M	V
Digits/Symbols:	5	<	4	#	@	3	*	^	8	%	9	!	~	1	$

Conditions:

i)   If the first letter is a vowel and the last letter is a consonant, then the codes are to be interchanged.

ii)   If both the first and the last letters are vowels, then both are to be coded as the code for the last letter

iii) If any word has more than two vowels, then all vowels are coded to be as the code for I.

Q.1 UNRBV

A. 4*9#$
B. $*9#$
C. $*9#4
D. $*4#9
E. None of these.
Ans.   C
Solution: UNRBV - $*9#4 (Condition i)

Q.2 SMALKI

A. %15!8^
B. !1^58%
C. 1#!568
D. !1^5%8
E. None of these
Ans .   B
Solution: SMALKI - !1^58%

Q.3 AMBLPU

A. ^5#34^
B. 1#543^
C. ^1#534
D. 41#534
E. None of these

Ans.D
Solution: AMBLPU - 41#534 (Condition ii)

Q.4 KINAHE

A. 9*#%15
B. 8%*%<%
C. @*%$56
D. %^85@1
E. None of these
Ans.B
Solution: KINAHE - 8%*%<% (Condition iii)

Q.5 EMKLVP

A. $5&58^
B. $5&^85
C. @1853$
D. 3185$@
E. None of these
Ans.D
Solution: EMKLVP - 3185$@ (Condition i)

4. BLOOD RELATIONS

Definition- A person who is related to another by birth rather than by marriage.

NOTE- Relation on the mother side is called **maternal** and that on the father side is called **paternal** and if the relation is on the partner side (Husband or wife) is called   **in-law.**

A method known as **FAMILY TREE** is used to solve the questions regarding blood relation which is just a graphical method to show all the possible relation.

Used for males	Used for females	Husband wife relationship	
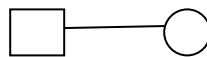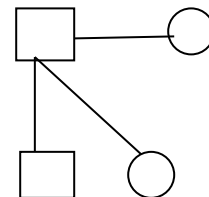
Son and daughter

Indirect Reference	The real relation
Father's or Mother's Daughter	Sister
Father's or Mother's Son	Brother
Father's or Mother's Sister	Aunt
Father's or Mother's Brother	Uncle
Father's or Mother's Mother	Grandmother
Father's or Mother's Father	Grandfather
Daughter's Husband	Son-in-law
Son's Wife	Daughter – in – law
Husband's or Wife's Brother	Brother – in – law
Husband's or Wife's Sister	Sister – In – law
Brother's Daughter	Niece
Brother's Son	Nephew
Brother's Wife	Sister-in-law
Sister's Husband	Brother- in- law
Aunt's or Uncle's Son or Daughter	Cousin
Granddaughter's or Grandson's daughter	Great grand daughter

The first step to being able to solve blood relation questions is a logical reasoning of the relations that exist between different members of a family, both close and far.

EXAMPLES

Question 1: Pointing to a girl in the photograph, Ajay said, "Her mother's brother is the only son of my mother's father." How is the girl's mother related to Ajay ?

A) Mother

B) Sister

C) Aunt

D) Grandmother

E) None of these

Solution:

Only son of Ajay's mother's father -- Ajay's maternal uncle.

So, the girl's maternal uncle is Ajay's maternal uncle.

Thus, the girl's mother is Ajay's aunt.

Question 2:

1. A + B means A is the brother of B

2. A × B means A is the father of B

3. A ÷ B means A is the mother of B

Which of the following would mean "G is the son of H"?

A)H ×I × G

B)H + G × I

C)H ÷ G ÷ I

D) H × G + I

Solution: Answer: Option D

Go by options. In fourth option, our diagram will be like

We don't know the gender of I. So. We will not put any symbol on its side.

Question 3.A is B's sister. C is B's mother. D is C's father. E is D's mother. Then, how is A related to D?

A. Grandfather

B. Grandmother

C. Daughter

D. Granddaughter

Answer: D) Granddaughter

Explanation:

A is the sister of B and B is the daughter of C.

So, A is the daughter of C. Also, D is the father of C.

So, A is the granddaughter of D.

Question 4.P is the brother of Q and R. S is R's mother. T is P's father. Which of the following statements cannot be definitely true ?

A. T is Q's father

B. S is P's mother

C. P is S's son

D. Q is T's son

Answer: D) Q is T's son

Explanation:
P, Q, R are children of same parents. So. S who is R's mother and T, who is R's father will be mother and father of all three.

However, it is not mentioned whether Q is male or female So, D cannot be definitely true.

Question 5. Pointing to a person, a man said to a woman, "His mother is the only daughter of your father." How was the woman related to the person ?

A. Aunt

B. Mother

C. Wife

D. Daughter

Answer: A) Aunt

Explanation:
Daughter of your father — your sister. So, the person's mother is woman's sister or the woman is person's aunt.

UNIT – 2 : Logical Statements – Two premise argument, More than two premise argument using connectives

In logic, any statement is termed as the Proposition. Thus a proposition is a statement expressing certain relation between two or more terms, analogous to a sentence in grammar.

The proposition consists of three parts:

- Subject-The subject is that about which something is said
- Predicate-The predicate is the part of the proposition denoting that which is affirmed or denied about the subject.
- Copula-The copula is that part of the proposition which denotes the relation between the subject and the predicate.
- Consider the proposition('Man is cultured')
  Here 'man' is the subject.
  'Cultured' is the quality affirmed for this subject. So it is the predicate.
  'is' denotes the relation between the subject and the predicate. So it is the copula.

FOUR FOLD CLASSIFICATION OF PROPOSITIONS:

a. **Universal Affirmative Proposition**
   Example-All lions are animals.

From this, we cannot say 'All animals are lions.

b. **Universal Negative Proposition**

   Ex. - No child is intelligent by birth.

c. **Particular Affirmative Proposition**

Ex. - Some people are foolish.

Here the subject term 'Some People' is used not for all but only for some people and similarly the predicate term 'Foolish' is affirmed for a part of the subject.

d. **Particular Negative Proposition**

e.g. " Some animals are not wild "

Here the subject term ' some animals' is used only for a part of its class while the predicate term 'wild' is not denied in entirety to the subject term.

These facts can be summarized as follows :

Proposition	Type
a) Universal Affirmative Proposition	All S is P.
b) Universal Negative Proposition	No S is P.
c) Particular Affirmative Proposition	Some S is P.
d) Particular Negative Proposition	Some S is not P.

SYLLOGISM:
Two premise argument

In Syllogism, a conclusion has to be drawn from two propositions , referred to as the Premises.

Example 1–   a. All lotus are flowers.
               b. All flowers are beautiful.
               c. All lotus are beautiful.

The propositions a) and b) are the Premises and the proposition c) is called the Conclusion which follows from the first two propositions.

Syllogism is concerned with 3 terms –
1. **Major term** : It is the predicate of the conclusion and is denoted by P .
2. **Minor term** : It is the subject of the conclusion and is denoted by S.
3. **Middle term** : It is the term common to both the premises and is denoted by M.

Example 2-   Premises   :   1. All dogs are animals.
                            2. Tiger is a dog.

             Conclusion : Tiger is an animal.

Rules for deriving the conclusion :

I.   The conclusion contain the middle term.
     Example - Statements : 1. All men are girls.
                             2. Some girls are students.
               Conclusion : 1. All girls are men.
                             2. Some students are girls.

<center>A   B</center>

Here both the conclusions 1 and 2 contain the middle term 'girls'. From the above figures, It is clear that conclusion 1 does not follow, but conclusion 2 follows.

II. No term can be distributed in the conclusion unless it is distributed in the premises.

  Example - Statements : 1. Some dogs are goats.
             2. All goats are cows.
     Conclusions : 1. All cows are goats.
           2.Some dogs are cows.

<center>A   B</center>

Statement 1 is an I type proposition which distributes neither the subject nor the predicate . Statement 2 is an A type proposition which distributes the subject i.e 'goats' only.

Conclusion 1 is an A type proposition which distributes the subject 'cow' only.

Since the term 'cow' is distributed in conclusion 1 without being distributed in the premises , so conclusion 1 cannot follow.

III. The middle term (M) should be distributed at least once in the premises. Otherwise, the conclusion cannot follow.

  For the middle term to be distributed in a premise,
  i) M must be the Subject if premise is an A proposition.
  ii) M must be Subject or Predicate if premise is an E proposition.
  iii) M must be Predicate if premise is an O proposition.

 NOTE : In an I proposition, which distributes neither the subject nor the Predicate, the middle term cannot be distributed.

 Example : Statements : 1. All fans are watches.
           2.Some watches are black.
     Conclusions : 1. All watches are fans.

2. Some fans are black.

A   B

In the premises, the middle term is 'watches'. It is not distributed in the first premise which is an A proposition as it doesn't form its subject. Also, it isn't distributed in the second premise which is an I proposition. Since the middle term is not distributed at least once in the premises, so no conclusion follows.

IV. No conclusion follows
  a) If both the premises are particular
    Example : Statements : 1. Some books are pens.
             2.Some pens are erasers.
        Conclusions : 1. All books are erasers.
             2.Some erasers are books.

A   B

    Since both the premises are particular, no conclusion follows.
  b) If both the premises are negative
    Example : Statements : 1. No flower is mango.
             2.No mango is cherry.
        Conclusions : 1. No flower is cherry.
             2.Some cherries are mangoes.

A   B

Since both the premises are negative, neither conclusion follows.

c) If the major premise is particular and the minor premise is negative.

Example :   Statements :   1. Some dogs are bulls.
                                     2. No tigers are dogs.
              Conclusions :   1. No dogs are tigers.
                                     2. Some bulls are tigers.

A   B

Here the first premise containing the middle term 'dogs' as the Subject is the major premise and the second premise containing the middle term 'dogs' as the Predicate is the minor premise. From the figure it is clear that conclusion 1 follows and conclusion 2 does not follow.

V.   If the middle term is distributed twice, the conclusion cannot be universal.

Example: Statements :   1.All fans are chairs.
                                       2.No tables are fans.

               Conclusion :   1.No tables are chairs.
                                       2. Some tables are chairs.

A   B

Here the first premise is an A proposition and so the middle term 'fans' forming the subject is distributed. The second premise is an E proposition and so the middle term

fans forming the predicate is distributed. Since the middle term is distributed twice so the conclusion cannot be universal.

VI.   If one premise is negative, the conclusion must be negative.
       Example: Statements: 1. All grasses are trees.
                                       2.No tree is shrub.
                Conclusion: 1. No grasses are shrubs.
                                         2.Some shrubs are grasses.

Since one premise is negative the conclusion must be negative. So, only conclusion 1 follows and conclusion 2 cannot follow.

VII.   If one is particular the conclusion is particular.
       Example: Statements: 1. Some boys are thieves.
                                         2. All thieves are dacoits.
                Conclusion: 1. Some boys are dacoits.
                                       2.All dacoits are thieves.

                       A   B

Since one premise is particular the conclusion must be particular. So, only conclusion 1 follows and conclusion 2 cannot follow.

VIII.   If both the premises are affirmative, the conclusion would be affirmative.   Example:
       Statements: 1.All women are mothers.
                                      2.All mothers are sisters.
       Conclusion: 1.All women are sisters.
                                     2.Some women are not sisters.

Since both premise are affirmative, the conclusion must be affirmative. So, only conclusion 1 follows and conclusion 2 cannot follow.

IX.   If major premise be affirmative the conclusion must be particular.

Example: Statements: 1.All plays are stories.
                                    2.Some poems are plays.
            Conclusion: 1.Some poems are stories.
                               2.All stories are poems.

A   B

 The first premise containing the middle term 'plays' as the subject is the major premise. Also, it is affirmative. So, the conclusion must be particular. So, only conclusion 1 follows and conclusion 2 cannot follow.

Example1: Which of the two conclusions can be concluded on the basis of given statements?

Statements: Some parrots are scissors.

            Some scissors are not combs.

Conclusions: Some scissors are parrots.

            Some combs are parrots.

Solution: Now, in this case, the possible conclusion is: Some scissors are parrots (I to I), as the universal principal no. 4 says, that with two particular statements only I to I is possible. Therefore, only 1 conclusion is possible. Nothing else is possible.

Example 2 : Which of the two conclusions can be concluded on the basis of given statements?

Statements: All flowers are candles.

All lanterns are candles.

Conclusions: Some flowers are lanterns.

Some candles are lanterns.

Solution:

Three possible diagrams are shown above for the given statements.

Conclusion I follows from last two possible solutions, but does not follow from the first possible solution. Therefore, this conclusion is false.

Conclusion II follows from all the three possible solutions.

Therefore, conclusion II is true.

Example 3: Which of the two conclusions can be concluded on the basis of given statements?

Statements: All prisoners are men.

No man is educated.

Conclusions: All prisoners are uneducated.

Some men are prisoners.

Solution: Two possible diagrams are shown below for the given statements.

	A			B	

Conclusion I follows from both the possibilities, so conclusion I is true. Conclusion II also follows from both the possibilities, so conclusion II is also true. Therefore, both conclusions are true.

Example 4: Which of the two conclusions can be concluded on the basis of given statements?

Statements: All sides are lengths.

No length is a breadth.

Conclusions: All lengths are sides

No breadth is a side

Solution: Two possible diagrams are shown below for the given statements.

	A			B	

Conclusion I: False (conclusion follows from the second possibility but doesn't follow from the first possibility)

Conclusion II: True (conclusion follows from both the Venn diagram possibilities.)

Therefore, only conclusion II is true.

Q 5 - Statements: I. Some pigs are bachelors.
II. All bachelors are blessed.

Conclusions: I. Some pigs are blessed.

II. At least some blessed are bachelors.

A - If only conclusion I follows.

B - If only conclusion II follows.

C - If either conclusion I or II follows.

D - If neither conclusion I nor II follows.

E - If both conclusion I and II follows.

Answer : E

Explanation

A   B

Some pigs are bachelors (I) + all bachelors are blessed (A) = I + A = I = some pigs are blessed. Hence conclusion I follows. Again all bachelors are blessed - conversion - some blessed are bachelors. Hence conclusion II also follows.

Q 6 - Statements: I. Some pictures are beds.

II. All beds are trees.

Conclusions: I. Some pictures are trees.

II. At least some trees are beds.

A - If only conclusion I follows.

B - If only conclusion II follows.

C - If either conclusion I or II follows.

D - If neither conclusion I nor II follows.

E - If both conclusion I and II follows.

Answer : E

Explanation:

A   B

Some pictures are beds (I) + all beds are trees (A) = I + A = I = some pictures are trees. Hence conclusion I follows. Again all beds are trees - conversion - some trees are beds. Hence conclusion II also follows.

Three premise argument

A syllogism is a form of reasoning in which the conclusion is drawn from the given statements. Three Premise Arguments means that there are 3 statements and 1 or more conclusions. These are same as the two premise arguments. They are also represented in the form of Venn Diagrams.

A. Definite Conclusions

In the three premise arguments, three statements are given. These three statements can be used to draw conclusions or define possibilities. Conclusions are drawn when the statements directly lead to one of the conclusions. Below each set of statements, a set of conclusions will be given. your job is to identify the correct option.Definite conclusions are those conclusions which are definitely true from the given Premises. In the arguments, the premise is very important. The conclusions or the inference are drawn from the premise and the reasoning is entirely based on the premise.

Examples –

1. Statements: I. All A are B
                    II. All B are C
                    III. Some D is A

    Conclusions: I. All A is C.
                   II. All A are D
                   III. Some D is B

A) I, II and III are correct

B) Only I and II are correct

C) Only II and III are correct

D) Only I and III are correct

Answer- We can solve this question similarly as we used to solve the Questions of 2 Premises by using the Venn Diagrams. We can use the Venn Diagrams to easily solve this question. In fact, to solve the questions on arguments, we will have to use the Venn diagrams. Let us see below:

A   B   C
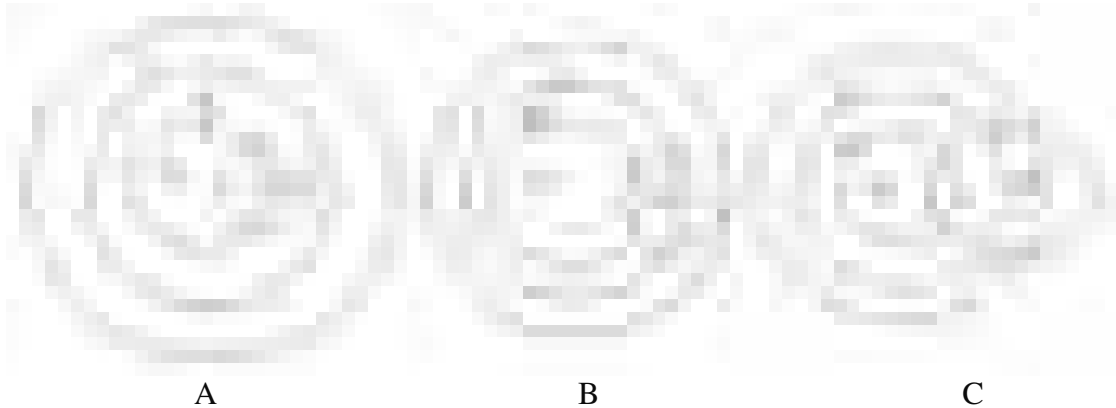
From the Venn Diagram, we can see that the conclusions I and III definitely follow.

So the correct option is D) Only I and III are correct.

Explanation: The conclusion II does not follow because in the statement it is given that Some D is A and in the conclusion, it is given that All A is D. There is some part of A about which we do not have any information so any definite conclusion about it will not follow.

B. Possibilities

Possibilities are those conclusions which are not definitely true but they may or may not be true. We can take the same example here as we saw above.

1. Statements :   I. All A are B

                             II. All B are C

                             III. Some D are A

    Conclusions :   I. All D are A is a possibility.

                             II. All C are A is a possibility.

    A) Both I, II are correct

B) Only I is correct

C) Only II is correct

D) The data is not sufficient

Answer: We can solve this question by using the Venn diagram.

Here both the conclusions follow.

Explanation: For Conclusion I: From the above Venn diagram (iv) we can conclude that conclusion I clearly follows being a possibility.

For Conclusion II: From the above Venn diagram (iv) we can conclude that conclusion II clearly follows being a possibility.

Hence the correct option is A) Both I, II are correct.

Other Types of Questions

2. Statements :   I. Some A is not B

II. Some B are C

III. Some D is C

Conclusions: I. All A is not B is a possibility

II. Some B are D

Answer:- We can solve this question by the below Venn Diagram. The cross in the red designates the relation "are not". We can say that since some A are B, not all A are B is also one possibility. The following Venn Diagram represents the statements present in the above question.

| (i) | (ii) | (iii) |

Hence only the conclusion I follow.

Explanation: For Conclusion I: It is given that All A is not B is a possibility but in Statement I, it is given that Some A are not B.

So, from the above Venn diagram it is clear that conclusion I is correct.

For Conclusion II: It does not follow because no direct relation between B and D is given. The only relation is between C and D and between B and C. So conclusion II doesn't follow.

Questions -

1. Statements: I. All Teachers are Lawyers
                   II. All Lawyers are Doctors
                  III. All Doctors are Engineers

   Conclusions: I. Some Engineers are Lawyers
                   II. Some Doctors are Teachers

       A) Both are the wrong
       B) Both are correct
       C) They may be correct
       D) Data Insufficient

Ans:
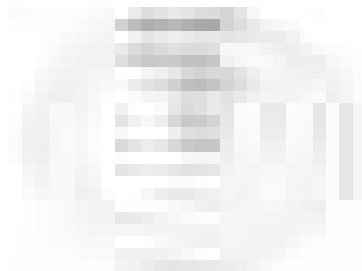
B) Both are correct

2. Statements: I. Some Trains are not Cars
     II. Some Cars are Bikes
     III. Some Scooters are Bikes

Conclusions: I. All Trains are not Cars a possibility.

     II. Some Scooters are Cars.

A) Both are the wrong
B) Both are correct
C) I is correct
D) II is correct

Ans:

C) I is correct.

UNIT -3: Venn Diagrams, Mirror Images, Problems on Cubes and Dices

VENN DIAGRAMS

It is a process of showing complex relationship between 2-3 categories diagrammatically through various geometric strictures. Intersection between two geometric structures indicate that they have something in common and total isolation indicates just opposite of that.

Venn diagram, also known as Euler-Venn diagram is a simple representation of sets by diagrams. The usual depiction makes use of a rectangle as the universal set and circles for the sets under consideration.

(a)   Venn Diagram in case of two elements

Where;
X = number of elements that belong to set A only
Y = number of elements that belong to set B only
Z = number of elements that belong to set A and B both $(A \cap B)$
W = number of elements that belong to none of the sets A or B
From the above figure, it is clear that
$n(A) = x + z$;
$n(B) = y + z$;
$n(A \cap B) = z$;
$n(A \cup B) = x + y + z$.
Total number of elements $= x + y + z + w$

Venn Diagram in case of three elements
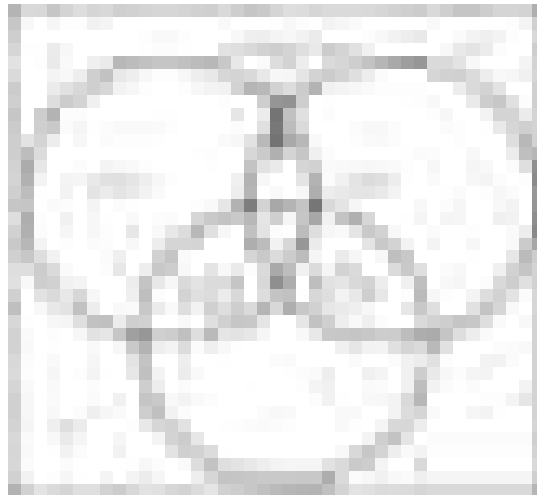
Where,

W = number of elements that belong to none of the sets A, B or C

Let's take a look at some basic formulas for Venn diagrams of two and three elements.

$n (A \cup B) = n(A) + n(B) - n(A \cap B)$

$n (A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

Venn diagram	Applicable cases	Example
	There will be a series of sub cases one under another.	Colour >Green>light green. Light green colour is a sub part of green colour and both of them belongs to colour group.

	One main category, under it two sub categories and both bear some similarities among them.	Liquids>Petrol, Car fuel. Here both are flammables in nature, thus bear similarity.
	One category may have one sub category. They both partially satisfy some conditions (not always).	Vegetable>Capsicum>Red. Some capsicums are red and so as some other vegetables.
	Among three different sections, two may have some common properties those do not match with third one.	Actor>Headmaster>Queen. From the above, actor and headmaster are showing masculinity, thus bearing some common properties which is just opposite to Queen.
	Three sections having no common feature.	Tree>Angry>Coffee. There is no logic of finding any common aspect among above three terms.

	There is a chance of finding a common place that satisfies all the properties of three individual sections.	Mother>Step mother>Sister-in law. A single woman can be all of the above said simultaneously.
	This is particular for those cases in which out of three sections, two are inter related as parent child relationship, whereas third one has no relation with them.	Tree>banana tree>Angry. We all know banana tree is coming under tree category but emotion" Angry" has nothing to do with these 2 words.

Example 1:

If all the words are of different groups, then they will be shown by the diagram as given below.

Dog, Cow, Horse
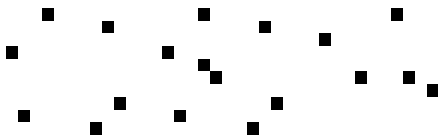
All these three are animals but of different groups, there is no relation between them. Hence they will be represented by three different circles.

Example 2:

If the first word is related to second word and second word is related to third word. Then they will be shown by diagram as given below.

Unit, Tens, Hundreds
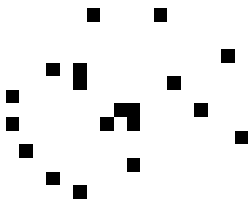
Ten units together make one Tens or in one tens, whole unit is available and ten tens together make one hundreds.

Example 3:

If two different items are completely related to third item, they will be shown as below.

Pen, Pencil, Stationery
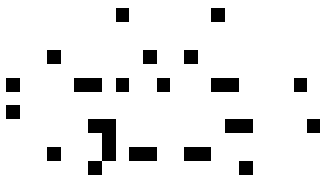
Example 4:

If there is some relation between two items and these two items are completely related to a third item they will be shown as given below.

Women, Sisters, Mothers
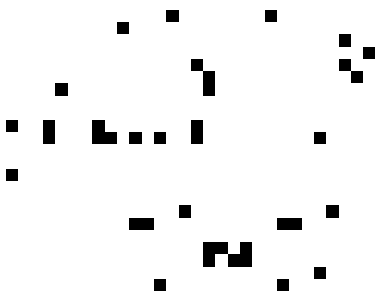
Some sisters may be mothers and vice-versa. Similarly some mothers may not be sisters and vice-versa. But all the sisters and all the mothers belong to women group.

Example 5:

Two items are related to a third item to some extent but not completely and first two items totally different.

Students, Boys, Girls
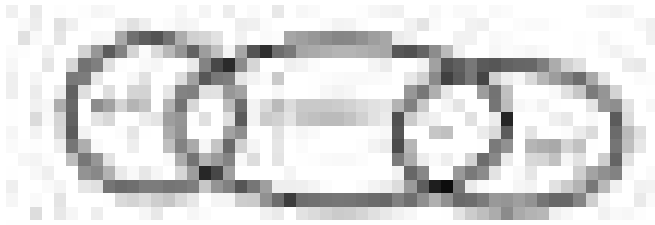
The boys and girls are different items while some boys may be students. Similarly among girls some may be students.

Example 6:

All the three items are related to one another but to some extent not completely.

Boys, Students, Athletes
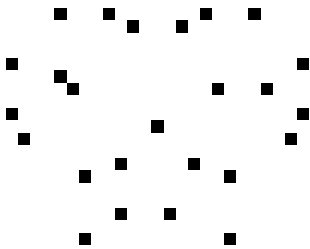
Some boys may be students and vice-versa. Similarly some boys may be athletes and vice-versa. Some students may be athletes and vice-versa.

Problems

<u>**Example-1**</u>
Which of the following diagrams indicates the best relation between Travelers, Train and Bus ?

A.

B.

C.

D.
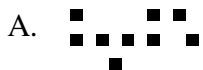
Solution- Option **C**

Bus and Train are different from each other but some travelers travel by bus and some travel by train.

Example 2: In a college, 200 students are randomly selected. 140 like tea, 120 like coffee and 80 like both tea and coffee.

- How many students like only tea?
- How many students like only coffee?
- How many students like neither tea nor coffee?
- How many students like only one of tea or coffee?
- How many students like at least one of the beverages?

Solution: The given information may be represented by the following Venn diagram, where T = tea and C = coffee.
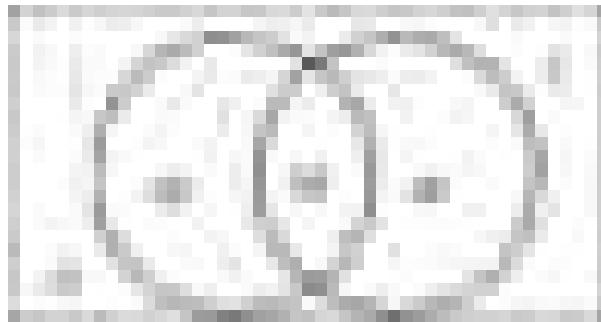
Number of students who like only tea = 60

Number of students who like only coffee = 40

Number of students who like neither tea nor coffee = 20

Number of students who like only one of tea or coffee = 60 + 40 = 100

Number of students who like at least one of tea or coffee = n (only Tea) + n (only coffee) + n (both Tea & coffee) = 60 + 40 + 80 = 180

Example 3 :

The population of a town is 10000. Out of these 5400 persons read newspaper A and 4700 read newspaper B. 1500 persons read both the newspapers. Find the number of persons who do not read either of the two papers.

Solution :

Let A = The set of persons who read newspaper A

B = The set of persons who read newspaper B
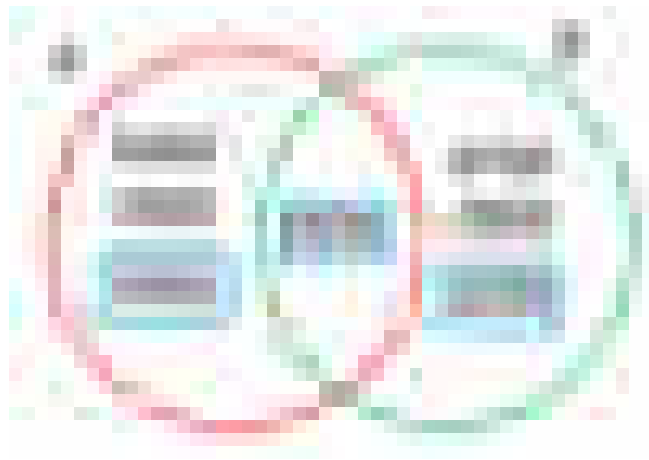
Number of persons who read at least one news paper = 3900 + 1500 + 3200

= 8600

Total population = 10000

To find the number of persons who do not read either of the two papers, we have to subtract number of persons who read at least one from total population. = 10000 - 8600

= 1400

Hence the number of persons who do not read either of the two papers is 1400.

Example 4:

In a school, all the students play either Foot ball or Volley ball or both. 300 students play Foot ball, 270 students play Volley ball and 120 students play both games. Find

(i) the number of students who play Foot ball only
(ii) the number of students who play Volley ball only
(iii) the total number of students in the school

Solution :

Let A = The set of students who play foot ball

B = The set of students who play volley ball

(i) The number of students who play Foot ball only is 180

(ii)The number of students who play Volley ball only is 150

(iii) The total number of students in the school = 180 + 120 + 150

$$= 450$$

Example 5 :

In a School 150 students passed X Standard Examination. 95 students applied for Group I and 82 students applied for Group II in the Higher Secondary course. If 20 students applied neither of the two, how many students applied for both groups?

Solution :

A = The set of students who applied for Group I

B = The set of students who applied for Group II

Number of students who applied at least one group = 150 - 20

$$= 130$$

n (A) = 95, n (B) = 82 and n (A U B) = 130

n (A U B) = n (A) + n (B) - n (A n B)

130 = 95 + 82 - n (A n B)

130 = 177 - n (A n B)

n (A n B) = 177 - 130 = 47

Hence the number of students applied for both groups is 47.

MIRROR IMAGE

A mirror image (in a plane mirror) is a reflected duplication of an object that appears almost identical, but is reversed in the direction perpendicular to the mirror surface. As an optical effect it results from reflection off of substances such as a mirror or water. It is also a concept in geometry and can be used as a conceptualization process for 3-D structures.

The image of an object as seen in a mirror is its mirror reflection or mirror image. In such an image, the right side of the object appears on the left side and vice versa. A mirror-image is therefore said to be laterally inverted and the phenomenon is called the lateral inversion.

Some letters don't change upon reflection. In other words, they are the same as that of their Mirror Images. The letters having identical mirror images are A, H, I, M, O, T, U, V, W, X, Y. Similarly, in small letters we have i, l, o, v, w, and x that have the same Mirror Image as that of their original images. The number 1 and 8 are the only two numbers with their identical mirror images.

The Left Hand Side (L H S) of real image becomes the Right Hand Side (R H S) in mirror image and the R H S in the real image becomes the L H S in the mirror image.

Mirror Images of Capital Letters –

Mirror Images of Small Letters -

Examples -

1. Which among the following illustrations specifies the correct mirror image of O B S T I N A T E ?

    Solution-

     The first step is to check the first and the last letters. We know that the reflection at a mirror is equivalent to an inversion. In other words, we say that in a mirror top and bottom of an image doesn't change but the Left Hand Side (L H S) of real image becomes the Right Hand Side (R H S) in mirror image and the R H S in the real image becomes the L H S in the mirror image. So, (a) is the correct option.

2. Which among the following illustrations specifies the correct mirror image of P R O C R A S T I N A T E ?

    Answer: Let us see the first letter in the mirror image of P R O C R A S T I N A T E.
    The first letter in the mirror image would be the last letter in the original word P R O C R A S T I N A T E, which is E. The only option that has its first letter as the mirror image of E is option (b). Therefore (b) is the correct option.

3. Choose the alternative which is closely resembles the mirror image of the given combination.

Ans : (2)

MIRROR IMAGES OF NUMBERS

EXAMPLES -

1. Choose the alternative which is closely resembles the mirror image of the given combination.

Ans. (4)

2. Choose the alternative which is closely resembles the mirror image of the given combination.
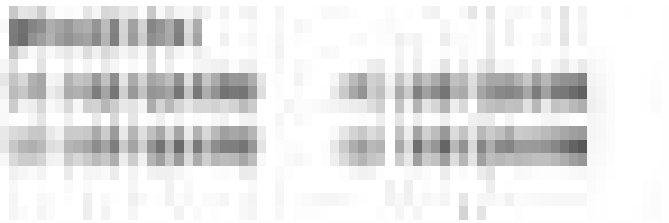
Ans (1)

3. Choose the alternative which is closely resembles the mirror image of the given combination.

Ans. (4)

4. Choose the alternative which is closely resembles the mirror image of the given combination.

Ans. (3)

5.Choose the alternative which is closely resembles the mirror image of the given combination.

Ans. (2)

MIRROR IMAGES OF FIGURES

.

1. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)   (1)   (2)   (3)   (4)

Ans . (4)

2. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)   (1)   (2)   (3)   (4)

Ans. (4)

3. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)   (1)   (2)   (3)   (4)

Ans. (4)

4. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)   (1)   (2)   (3)   (4)

Ans. (3)

5. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)   (1)   (2)   (3)   (4)

Ans. (3)

6. Choose the correct mirror image of the given figure (X) from amongst the four alternatives.

(X)　　　(1)　　(2)　　(3)　　(4)
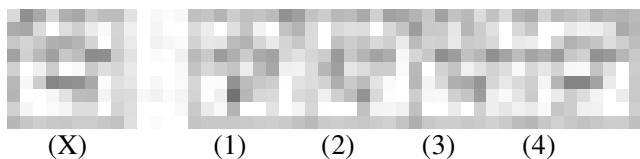
Ans. (4)

PROBLEMS ON CUBES AND DICES

CUBES

Let's first learn some basic terminologies i.e. face, vertex and edge of a cube.

In a cube, there are 6 faces, 8 vertices & 12 edges. Vertex means corners & edge means side.

Generally, questions from this topic are of the type wherein, a cube with side measuring unit 'x' is painted on all faces and is cut into smaller cubes with sides measuring unit 'y'. You are then required to find the number of cubes having 'n' faces painted.

The first thing that you need to figure out is the number of smaller cubes. For this, you look at one particular edge of the big cube and figure out how many smaller cubes can fit into this. It will be $\frac{x}{y}$. So, the number of smaller cubes will be $\left(\frac{x}{y}\right)^3$

Since all the smaller cubes will have at least one face facing inside i.e. not on the surface of the original cube, hence, none of the smaller cubes will have all faces painted. Further, since the maximum number of faces of the larger cube that intersect at a point are 3(at the corners), hence, the smaller cubes can have a maximum of 3 faces painted.

So, the number of smaller cubes with 3 faces painted = No of corners of larger cube = 8 (always), provided none of the faces of the larger cube is left unpainted.

Cube Sample Questions

Example 1: A cube having a side of 6 cm is painted red on all the faces and then cut into smaller cubes of 1 cm each. Find the total number of smaller cubes so obtained.

Solution:

As explained above, the number of smaller cubes = $\left(\frac{6}{1}\right)^3$ = 216 smaller cubes.

(Here x=6 and y=1)

Example 2: In the above example, how many cubes will have three faces painted?

Solution: As explained above, only the corner cubes i.e. the 8 cubes at the corners of the original cube will have three faces painted. Hence the answer will be 8 only. To find the number of smaller cubes with only 2 faces painted, you need to consider the cubes where 2 faces of the bigger cube

meet, i.e. the edges. Remember, this includes the cubes present at the corners as well, so you need to remove those 2 cubes from the number of cubes on each edge.

Example 3: In the above example, how many cubes will have only two faces painted?

Solution: As discussed above, only the cubes at the edge of the bigger cube can have two faces painted. The larger cube has 6 cm edge and smaller cube is 1 cm edge. Hence, there are 6 cubes on each edge. However, you need to consider 4 middle cubes only, as the 2 cubes on each corner will have 3 painted faces. Hence, there are 4 such cubes on each edge. As there are 12 edges, there will be $4 \times 12 = 48$ cubes

Example 4: In the above example, how many cubes will have only one face and no side painted?

Solution: As discussed above, only the cubes at the face of the bigger cube can have only one painted face. Since the larger cube has 6 cm edge and smaller cube is 1 cm edge, hence, if you see one of the faces of the larger cube, you will see $6 \times 6 = 36$ cubes. Out of these, exclude the cubes which lie on the edges, as they have two or more faces which are painted. Thus, on each face of the original cube, there will be $4 \times 4 = 16$ cubes will have only one face painted.
As there are 6 such faces, the number of such smaller cubes will be $16 \times 6 = 96$.

Lastly, the number of cubes having no faces painted can be found by subtracting the sum of the painted cubes from the total number of smaller cubes. Therefore, the required answer is $216 - (8 + 48 + 96) = 64$ cubes.

Example 5: A cube having an edge of 12 cm each. It is painted red on two opposite faces, blue on one other pair of opposite faces, black on one more face and one face is left unpainted. Then it is cut into smaller cubes of 1 cm each. Answer the following questions:

- The total no. of smaller cubes/
- The no. of smaller cubes which are having three-faces painted.
- The no. of smaller cubes which are having two-faces painted.
- The no. of smaller cubes which are having one-face painted.
- The no. of smaller cubes which are having zero-face painted.
Solution:

- Total number of cubes= (12× 12 × 12) / (1× 1 × 1)=1728
- For a cube with all sides painted we have 8 cubes with 3 sides colored. But here we have 1 side unpainted. Therefore, we will have only 4 cubes with 3 sides painted. The other 4 cubes will have only 2 sides painted.
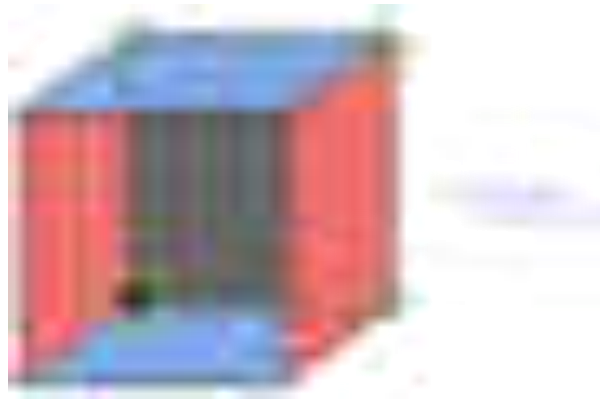
- For 2 sides painted, we look for the edges.

  A cube has 12 edges.

  8 edges, each edge having 10 cubes will have 2 sides painted. (4 edges of an unpainted side won't be included).

  We'll also include those 4 cubes (which we didn't count while counting 3 coloured sides, as they have 2 sides painted)

  Cubes on 4 edges of the unpainted side of the cube will have 1 side painted (due to the unpainted side).

  Therefore, total cubes with 2 sides painted= 8 ×10 + 4= 84 cubes.

- For 1 side painted, we look for the faces of the cube.

  A cube has 6 faces.

  5 faces each having (12 – 2) × (12 - 2) = 100 cubes will have one side painted.

  We'll have to include those cubes on the edges linked with an unpainted face.

10 cubes on each of those edges will have 1 side painted.

Therefore, total cubes with 1 side painted= $5 \times 100 + 4 \times 10 = 540$ cubes.

- According to the formula, cubes with no side painted= $((12 - 2)^3)= 1000$.

  But we have to include the cubes from the unpainted side too. It will be $10 \times 10 = 100$

  So, total number of unpainted cubes= 1000+100=1100.

Shortcut Formulae

- For a cube of side n × n × n painted on all sides which is uniformly cut into smaller cubes of dimension $1 \times 1 \times 1$,
- Number of cubes with 0 side painted= $(n - 2)^3$
- Number of cubes with 1 sides painted $= 6 (n - 2)^2$
- Number of cubes with 2 sides painted= $12(n - 2)$
- Number of cubes with 3 sides painted= 8 (**always**)

DICE

A Dice is a cube. In a cube, there are six faces.

The six faces in the cube are– ABCG, GCDE, DEFH, BCDH, AGEF and ABHF.

1. Four faces are adjacent to one face
2. There are pairs of opposing faces e.g. Opposite of DEFH is ABCG and so on
3. CDEG is the upper face of the cube
4. ABHF is the bottom face of the cube

Important Facts:

1. A cube has 6 square faces or sides

2. A cube has 8 points (vertices)
3. A cube has 12 edges
4. Only 3 sides of a cube are visible at a time (known as "Joint Sides") and these sides can never be on the opposite side of each other
5. Things that are shaped like a cube are often referred to as 'cubic'
6. Most dice are cube shaped, with the numbers 1 to 6 on the different faces.

Certain Basic Rules:

There are certain dice rules in reasoning which can be sued to solve dice-based questions:

Rule No. 1:

Two opposite faces of the dice cannot be adjacent to each other.

E.g. Two positions of a dice are shown below.

Here, faces with number 4, 3, 6 and 1 are adjacent to the face number 2.

Therefore, the 4,3,6,1 can't be opposite to the face number 2.

Therefore, face number 5 is opposite to the face number 2.

Rule No. 2:

If two dice are shown as below, and one of the two common faces (Face number 4) is in the same position, then the remaining faces will be opposite to each other.

E.g.: Two dice are shown below.

In both the diagrams, two faces numbered 1 & 3 are common.

Also, 5 & 6 are remaining faces. Hence, face which is number 5 is opposite to the face number 6.

Rule No. 3:

If in 2 different positions of the dice, the positions (different), the position of the face that's common is the same, and then the opposite faces of the faces that remain will be in the same positions.

E.g.:

In both the positions, face number 1 is common for both dice is same. Therefore, the opposite of 4 is 2 and the opposite of 5 is 6.

Rule No. 4:

If 2 positions of a die are given (Different) and it is also stated that common face is different then the face opposite to the given common face would be that which is not shown on any given face in the 2 given positions. It is also to be noted that the opposite face of the faces that are left cannot be the same.

E.g.:
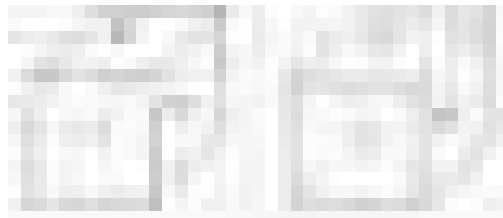
Note, in the above shown dice, the face having value 6 is not in the similar position. The face numbered 1 is not shown. So, the face opposite to the face with number 6 is 1.Also, the opposite face of 3 is the face with number 2 and the opposite to face numbered 5 is the face with number 4.

Now that you know the basic concepts on cubes and dice reasoning tricks. Let us study a few solved examples on dice reasoning

Dice Sample Questions –

1. Which symbol will be on the face opposite to the face with symbol * ?

   A. @

   B. $

   C. 8

   D. +

   Answer : Option **C**

   Explanation: The symbols of the adjacent faces to the face with symbol * are @, -, + and $. Hence the required symbol is 8.

2. Two positions of dice are shown below. How many points will appear on the opposite to the face containing 5 points?

   A. 3

   B. 1

   C. 2

D. 4

Answer : Option **D**

Explanation: In these two positions one of the common face having 1 point is in the same position. Therefore according to rule (2), there will be 4 points on the required face.

3. Which digit will appear on the face opposite to the face with number 4?
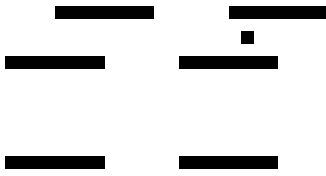
A. 3

B. 5

C. 6

D. 2/3

Answer   : Option A

Explanation : Here the common faces with number 3, are in same positions. Hence 6 is opposite to 2 and 5 is opposite to 1. Therefore 4 is opposite to 3.

4. Two positions of a dice are shown below. Which number will appear on the face opposite to the face with the number 5?
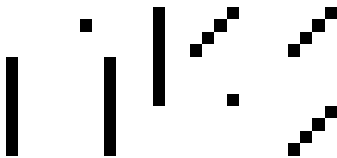
A. 2/6

B. 2

C. 6

D. 4

Answer : Option **C**

Explanation: According to the rule no. (3), common faces with number 3, are in same positions. Hence the number of the opposite face to face with number 5 will be 6.

5. How many points will be on the face opposite to in face which contains 2 points?
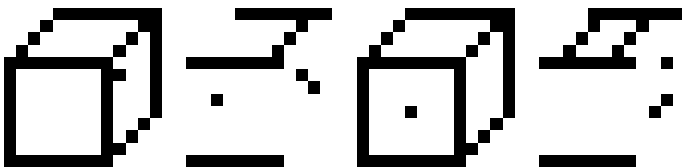
A. 1

B. 5

C. 4

D. 6

Answer : Option **D**

Explanation:
In first two positions of dice one common face containing 5 is same. Therefore according to rule no. (3) the face opposite to the face which contains 2 point, will contains 6 points.

SKILL ENHACEMENT COMPUYSLORY COURSE-I

COMMUNICATIVE ENGLISH

(SPECIAL COURSE)

Enriching Linguistic Knowledge & Communication Proficiency

ODISHA STATE HIGHER EDUCATION COUNCIL

BHUBANESWAR

STATE MODEL SYLLABUS FOR UNDER GRADUATE
COURSE IN SKILL ENHANCEMENT
COURSE (I)
(Bachelor of Arts/Sc/Com Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

FOREWARD

The higher education system has undergone a paradigm shift in Odisha with the introduction of Choice Based Credit System (CBCS) in academic year 2015-16 as per University Grant Commission regulation. Initially it was adopted in all Autonomous colleges and from 2016-17, in all the colleges of Odisha. CBCS offers students the liberty to choose from available lists of courses under the domains of Ability Enhancement, Skill Enhancement and General electives. This book on English aims to engage the students more creatively to improve their English language and communication skills. This paper will be taught under Skill Enhancement Compulsory Course (SECC).

The main intent of this paper is to strengthen the language competency of graduate students, majority of who are set to enter the job market with high hopes. Needless to say, a good command over English language is one skill which various companies expect from the prospective employees. The course content is adopted from the study material of Infosys Foundation. They have had the experiences of conducting faculty development programme under Project Genesis in Odisha. A group of academicians from state universities were involved in the process of contextualising the material to the needs of students of Odisha. We would like to acknowledge the vital contribution from Infosys Foundation in sharing the study material and conducting faculty training. We hope the students find merit in using this book not just as a course study material but as a life time companion in improving his / her English skills.

Vice Chairperson

Bhubaneswar   OSHEC

Some Useful Apps downloadable from Play store

Dictionary- Word Web

Oxford Dictionary of English

(to add some English learning apps)

Word Connect- Word Games Puzzle

(to add some English learning game apps)

Some Useful links

https://learnenglish.britishcouncil.org/english-grammar

http://library.aceondo.net/ebooks/English_Language/how_english_works_a_grammar_practice_book_oxford_1997.pdf

http://primus.arts.u-szeged.hu/bese/bese.pdf

https://play.google.com/store/apps/details?id=com.radioboxlabs.englishgrammerbywrenmartin&hl=en_US

https://play.google.com/store/apps/details?id=org.cambridge.englishgrammar.egiu&hl=en

https://elt.oup.com/catalogue/items/global/grammar_vocabulary/practical_english_usage_4th_edition/?cc=global&selLanguage=en

Table of Contents

COMMUNICATIVE ENGLISH (SPECIAL COURSE)

UNIT-I- BUSINESS COMMUNICATION AND GRAMMAR

1. **Why English Communication is Essential and How to Improve the Skill?**
   (Extempore discussion. Students to list benefits. Faculty to guide)

2. **Introduction to Voice and Accent**

   Introduction - Faculty to elicit answers for this question

   Why do we have such different accents?

   Answers can primarily be categorized into any one of the aspects mentioned below:
   - **First language influence -**Every language has a unique pronunciation system and as little children when we learn our first language, we internalize this pronunciation system. Thus, when we learn a new language (especially after puberty), it is filtered through the pronunciation system of our first language. This process causes the sounds to be influenced by the system of our first language.
     Thus, for most of us- for whom English is not the first language, the accent is influenced by our mother/native tongue.

   - **Geographical influence –** Languages have evolved over the years with the dynamic changes in society, cultures and people and so has the accent. The same language is spoken in different ways in various parts of the same country, this is called a dialect. As people

     travelled around the world and began settling in other countries, they brought about an influence of their language in the way they spoke the foreign languages

as well. Over the years (and even to this date), this has changed the way, various groups speak in a place.

- **Socio economic influence-** For many years, our society has shown an evident presence of classes and ranks brought about by the difference in economic standards and social /cultural groups. Due to the closer interaction amongst one's own group/rank, the language and accent have distinct differences that have developed over the years. The intermingling of these classes/ranks in the years of the modern era has also created hybrid dialects with a different pronunciation system.

- **Educational influence**-Every country has its own laws on English as the medium of instruction in schools and colleges; this certainly has an influence in the development of the use of English. With the advent of students travelling to various countries to study, foreign student exchange courses and the rising using of English in higher education-the language has evolved and developed.

- **Climatic influence-** According to a linguistic theory in history, climate has influenced human history a lot with its grasp over language too. In cold counties people speak with tight lips so that the extremely cold weather does not affect them. This results in a distinct accent. Similarly accents of people from tropical countries have a more open phonetic system.

Accent Training-Consequences

What would be the consequence?

What is the importance of Accent Training?
In order to understand the extent to which the business would benefit from Accent Training, let us look at the scenarios mentioned below:
Display the scenarios one-by-one and elicit answers from the students for these questions -what would be the consequence of this situation?

Discuss the answers in alignment with the one on the PPT.

   i.   **Scenario 1**

Agent: the problem is due to b(p)oor network, ma'am!

Customer: What network?

Agent: Boor network ma'am!

Customer: I am sorry I don't understand!

Consequence: The agent confuses the P/B sounds. This will result in increased call handling time and the customer will get frustrated as she is unable to comprehend the agent.

   ii.   **Scenario 2**

Agent: Can I have De number on the invoice?

Customer: Sorry, what number?

Agent: De number on the invoice?

Customer: I am sorry, I cannot understand you!

Consequence: The agent pronounces "The" as "De". The customer is confused and is unable to comprehend the word.

   iii.   **Scenario 3**

Agent: Mrs. Stephen, have YOU made the payments?

Customer: uumm…. No, but my daughter did, is that a problem?

Agent: No, I was just checking if YOU made the payments.

Customer: Like I said, I did not but my Daughter did.

Consequence: The agent stresses on the wrong word and thus the intent of the message is not communicated correctly. The customer is confused.

   iv.   **Scenario 4:**

Agent: May I speak with Mr. Burton?

Customer: I am sorry dear, he has kicked the bucket.

Agent: uhhh…. So when can I call back to talk with him?

Customer: I am sorry???

Consequence: The agent is not aware of the idiom that conveys that Mr. Burton has passed away. The agent's response shocks the customer.

Debrief:

- The effect of pronunciation errors has grievous consequences, more so when it is a telephonic conversation.
- The possibility of misunderstanding in an inter-country communication scenario is quite high, thus making the improvement of one's language and accent more vital.
- The awareness of the client's language usage is vital in customer service, since this would help create a positive impact on the customer.
- The aim is to ensure our language and accent each comprehensible.

Voice and accent in the Enterprise Industry

- Communication is the heart of the business and the previous examples bring forth the importance of developing one's awareness of the language.
- Training and developing Accent and Language has the following advantages:
  - Enriches customer experience by displaying greater comprehension skills
  - Enhances knowledge of current vocabulary and pronunciation
  - Decreases the chances of inter- cultural communication failure
  - Projects a professional image, as the language is globally understood

Globally Comprehensible Accent

Our accent has developed over the years with the influence of various factors and any change or development that we intend to bring, will only be fruitful with a lot of practice and dedication.

In this training, we will follow the path below to help improve and develop our accent skills.

Awareness Of Individual Communication Style → Identify areas of Improvement → Develop an Understanding Of The Phonetic System → Understand the Syllabic Stress & Intonation → Correct Improve and Practice → Evaluate Improvement
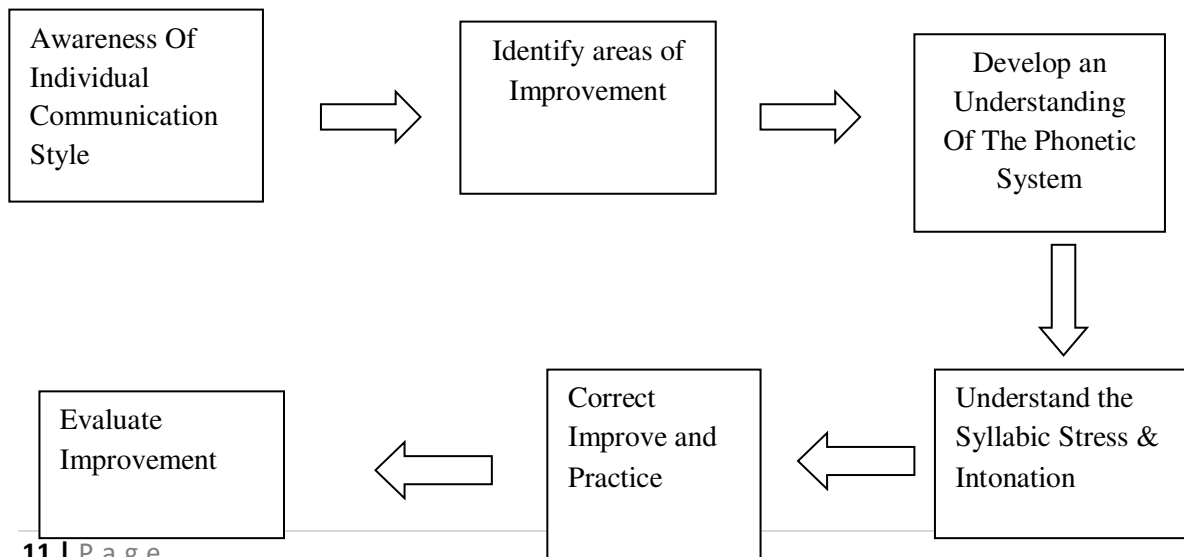
1. **Awareness of individual communication style:** Every student must get feedback from the faculty, other students and from oneself on their communication styles. This would include feedback on :
a) Articulation
b) Pronunciation
c) Syllable/ word/ sentence stress
d) Intonation

This awareness will help the students understand where they stand and will help the faculty draw up a personal improvement plan.

2. **Identify areas of improvement:** The following exercise will illustrate the individual areas of improvement for each training. The primary areas of concern would be around the points mentioned below:
a) Interchanging sounds- for example: interchanging the / s / and / sh/ sounds pronouncing "shame" as "same".
b) MTI- Mother Tongue Influence on the manner of articulation and speech. For example: pronouncing "this" as "dis" due to prominent presence of the / d / sound in one's language.
c) Incorrect stress - pronouncing "technology" as "technoLOgy"- stressing on the third syllable instead of the second.
d) In appropriate intonation – example of this could be the sing song or the flat intonation styles.

3. **Develop an understanding of the phonetic system:** Once students evaluate and understand their strengths and weaknesses in terms of the accent of a language, the importance of learning the English Phonetic system is evident.
This learning will help bring about an awareness of the correct manner and place of articulation for each sound in the English language.

4. **Understand the syllabic stress and intonation:** Students can build on their communication skills through the process of understanding the syllabic patterns and intonation styles appropriate in English. This would also help enhance comprehension and thus improve, communication.

5. **Correct, Improve and Practice:** As students continue to understand and the English phonetic system, the error correction and practice would happen simultaneously. However, please note that this is the most important part of the process, since positive change & improvement is the end objective of accent improvisation.

6. **Evaluate improvement:** the final step is to check the improvement by testing the students. Gauging the level of the improvement and the areas of weakness, the faculty can decide if the student is good to go!

Introduction to Phonetics

Look at the word pairs shown below and ask the students to find out what is being conveyed?

Introduction to phonetics

Sultry sugar

Sea Idea

Heave Heaven

Frown & Blown

Towed vowed

Cushion & Million

Chair Chaos

Laugh Ghost

Polka & talk

Worm& Storm

People leopard
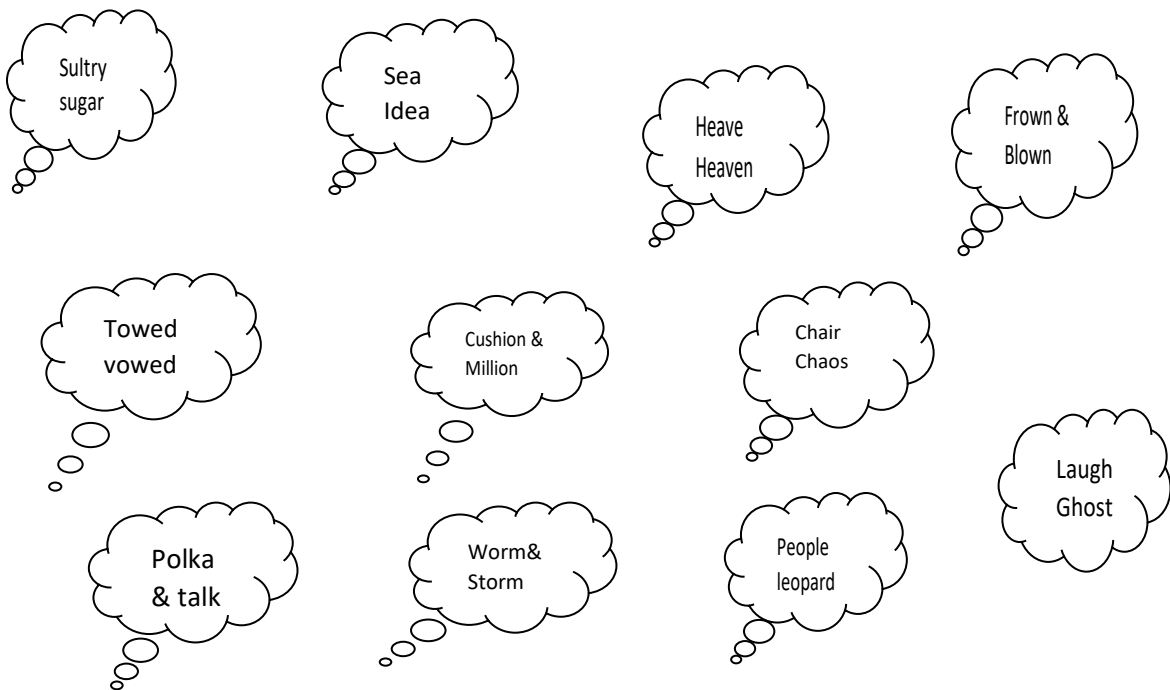
Each of the word pairs have similar words; however each of them is pronounced differently. Let us look at them one by one:

1. **Sultry & sugar:** The two words have the letter of the alphabet 's', however the first word is pronounced with a $/s/$ sound and the second word has a $/\int/$ sound.

2. **Sea & idea:** The two words have the letters of the alphabet 'ea', however the first word has a $/\text{I:}/$ sound and the second word has a $/\partial/$ sound.

3. **Heave & Heaven:** The two words have the letters of the alphabet 'heave'. However the first word has / hi:v/sound and the second word has the /hev/sound.

4. **Towed & vowed:** The two words have the letters of the alphabet 'owed' however the first word has the / $\cong Y\delta$/ sound and the second word has the / αYd/ sound.

5. **Cushion & Million:** The two words have the letters of the alphabet 'ion', however the first word has the /∂n/ sound and the second word has the /j∂n/ sound.

6. **Chair & chaos:** The two words have the letters of the alphabet 'ch', however the first word has the /t∫/ sound and the second word has the /k/ sound.

7. **Frown & blown:** The two words have the letters of the alphabet 'own', however the first word has the /∝ Y/ sound and the second word has the /$\cong$Y/ sound.

8. **Polka & talk:** The two words have the letters of the alphabet 'lk', however the first word has the /Θlk/sound and the second word has the /ɔ:k/sound.

9. **Worm & storm:** The two words have the letters of the alphabet 'orm', however the first word has the /Ʒ:m/ sound and the second word has the/ɔ:m/sound.

10. **People & leopard:** The two words have the letters of the alphabet 'eop', however the first word has the /i:p/ sound and the second word has the /ep/ sound.

11. **Laugh & ghost:** The two words have the letters of the alphabet 'gh', however the first word has the /f/ sound and the second word has the /g/ sound.

Debrief:

- The word pairs shown have similar spellings but different pronunciation and thus it is important to have a system that has a one–to-one co relation with what is written and what is pronounced.
- Keeping the thread ,we have two types of languages:
    - Phonetic languages-the words are pronounced exactly the way they are written and are also written exactly the way you hear it. There is a direct relationship between the spelling and the pronunciation. For example: Arabic, Hindi & Spanish.
    - Non-Phonetic languages-The words are not pronounced exactly the way they are written. There is no correlation (one-to-one) between the spelling and the pronunciation. For example: French & English.
- A system that would help us to understand pronunciation better is the IPA –the International Phonetic Alphabet.
- The IPA was published by the International Phonetic Association in 1888.

International Phonetic Alphabet
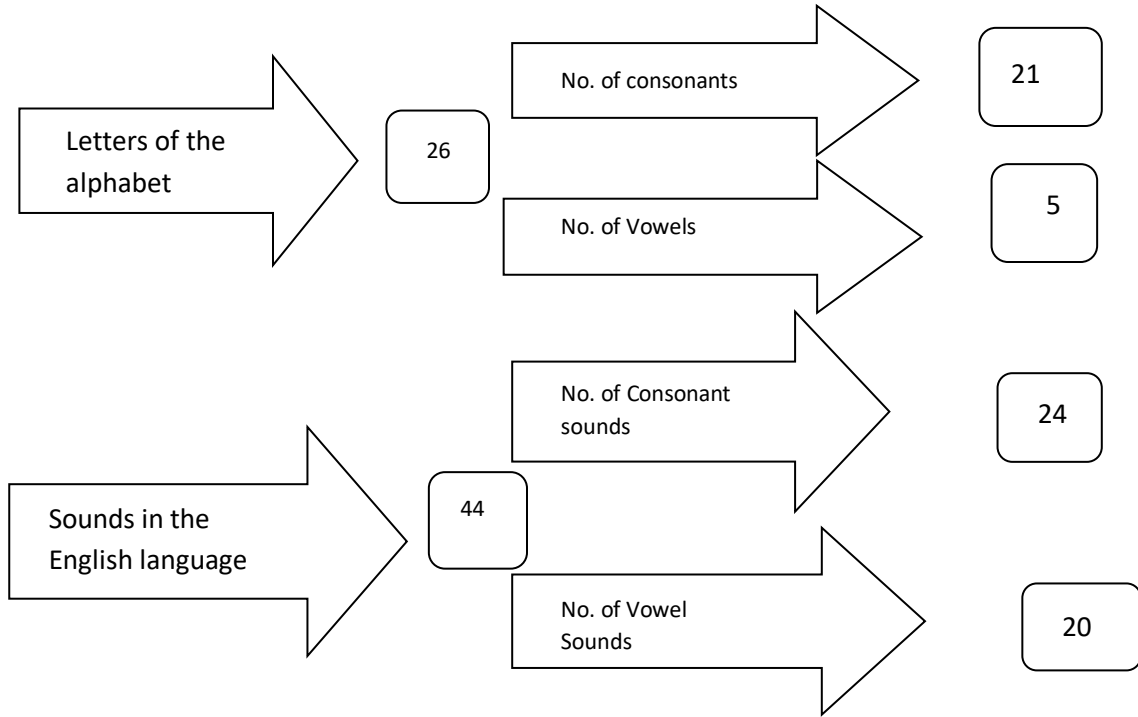
Letters of the alphabet → 26

No. of consonants → 21

No. of Vowels → 5

Sounds in the English language → 44

No. of Consonant sounds → 24

No. of Vowel Sounds → 20

STOP! GO BACK AND REFLECT!

I learnt ………

I would like to know more about ……………………………………………………………………………………….

Activities / tasks I liked / found useful…………………………………………………………………………………

Something I would adapt / do differently…………………………………………………………………………………

---

3. Consonant Sounds

These 44 sounds constitute the IPA. The breakup of these 44 sounds is shown below.

| Plosives (6) | Fricatives (9) | Affricates (2) | Nasals (3) |

| Semi Vowels (3) | ◄———————► | Laterals (1) |
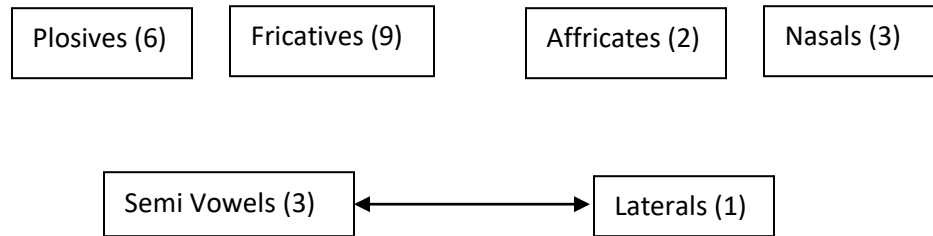
Only for Faculty's Knowledge

Every sound has two aspects with respect to its articulation:

1. Place of Articulation- This indicates **where** the sound is produced.
2. Manner of Articulation- This indicates **how** the sound is produced.

As faculty, it is important to know the articulation system as this would help enhance the expertise one has.

Let us understand the places of articulation for each of the Consonant sounds. In order to do this we need to familiarize ourselves with the articulators in the mouth.

The picture below illustrates the various articulators:

Each of the articulators helps us to produce all various sounds of the English Language. The sound shave been classified according to their places of articulation, as shown below:

I. Bilabial Consonants (Two Lips) – the sounds / p/ b/ m/ w/, both the lips are used to produce the sounds and thus they are called bilabial sounds.

II. Labiodental Consonants (Lips and teeth) – the sounds / v/ f/ are produced by placing the upper teeth of the lower lip.

III. Dental Consonants (Tongue and teeth) – The sounds / t/ d/θ/&/ Δ/, are produced when the tip of the tongue touches the teeth.

IV. Alveolar Consonants (Tongue and Alveolar Ridge)- The sounds /s/,/z/,/t/,/d/,/n/,/r/ and /I / are produced when the tip of the tongue touches the Alveolar ridge.

V. Palatal Consonant (Tongue and Palate) – These sounds /j/ are produced when the blade of the tongue touches the hard palate.

VI. Glottal Consonants (Tongue and Velum- soft part of the palate) –These sounds /g/&/k/ are produced when the back of the tongue touches the velum.

Let's begin with the understanding of each of the 44 sounds of the IPA.

IPA-44 sounds: Consonant Sounds

Plosives:

Ask students "What word comes to your mind when you hear the word- "PLOSIVES"?

Responses would be around the words mentioned below:

- Explosion, Explosive, Explode, Crackers and other words in the same context.

Plosives,as the word suggests, is a set of sounds that are articulated in the form of a mini explosion in the mouth. They are called stop sounds- the air is blocked in the mouth and is then suddenly released.

We have 6 sounds classified under this category; of which 3 are aspirated and remaining 3 are non-aspirated sounds.

Aspirated Plosives- A puff of air is released during the articulation of these sounds. The aspirated plosives are /p/t/&/k/ .

Non-Aspirated Sounds- No puff of air is released during the articulation of these sounds. The non-aspirated plosives are /b /d/ & /g/.

Activity: Air Football

Materials Required: 2 sheets of paper and a pen.

Instructions: instruct the students to take one of the sheets and tear it into 6 pieces and then scrunch these pieces into small paper balls. Now, ask them to draw two lines on the other sheet of paper and place the paper balls within the first line enclosure (as shown below).
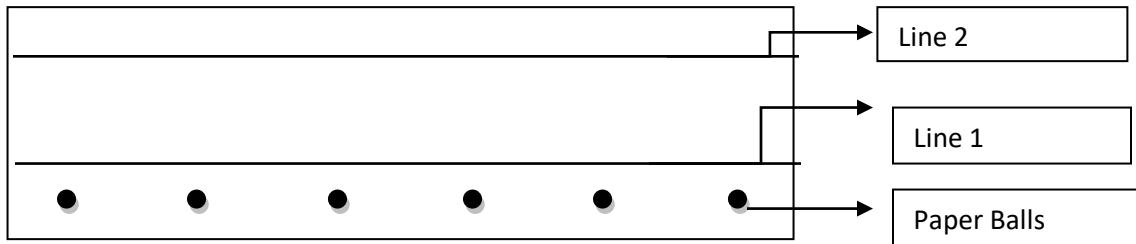
Every student must have the above set-up on their respective desks (faculty to go around the class to check). Now, the faculty would read a word at a time and students must pronounce each word, keeping their mouth at the level of the paper balls. One word for each paper ball they have placed on the paper.

Word List:

1. Gracious
2. Christmas
3. Patience
4. Dungeon
5. Tornado
6. Blessing

Debrief:

After the 6 sounds are pronounced, ask the students to make note of the words whose pronunciation made the ball move. They will notice that when they pronounce the word Christmas, Patience & Tornado the paper balls move. However, the paper balls remain in the same position while pronouncing the words Gracious, Dungeon & Blessing. This is because the /p/, /t/& /k/ sounds are aspirated and thus have a puff of air that is released when it is articulated- making the paper balls move. Since /b/,/d/& /g/ are non-aspirated sounds , the paper balls remain motionless.

Students can practice and check if the articulation of the aspirated sounds is correct by placing their palms before their mouth while pronouncing the sounds (the puff of air would hit their palms).

Plosive Sounds

<u>**Aspirated plosives:**</u>

1. /p/ - Punctual , Leopard, Gallop
   A poor passenger was poisoned by a Piranha
   Create a sentence with at least five /p/ sounds-
   Example: Peter bought a pile of papers from Mrs. Parkers 'Pink n Carry' sale.

2. /t/ - Teeth, Button, Bullet
   A toy train takes Timothy to Trentworld
   Create a grocery list with at least five /t/ sounds-
   Example: Tomatoes, Toilet roll, Turpentine, Potatoes and Castor oil

3. /k/ - Christmas, Trickle, Ballistic
   Kelly complained about the choir at the Cambridge College
   Create a write-up for a Car Ad with at least five /k/ sounds-
   Example- A cool car that can give you great comfort and care.

   <u>**Non-Aspirated Plosives**</u>

4. /b/- Byzantine, Bubbles, Absorb
   Billy bought a big boar from the bounty bargain festival.
   Create a birthday-wish write-up with at least five /b/ sounds-
   Example: Dear Billy Baby, wish you a great big birthday bash!!
   Your brother Bob.

5. /d/ - Dance, Grandeur, Cascade
   Does Dorothy drink detox drinks daily?
   Create a two –line diary entry with at least five /d/ sounds-
   Example- Dear Diary, today was an amazing day since Dunston from Dutch class asked me out for a date.

6. /g/- Grudge, Vagabond, Log
   Green goblins gobble goodies and remain grumpy.
   Create a postal address with at least five /g/ sounds-
   Example: Gate no-17, Goodwill Home, Ghost Street, Greenlight town, Greenland.

The /P/-/b/ divide

Ask the students to read out each of the words (from left to right).

A trick that will help them understand the difference in the articulation of the two sounds would be to look at the 'voiced' and 'voiceless' aspect.

While articulating the /p/ sound, place your hand on your throat- you would feel no vibration however while articulating the /b/ sound you would feel the vibration in your throat.

Any sound that produces vibration is called a Voiced sound and ones that do not produce vibrations are called Voiceless sounds.

Bin	Bat	Bug	Bet	Ben
Pin	Pat	Pug	Pet	Pen
Bill	Beat	Bear	Balm	Best
Pill	Pete	Pear	Palm	Pest

Please bring Peter a Book and post Bob's package today
The building has plenty of beauty salons and posh bookstores.

Bold	Posh	Braille	Pursue
Blend	Polka	Brittle	Plunder
Blush	Plant	Beeper	Poster
Bread	Purse	Boastful	Precarious

Fricatives
Fricatives are produced when the two parts of the mouth force air through a small space, thus creating audible friction. We have nine sounds classified in the category:

7. /f/- Fish, Stifling, Plaintiff
   Five foreigners left to the famous Filipino fantasy park.
   Create five female names that begin with /f/ sound-
   Example: Fiona, Farah, Faiza, Freeda, Fathima and Feeza.

8. /v/- Victorious, Frivolous, Believe
   Viceroy Vivian was very vindictive and vicious.
   Create a list of five food items that begin with a /v/ sound-
   Example: Vanilla cake, Vermicelli pasta, Vegetables, Vienna Sausage and Veal.

9. /θ/ - Thermometer, Catholic, Aftermath
   Theoretically, three thieves are caught every three hours.
   Create a movie name with at least five /θ/ sounds-
   Example: The theory behind thirty-three thieves and a thistle.
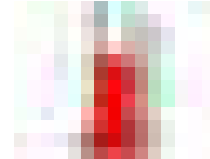
10. /ð/ - Thereafter , Feather, Breath
    The mothers gathered at the feathers hall now and then.
    Create a two line letter with at least five /ð/ sounds-
    Example- Dear father, the gathering has decided to go with leather couches rather than synthetic ones.

11. /s/- Synchronise, Pastry, Meticulous
    A sinister silence followed the song sung by Sasha.
    Create a two- line poem with a at least five /s/ sounds-
    Example: A sweet soldier said to his wife, my sweetheart I will never sell you to solitude.

12. /ʃ/- Champagne, Rational, Polish, Luxury, Fissure
    Shelly is the fashionable cashier at the Lush Shoe Shop.
    Create five sentences with two /ʃ/ sounds-
    Example: She sold all her shares. Puppies take shelter in roadside shacks, She will be in ship shape, Fashionable shoes are out & The railway station is crazy during rush hour.

S/SH Exercise

She	Sea
Ship	Sip
Seat	Sheet
Sell	Shell

Single	Shingle
Leash	Lease
Self	Shelf
Said	Shed

Ask the students to read out the word pairs and identify the difference in the articulation of two sounds.

13. /Ʒ/ - Pleasure, Seizure, Closure, Luxurious
    The pleasure of a leisure break is a luxurious feeling.
    Create a five word list of /Ʒ/ sounds-
    Example: Pleasure, Measure, Enclosure and Explosion

14. /z/ - Zebra, Guzzle, Craze
    Frizzy hair marine likes puzzles and going to the zoo.
    Create a sentence with at least five /z/ sounds-
    Example: The zoo keeper was zapped when he heard the crazy buzzing noise.

15. /h/ - Hilarious, Historical, Stockholm
    He hinted at her to hike with him to the top of Histone hills.
    Create a personal introduction with at least five /h/ sounds-
    Example: My name is Helena and I teach History for high-school kids in the Hispanic part of Holland.

Z/Th Sound Exercise

Bays	Bathe
Breeze	Breathe
Zen	Then

Sues	Soothe
Close	Clothe
Rhythm	Risen

Ask the students to read out the word pairs and identify the difference in the articulation of the two sounds.

Affricates

Affricates are the combination of plosives and fricatives.
We have two sounds classified under this category.

16. /ʧ/- Challenge, Stretchable, Staunch
    I cherish a chilled cherry drink and chocolates.
    Create a 2- line dialogue with at least five/ʧ/ sounds-

Example: Charlotte- "Hey, Charlie! Are you going to the church fare today? "Charlie –
"Oh no, Charlotte! I need to fetch chocolates for my sister.

17. /dʒ / - Gigantic, Gorgeous, Marriage
Gina dressed like a gentle giraffe named Ginger.
Create five male names that have /dʒ/ sounds-
Example: George, Sanjay, Jason, Joshua & Josiah

Nasals

Nasals are sounds produced with help from nasal passage.
We have 3 sounds in this category.

18. /m/- Mystical, Fumble, Aquarium
My mother makes mouth-watering mango milk shakes.
Create a two- line recipe with at least five /m/ sounds-
Example: Mushroom Mayo- boil and cook mushrooms in medium hot oil and mix mayo
and serve hot with minestrone soup.

19. /n/ - Notorious, Lunatic, Valentine
Nathaniel is not a nice neighbour, say many in Newcastle.
Create a list of five places, you've not visited, with /n/ sound-Netherlands, New Zealand,
Nebraska, Nottingham & Nepal

20. /ŋ/ - Sting, Blaring, Triangle
The king had a song ringing in his head since morning.
Create two- liner songs with at least five / ŋ/ sounds-
Examples: The fragrance lingered in the morning; it stung me like the setting of the sun
as I knew she left the ring behind.

Semi Vowels

21. /j/ - Yawn, Youngster, Kayak
Yellow flowers and yummy food is aplenty in Mr. Yuri's home.
Create a sentence with at least five /j/ sounds-
Example: Yellow magazine had an article on how youngsters
waste their lives, yearning for luxury and letting their youth and
years pass by.

22. /w/ - Winter, Wailing, Powerful
When Wendy went to the White House she was not well.
Create a list of five questions you have 1 /w/ sound each –
Example: Where were you yesterday? When will you arrive? Which dress is a better
option? Why were you busy today? I want to know whether this is the right thing to do?
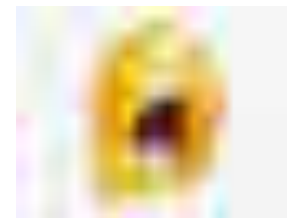
23. /r/- Rustic, Guaranteed, Shopper
Recently no rooms were free at the romantic River Resort.
Create a five –line 'To –Do' list with at least five /r/ sounds-
Example: Run to the local market to buy a bunch of red roses, Raise a request for a new Debit Card, Go to the Rodeo Drive to buy Rayban sunglasses.

Lateral Consonants
24. /l/ - Leprechaun, Fallacy, Coral
Lincoln lost his lucky locket at the local market.
Create a list of five gift items that begin with /l/ sound-
Example: Lilac Lip Gloss, Lotus- shaped candles, Leather Boots, Lavender Stole & Little Black Dress.

Activity: Rhyme time
Materials Required: None
Instructions:

- Tell the students that they will be given five minute to think of a rhyme.
- The rhyme should include the usage of all the consonant sounds.
- The students can be called randomly to make their presentation.
- In case of shortage of time, the students may work in groups and one from the group may make the presentation.
- The faculty will check against a list of consonant sounds listed on the board for usage and pronunciation as well.
- The group that has used all the consonant sounds and finishes the fastest is entitled to a prize.

STOP ! GO BACK AND REFLECT !

I learnt ……

I would like to know more about ……………………………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………………………………

Something I would adapt / do differently………………………………………………………………………………

---

4. Vowels

We have 20 vowel sounds.

"Vowel" has its roots in the Latin word 'vocalis' which means- speaking, since vowels are the most important aspect of speaking any language.

25. /∂/- America, Against, Afraid, Agriculture, Annoy, Another
    Create a sentence with a t least five /∂/sounds

26. /3:/ - Stir, Pearl, First, Hurt, Shirt, Bird, Learn, Burly, Mirth
    Create a sentence with at least five /3:/ sounds

27. /∧/- Butter, Stuck, Money, Lucky, Shut, Cutter, Nut
    Create a sentence with at least five /∧/ sounds

28. /æ/- Fan, Cramp, Gaggle, Stack, Parasite, Clap
    Create a sentence with at least five /æ/ sounds.

29. /a:/- Farmer, Shark, Chance, Starter, Glass
    Create a sentence with at least five /a:/ sounds.

30. /I/ - Kiss, Sting, Interval, Print, Whimsical, Interest
    Create a sentence with at least five /I/ sounds.

31. /i:/- Heels, Phonics, Devious, Leader, Preacher
    Create a sentence with at least five /i:/ sounds.

32. /Θ/ -Cot, Stock, Potter, Fought, Rotting
    Create a sentence with at least five /Θ/ sounds.

33. /ɔ:/- Awesome, Awful, Caught, Origin, Four
    Create a sentence with at least five /ɔ:/ sounds.

34. /Y/- Footprints, Good, Should, Look, Hook, Shook
    Create a sentence with at least five /Y/sounds.

35. /u:/- Spooky, Foolish, Prudent, Moon, Fume
    Create a sentence with at least five /u:/ sounds.
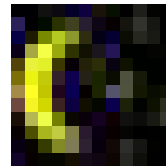
36. /e/- Elephant, Egg, Plenty, Blend, Kentucky
    Create a sentence with at least five /e/ sounds.
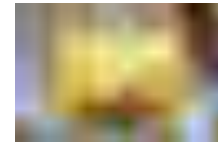
Activity: The Great Vowel Hunt

Materials required: 10 blank A4 size papers, 4 bowls, a pack of post-its & Sketch pens

Instructions:

- Divide the class into four teams
- Each team will be given 15 minutes to come up with two words for every vowel sound. These 24 words should be written in separate slips of paper, clearly underlining the vowel sound. For example, a slip containing a word that highlights the /e/ sound should look like this:

> M<u>e</u>ntor

- Once the team has prepared 24 such slips containing words, they fold up the slips, mix it all up and put it into the bowl given to the team.

- Swap the bowls of one team with another.
- Write each vowel sound on a post it (one on each) and place the post-its randomly around the room(on the door, on the white board, on the desk, near the window, etc)
- Instruct the teams to divide their team members into "Runners", "Callers" & "Readers".
- Once the teams decide on the members who take on the titles mentioned above, tell them the rules of the game.
- Rules of the game:
  - The "Readers" would pick one word at a time from the bowl and inform the "Caller" of the word and the sound it highlights.
  - The "Caller" then shouts out the word and the sound to the "Runner".
  - The "Runner" in turn needs to identify the post-it which has the symbol for this sound and needs to run to it and write down the word on the post-it.
  - The process is repeated for every word, the team that finishes first shouts out "Bingo!!!"
  - The game is continued till the final team shouts out "Bingo!!!"
  - The faculty to make note of the order.
  - The final task is to cross check the words and see if the teams have been able to pick out the word in correct post-it: this final check is done by the other teams.
  - Based on the final score (2 points for every correct word in the correct post-it) the winners are declared.

Debrief:

This activity helps the students to apply the understanding of sounds and symbols. This brings about the clear comprehension of the sounds and their distinctions.

5. Diphthongs

A diphthong is made of two vowel sounds placed adjacent to each other within the same syllable. When we represent a diphthong sound using the IPA code we use a combination of two vowel symbols placed next to each other.

Look at the examples below.

37. /ɛɪ/- Vacation, Placement, Payment, Facial, Baseball
    Create a list of 5 words with /ɛɪ/ sound.

38. /ɑɪ/- Sunshine, Crime, Behind, Bright, Guide, Style, Shy
    Create a list of 5 words with /ɑɪ/ sound.
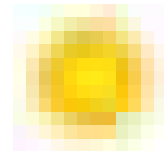
39. /Oɪ/- Soil, Oyster, Ploy, Stoic, Boisterous, Boys, Coin
    Create a list of 5 words with /Oɪ / sound.
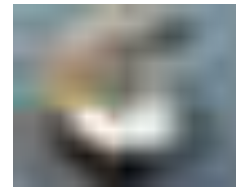
40. /ɪ ≅/- Beer, Sheer, Clear, Fierce, Pioneer, Steer
    Create a list of 5 words with /ɪ ≅ / sound.
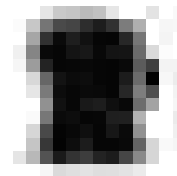
41. /ɛ≅/- Bear, Chair, Careful, Scare, Flair, Share, Ware
    Create a list of 5 words with /ɛ≅ / sound.

42. /ʏ≅/- Tour, Poor, Cure, Cruel, Sure
    Create a list of 5 words with /ʏ≅ / sound

43. /ɑʏ/- Flounder, Around, Cow, Couch, Loud, Prowl, Ouch
    Create a list of 5 words with /ɑʏ / sound

44. /≅ ʏ/- Ghost, Post Code, Stole, Boast, Joke, Low
    Create a list of 5 words with /≅ ʏ / sound

Activity: Diphthong Drummers

Materials Required: A4 size papers and Pens

Instructions:

- Divide the class into four teams.
- Ask each team to come up with a name for a music band for themselves
- Instruct them that they will be given 20 minutes to come up with a song that has words containing all the diphthongs
- The song should have 2 paragraphs and a two line chorus
- The team can set a tune and provide music (with no instruments- clapping/ beat boxing, using materials available in class, is allowed)
- Give each team 5 to7 minutes to make a presentation
- Rate the team son the usage of the diphthongs and creativity
- Conduct a blind voting score- ask all the students to put down their heads and call out one team at a time, except the team that is being called all the other teams need to raise their hands based on the rating they support. For example, if the faculty calls out "Team 1", then the members of teams 2, 3 and 4 can vote. The ratings that will also be called out by the faculty for each team is- "Amazing", "Average", "Not too good". Calculate the total votes giving "Amazing"- 20 points for every vote, "Average"- 10 points for every vote & "Not too good"- Negative 2 points for every vote

Debrief:

This activity helps the students familiarise themselves with the diphthongs and its classification. The students also practice the correct articulation of these diphthongs.

<u>Pronunciation checker</u>

Purpose	Possibly	Ambiguous
Executive	Recognise	Miser
Cache	Sachet	Business
Photocopier	Genre	Plush
Gather	Manoeuvre	Majority
Decision	Closure	Cabinet
Reservation	Surveillance	Archaic

Ask the students to pronounce each of the word in the grid and correct, if required.

STOP ! GO BACK AND REFLECT !

I learnt ……

I would like to know more about ………………………………………………………………………….

Activities / tasks I liked / found useful…………………………………………………………………

Something I would adapt / do differently………………………………………………………………

6. A Few Phonic Rules

Sometimes the rules don't work.

There are many exceptions in English because of the expanse of the language. The rules do apply however, in the majority of the words.

Ask the students to write more examples of their own to better understand the rules:

1. "C" followed by "e, i or y" usually has the soft sound of "s". For example: "cyst", "central" and "city".
2. "G" followed by "e, i or y" usually has the soft sound of "j". For example: "gem", "gym", "gist".
3. When a syllable ends in a consonant and has only one vowel, that vowel is short. For example: "fact, bed, fish, spot, luck".
4. When a syllable ends in a silent "e", the silent "e" is a signal that the vowel in front of it is long. For example: "make, gene, kite, rope and use".

Minimal Pairs:

- Pairs of words whose pronunciation differs at only one segment, such as Sleep and Slip or Pair and Pore.
- Since the articulation of these pairs are very similar, they lead to confusion.
- Write ten minimal pairs of your own (especially once that confuse you the most) - give students more examples with the minimal pairs they tend to confuse.

Minimal Pair – Consonant Sounds: read out and ask the students to write more examples of their own.

P B	Patter Batter	Rope Robe	Newspaper Observe
T D	Time Dime	Great Grade	Outside Children
K G	Class Glass	Back Bag	Technical Negligent
F V	Fairy Very	Off Of	After Involve

Th Th	Think These	With Smooth	Something Other
S Z	Sue Zoo	Police Please	Eraser Business
Sh Zh	Pressure Pleasure	Brush Beige	Reservation Decision
Ch J	Choke Joke	Batch Badge	Picture Educate

M N	Male Nail	Same Sane	Remember Convention
W V	Wary Vary	Wire Via	Wane Vein

Activity: The Missing Sound

- In one word in each group, the 'b' or 'p' is not pronounced. Circle the word
- Example: double   (debt)   Dublin

a.   (lamb)   label   lap

b.   crab   robbed   (climb)

c.   cup   (cupboard)   copy

d.   (photo)   potato   paper

e.   recipe   repeat   (receipt)

f.   possibly   (psychology)   special

g.   Cambridge   combine   (combing)

Minimal Pair- Vowel Sounds

Read out and ask the students to write more examples of their own.

Loud	Load	Lord
Miss	Mass	Mess

Cot	Curt	Caught
Fair	Fear	Far
Sam	Sum	Psalm
Wheat	Wet	Wit
Shone	Shorn	Shown
Beat	Bid	Bed
Fill	Feel	Fell
Led	Laid	Lad
Cart	Cut	Curt
Pull	Pool	Paul

Activity: They Sound the Same!!!

Ask the students to identify the right word for each sentence.

1. He wanted a Daze/ **Day's** leave.
2. King Henry **rode**/ road on his favourite horse that day.
3. Please **wring**/ ring the clothes before putting them to dry.
4. Her diamond ring shown/**shone** in the ballroom.
5. Mr. Paul has no write/**right** interfering in my business.
6. Ones/ **Once** upon a time.
7. Jones fell down the stares/ **stairs** and broke his leg.
8. Can you make the table with Mahogany would/**wood**.
9. She maid /**made** chocolate chip cookies in the evening.
10. Mary **ate** /eight all the toffees kept for little Ben.

STOP! GO BACK AND REFLECT!

I learnt ………

I would like to know more about ……………………………………………………………………………….

Activities / tasks I liked / found useful…………………………………………………………………………

Something I would adapt / do differently…………………………………………………………………………

---

7. Word Stress: Syllables

There are two very simple rules about word stress:
1. One word has only one stress
2. We can only stress vowels, not consonants.
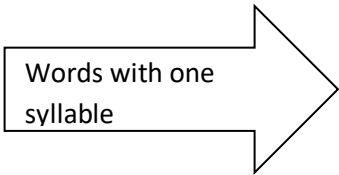
Let us understand Syllables:

A syllable is one unit of sound in a word.

3. For example: If you were to clap to the rhythm of every word, you would clap twice for the word "Water", once for the word "tap" and thrice for the word "Magazine"- this unit of sound is a syllable.
4. Every word is made up of syllables.
5. Each word has either one, two, three or more syllables.
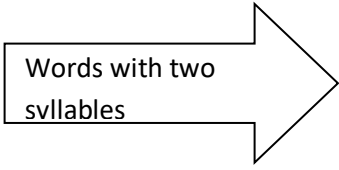
Syllables:

Words with one syllable

> Monosyllabic Words:
> Hat   Gun   Love   Pen
> Pet   Kin   Fill   Wrist
> Fun   Cub   Den   Fish
> Pin   Food   Run   King
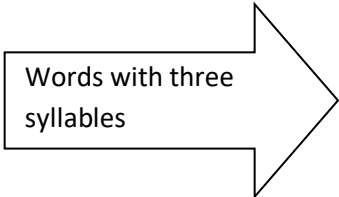
Words with two syllables
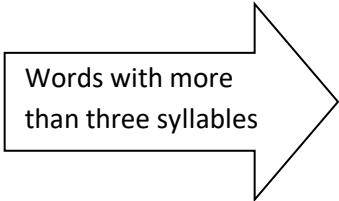
> Bi syllabic Words:
>
> Water   Pension   Ration
> Joker   Polka   Stigma
> Waiter   Polish   Ruler
> Falter   Cooker   Feline

Words with three syllables

> Tri syllabic Words:
>
> Computer   Government
> Newspaper   Rational
> Offensive   Microsoft

Words with more than three syllables

> Polysyllabic words
>
> Predictable   Hallucination
> Malnutrition   Stability
> Presentation   Technology

Ask students to write examples of their own.

Activity: Syllable Slot

Read out the list below and ask the students to classify them as Mono, Bi, Tri and polysyllabic words.

1. Tear- Monosyllabic
2. Finale- Trisyllabic
3. Greener- Bisyllabic
4. International – Polysyllabic
5. Law- Monosyllabic
6. Police- Bisyllabic
7. Fierce- Monosyllabic
8. Roller coaster – Polysyllabic
9. Princess- Bisyllabic
10. Fishing- Bisyllabic
11. Analysis- Polysyllabic
12. Presentation- Polysyllabic
13. Marker-Bisyllabic
14. Branding-Bisylalbic
15. Advertisement- Polysyllabic
16. College- Bisyllabic
17. Professor- Trisyllabic
18. Interview- Trisyllabic
19. Student- Bisyllabic
20. President- Trisyllabic

Word Stress: Rules

- You could stress on a syllable by using one or more of the following five features:
    - It is l-o-n-g-e-r-
    - It is LOUDER
    - It has a change in pitch
    - It is said more clearly
    - It uses larger fishing movements

Rules:

Stress on first syllable:

Rule	Example
Most **2- syllable nouns**	PRESent, EXport, CHIna, TAble
Most **2- syllable adjectives**	PRESent, SLENder, CLEVer, HAPpy

Stress on Second Syllable:

Rule	Example
Most **2- syllable verbs**	to preSent, to exPORT, to deCIDE,
	to beGIN

Stress on penultimate syllable (penultimate = second from end)

Rule	Example
Words ending in – ic	GRAPHic, geoGRAPHic, geoLOGic
Words ending in –sion and - tion	teleVIsion, reveLAtion

Stress on ante- penultimate syllable (ante- penultimate = third from end)

Rule	Example
Words ending in **–cy, -ty, -phy** and **-gy**	deMOcracy, dependaBility, phoTOgraphy, geOLogy
Words ending in **-al**	CRItical, geoLOGical,

Compound words (words with two parts)

Rule	Example
For compound **nouns, the stress is on the first part**	BLACKbird, GREENhouse,
For compound **adjectives, the stress is on the second part**	bad-TEMpered, old-FASHioned
For compound **verbs, the stress is on the second part**	to underSTAND, to overFLOW

STOP ! GO BACK AND REFLECT !

I learnt ……

I would like to know more about …………………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………………….

Something I would adapt / do differently………………………………………………………………………

7. Intonation Patterns:

Statement

Questions

Phrases

Tag Questions

Items in Series

Statements:

- Downward drop**:**
  - Indicates the end of an idea
  - Indicates that it is another person's chance to speak.
  For example:
  - The students are from National Science Academy.
  - He is capable of maintaining excellent health.
  - My boss decided to hire the five finalists.
  - The judge and jury joked about the arrangement.

Questions:

- Open- ended questions: Drop down at the end.

  Example: **Describe** the city in which you live.
- Closed-ended questions: Begin with a lower pitch and usually end in a rising pitch.

  Example: Have you been here **before**?

- Choice questions: The pitch will go up on the first choice and down on the next choice.

Example: Do you want a **Yellow** or an Orange t-shirt?

- <u>Wh' questions:</u> They have a rhythm that usually ends with a downward drop.
    - Which employee's bag is on the desk?
    - What Indian costumes do travelers find intriguing?
    - Who wrote the lyrics for the album?

- <u>Yes/ No questions:</u> This rhythm signals the listener that it is his turn to respond.
    - Did the couple split?
    - Will they finish the project before March?
    - Is Alisha eligible for the course in Journalism?
    - Does the chart at the end of the text make sense?

Phrases:

- The largest "step down" in pitch and volume usually happens at the end of a statement.
    - Before the author wrote, he thought things through.
    - When wires were crossed, the warehouse lost power.
    - As we walked, we talked about factory management.
    - In early summer, we will visit the western waterfall.

Items in a series:

- When items are presented in a particular order, you will notice upward inflection with each one until the final item, where there is usually a downward step.
- All kinds of data are on the charts, tables, and graphs.
- Desks were covered with computers, manuals and papers.
- Prepositions include "across", "until", "among", and "of".
- The last three letters of the alphabet are X, Y, Z.
- Add flour, sugar and butter to the batter.

Intonation and Stress

New Information:

- When any new information is given, the noun carries the stress in the sentence.
  Example: Meet **Mr.White**.
- The Intonation and stress change after the information is given. The verb takes on the stress.
  Example: He **sells** car accessories.

Contrast:

- Change in pitch indicates the emphasis laid on one thing over another.
- E.g. Keith studies **History**.
  Keith **studies** History, but he doesn't **use** it.

Stress changes meaning

Lets us see how the meaning and intention of the sentence changes with variation in stress.
For example: "He did not steal the money"
He did not steal the money- someone else did.
He did not **steal** the money- he borrowed it.
He did not steal the **money**- he stole the bag.

STOP ! GO BACK AND REFLECT !

I learnt ……….

I would like to know more about ……………………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………………………

Something I would adapt / do differently……………………………………………………………………………

---

9. Pacing and Chunking

Pacing: The method of varying the speed of your speech, the proper pace and rhythm helps a person to be understood better.

Examples:

1. Bad performance costs jobs.
Bad performance/ costs/ jobs

2. This is probably the first time I've fallen in love.
This/ is probably/ the first time / I've fallen in love.

In written English, the use of punctuation marks enables one to observe the punctuation and read the sentence accordingly, but when we speak English, a listener understands what we say because we group words together and pause appropriately to convey the meaning.

This allows us to speak in phrases or thought groups and to pause just after important information that we want to emphasise.

If we speak slowly and clearly, the phrases are shorter, but if we speak fast, the phrases are longer and we don't emphasise as many words.

It's important to know where to put the pauses in the sentences so that you can sound comprehensible to the native speaker.

Common Patterns of Pacing

Examples:

Noun phrases:	the obsolete software Army and Peter
Short subject and verb:	Mary walked The boy smiled
Verb phrases:	Jogged joyfully seemed correct
Prepositional phrases:	In the laboratory with the hammer to the mall
Relative clauses:	…. woman who wore glasses ….. book that I read, is ….
Parenthetical remarks:	Phrase (or thought groups) are … this is, in fact, an example.

Between each thought group, the speaker needs to pause. There are some pauses that are longer and more important than others. These would be marked with commas, semi-colons, colons and full stop in writing and will almost always be pauses, no matter how fast the person is speaking. The other pauses are less evident but definitely in place and they do impact speech.

Importance of Chunking

- A conversation is made more meaningful and clear.
- Helps one to learn to think and speak in complete phrases.
- The pitch, frequency, length and intensity help to add additional and variable meaning to a given statement.
- By deliberately placing the main stress at the beginning or in the middle of a chunk, you can subtly change the meaning of what you say.
- The stressed words tend to be nouns and verbs generally.
- It is better to pause after stressed words.
- Pausing can change the meaning of a sentence. The scope of an adjective can be altered depending upon the pausing.

Activity 1:

Faculty to read each of the three options for each sentence and students need to identify the sentence that has been wrongly paced.

1. a. The person who never made a mistake/ never/ made anything.
   b. The person/ who never made a mistake/ never/ made anything.
   c. The person/ who/ never made a mistake/ never/ made anything.

2. a. Management/ problems always /turn/ out / to/ be people problems.
   b. Management problems/ always turn out/ to be people problems.
   c. Management/ problems/ always turn out / to be people/ problems.

3. a. Big companies / are small companies/ that succeeded.
   b. Big companies / are/ small companies that/ succeeded.
   c. Big companies / are small companies that succeeded.

4. a. Hard work never killed anybody, / but worrying about it did.
   b. Hard/ work/ never/ killed /anybody, / but worrying about it did.
   c. Hard work never killed anybody, / but worrying/ about it did.

5. a. Ideas are/ like children./ Your own are / wonderful.
   b. Ideas are like children./ Your own are wonderful.

c. Ideas/ are like children. Your own/ are / wonderful.

Activity 2

Ask students to work in pairs: Each pair to be given a copy of the poem below. Ask them to read it to each other and with a slash, mark the areas where the appropriate pauses are to be made so that it can be understood better by the listener.

Ask each pair to read it out to you and then provide correction and adequate feedback:

Let's face it;
English is a stupid language.
There is no sand in a sandwich

No ham in a hamburger,
And neither pine nor apple in the pineapple.
Quicksand takes you down slowly,
Boxing rings are square.

If writers write, how come fingers don't fing?

If the plural of tooth is teeth,
Shouldn't the plural of phone booth be phone beeth?

If the teacher taught,
Why didn't the preacher praught?

If a vegetarian eats vegetables,
What does a humanitarian eat!?

When the stars are out they are visible,
But when the lights are out they are invisible.

Why do people recite at a play
Yet play at a recital?

And that is why you fill in a form by filling it out,

And a bell is only heard after it goes.

And why when I wind up my watch,
It starts,
But when I wind up this observation,

It ends.

Activity 3
Here is a short extract from President Obama's speech. Get your class into pairs, ask them to read it through.
Now make them read it again slowly and mark with a slash, the appropriate chunks of the sentence and have them read aloud to their partner. Ensure you give timely correction and feedback.

"It drew strength from the not – so – young people who braved the bitter cold and scorching heat to knock on the doors of perfect strangers and from the millions of Americans who volunteered and organized and proved that more than two centuries later, a government of the people, by the people and for the people has not perished from the Earth".
"This is your victory."

"And I know you didn't do this just to win an election. And I know you didn't do it for me."
"You did it because you understand the enormity of the task that lies ahead. For even as we celebrate tonight, we know the challenges that tomorrow will bring, are the greatest of our lifetime- two words, a planet in peril, the worst financial crisis in a century."

Extract: http://www.independent.co.uk/news

STOP ! GO BACK AND REFLECT !

I learnt …….

I would like to know more about …………………………………………………………………….

Activities / tasks I liked / found useful…………………………………………………………….

Something I would adapt / do differently……………………………………………………………

---

10. Fluency

Fluency denotes language proficiency. It is the ability to be understood by both native and non-native speakers of the language. Fluency in speaking, refers to one's ability to express their thoughts coherently and logically in complete sentences, using appropriate vocabulary and without hesitation.

How to improve fluency:

- Use a **variety of linkers** to organize and link ideas.
- Speak confidently for **long stretches** of time.
- Say things in a different way to **avoid saying the same things twice**.
- Avoid repeating content words and repeating phrases.
- Use synonyms and/ or referencing language (pronouns; this, that it, those, etc.) to avoid repeating things.
- Avoid regular hesitations/ **pausing for too long** (more than 3 seconds) when searching for words and expressions

Activity 1

Explain that there are only three rules to this game:

- No hesitation (more than 3 seconds).
- No repetition (saying the same thing twice; repeating phrases or content words)
- No (going off topic) deviation.

Note: Before getting the participants to do this activity in pairs, demonstrate how the rules get broken by getting one participant to the front of the class. This person is given a topic from the table and is told to speak for a minute on this topic. Tell the other participants that they must stop the speaker if any one of the three rules are broken. If the participants have not stopped the speaker for breaking any of the three rules, **the faculty must do this**.

Highlight which rule has been broken and ask participants what the speaker could have done to avoid breaking the rule; for example, if the speaker has repeated the phrase or content word, the whole class has to think of a synonym or referencing word (pronoun; it, this, that, etc.) to replace this word/ phrase.

Repeat this with more participants so that the three rules are highlighted and ways to avoid breaking these rules have also been brought to the attention of the participants.

Playing the game:

Participants sit in pairs (A and B) facing each other.

Partner A starts talking on one of the topics selected from the table. Partner B must stop A if A breaks one of the three rules. B gets 10 points for this. Then B continues the topic, and this time A must stop B if B breaks one of the three rules. The person who is talking at the end of the minute gets an extra 10 points. Points are added up to find a winner.

Monitor and encourage participants to find participants to find synonyms or other ways of saying something **to avoid repetition of phrases/ content words**. Also, remind them to use a variety of linkers to **organize and connect their ideas.**

Get participants to change partners, and repeat the steps above again with another topic. Now, B starts talking on a new topic from the table A and must stop B.

After some time, get everyone to **change partners** and repeat the activity with a new partner.

Continue until all participants have built up their confidence in talking on a topic for a minute, without any hesitation, repetition and digression.

Activity 2

The participant next get into pairs and choose at least four current affairs topics that they are both comfortable with and have sufficient knowledge of.

Participant A will introduce the topic and share his/ her viewpoint on it. Partner B will play the devil's advocate by disagreeing politely. They will have a structured discussion - give an argument, partner politely disagrees, ask for clarification, reply.

- Pairs discuss while the faculty monitors closely.
- Faculty provides feedback at the end, with special focus on clarifying and disagreement language and the ability to express thoughts fluently.

Activity 3

- Divide the class into groups of five. Ask each group to choose a common topic of interest.
- The group is allotted 10 minutes to brainstorm and make a mind-map of talking points relevant to the topic.
- The group now chooses a person to represent their group who will string these thoughts and make a speech. (if time permits, they could write out their speech.)
- Ask the speaker to address the class.
- At the end of the speech, permit the audience to ask questions.
- Throughout this activity, the faculty should monitor closely, taking note of areas to provide feedback on, later. Also be sensitive to any potential conflicts, defusing any tension, if necessary.

Group Discussion

What is it

In a group discussion, we discuss a topic by sharing different viewpoints. The idea is not to defeat each other but to ask questions and get to know each other's viewpoints and build upon that and if possible reach a final conclusion on a topic.

A group discussion involves discussion i.e. giving your opinion and supporting that with a reason, personal experience etc. participants ask questions to one another, building upon what the other person has said.

Group Discussion Structure

1. Appoint a moderator.
2. Moderator introduces the topic.
3. Then elicits everyone's views on the topic.
4. Ensures everyone gets a chance to share their view.
5. Ensures that the discussion stays on track and use functional language.
6. Summarises the key outcome of the discussion.

Activity 1

- Put participants in groups of 6 and ask them to choose a controversial topic (they can choose one of their own if they don't like the ones given). However, this must be a topic which everyone is comfortable discussing.
- Once they have chosen, give them time to brainstorm ideas on the topic and give reasons for their opinions.
- Highlight the importance of using phrases to introduce their opinion, ask questions and so on.
- Ask them to choose a moderator.
- Give the participants a topic. Give them 5 minutes to prepare their opinions.
- Allow participants 15 to 20 minutes to discuss their chosen topic.
- Monitor and make notes on their performance.
- Share your feedback.

STOP ! GO BACK AND REFLECT !

I learnt ……

I would like to know more about ………………………………………………………………………….

Activities / tasks I liked / found useful………………………………………………………………….

Something I would adapt / do differently……………………………………………………………

---

11. Indianisms

This refers to usage of certain turns of a phrase and anomalies in the use of a syntactic structure which is typical of the way English is spoken in India.

Most often, this is a result of direct translation from the mother- tongue into English, however such usages sound colloquial and may not be understood by the native speakers of the language. Strangely some of these usages, have, over a period of time, become an accepted way of speaking and goes unnoticed within the country, however they could be disastrous in an international forum.

Errors relating to Grammar
- Progressive tense used in stative verbs: I am knowing the result.
- Variation in noun number and use of determiners:
  - My brother loves to pull your legs.
  - I visited the Mysore.
- One-to – one correspondence of prepositional usage: Let us discuss about the book.
- Word order: my all friends are calling.
- Use of the Indefinite article- 'a' before words that start with vowels: I have a uncle who lives in Mumbai.
- Use of only as an intensifier: I only cooked the curry.
- Omission of definite article: Please bring bag when you come.

Vocabulary
Listed below are some of the common errors. There are many more that one can think of.

- Use of open and close/ on it/ off it instead of switch on and instead of switch off.
- Use of the word 'since' instead of 'for': I have been going to work <u>since four</u> years ago.
- Use of the phrase "I can be able" instead of "I can".
- Use of the word 'back' instead of 'ago'.
- Uses of the phrase 'pass out' to mean graduating from.
- Use of also in the place of 'too'.
- Doubling of adjectives to show intensification- 'curly curly' hair

Activity

Organize the class into pairs and ask them to work on the list below.

Listed below are typical Indian usages. Replace with the appropriate phrase:

1. I'll be there in 2 hours' time.	
2. You have trust on me.	
3. I am finding your details.	
4. I am going to my native.	
5. It's very much hot today.	
6. You have found the details?	
7. You can't see?	
8. I am having two cars	
9. I am having a bad headache	
10. He is my cousin brother	
11. She is my sister, isn't it?	
12. You are coming for the party, no?	
13. Are you sister of Reena?	
14. Can you explain me the problem?	
15. I said him that I'll come.	
16. I'll explain you how to do it.	
17. I'll help you out.	
18. It is on the backside of your monitor.	
19. I didn't went there	
20. I am going to Kerala today evening	
21. I got stuck up in the lift.	
22. She's got good communication skills.	
23. It's on the backside of next building.	
24. This has to be done by next to next week.	
25. I had to buy some small small things.	
26. Basically I'm from Delhi	
27. May I just have your account details?	
28. It'll be done in max to max 2 hours	
29. What is your good name?	

30. Myself Robin	
31. In case if I want it….	
32. This is Ram this side	
33. Me, my family and my friends had a great time at the party.	
34. It's his happy birthday	
35. The reason is because	
36. Let me check it out for you	
37. I will return it back to you.	
38. Please revert back to us	
39. What I have to do?	
40. I have a small brother	
41. I am very much delighted	
42. What you are waiting for?	
43. I can't be able to do it?	
44. I am a B.Com graduate	
45. She's wearing a blue colour dress	
46. He has a book of mine	
47. Who is the person who looks after this?	
48. The meeting has been preponed	
49. Does it pain?	
50. He has taken five offs this month	
51. Hope things are well at your end	
52. I'm going out of station	
53. Just let me tell you	
54. I've been working here since quite some time.	
55. I'm not getting you	
56. Could you repeat it once again?	
57. You have found the details?	

58. I got disturbed by the noise	
59. What is your order number?	
60. I'm put up at Benson Town	
61. I wrote to you one week back	
62. His grandfather is 65 years of age	
63. I don't think so he welcome	
64. Like I said you	
65. I will suggest you to take a look at this	
66. Would you like to go for it?	
67. I am not having any idea about it.	
68. I was not knowing the way to your house	
69. He is more taller than his brother	
70. This shirt is more better	
71. My friends and all went bowling	
72. What all can we do?	
73. Means they are not coming today	
74. This is very near to my place	
75. She is very much beautiful	
76. Today only I'll do that	
77. I want it done now itself	
78. They are here only	
79. You are not understanding me.	
80. Better you come with me	
81. It was cold yesterday night	
82. I ordered for some food	
83. Something and all he was talking about	
84. Where and all I looked for you	
85. Off/on the lights	
86. I'll be going tomorrow	

87. My name would be	
88. You are coming to the party no?	
89. Coming, no?	
90. She was saying she'll come on time	
91. Peoples, childrens, informations, datas, jargons, feedbacks	
92. Meet my better half	
93. Her would be is in US	
94. What for I am reading this book	
95. Just I was telling him this morning	
96. Please do the needful	
97. I need the same by tomorrow	
98. She bought a new dress for her son	
99. I like hot hot food	
100. She's standing on my head to get it done	

STOP ! GO BACK AND REFLECT !

I learnt ………

I would like to know more about ………………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………………….

Something I would adapt /do differently…………………………………………………………………

UNIT-II: GRAMMAR

1. English: Spoken Versus Written Communication

Have you often found it difficult to put across your thoughts in English when you speak, but found it easier to put your thoughts to paper? Have you found it easier to convey a written message more easily than a spoken one?

To set the pace and make the students experience it themselves, the facilitator could get one participant to the front of the class and ask him to speak on a topic in English for two minutes, go back to his seat and put down his thoughts on paper- time given for writing: four minutes. (All the students could be asked to participate in the writing experience)

The facilitator then asks the participants to share his thoughts on the process that he went through. Ask the participant to tell the class about all the feelings he experienced, his fears, his body feelings, the tension he felt, any symptoms of stress, etc.

Now ask the entire class to attempt the activity listed below. The build-up is aimed to help the participants realize, both the importance of English as a global language and the need to attain fluency in speech and writing.

Chose one of the topics given below and write a paragraph of about 70 to 100 words in your first language. Time yourself and note it down.

1. **My role model.**
2. **My vision for India.**
3. **My dream holiday destination.**

_____

_____

_____

_____

_____

_____

Now write on the same topic on English and time yourself again.

_____

_____

_____

_____

_____

_____

_____

Which was the easier of the two choices? Was it easier to write or speak in your mother tongue or in English?

_____

_____

What were the areas of difficulty that you faced? Did they relate to sentence structure, grammar or vocabulary?

_____

_____

The facilitator asks the participants to write their individual areas of difficulty. The participants could share this with the facilitator and subsequently map it to their progress along the course.

_____

_____

_____

_____

_____

What is language? Would you say it is a tool that aids communication? When you started to speak as a child, you did not realize the difficulties you faced learning the language, since people all around you spoke it. Besides, that was the only tool you had to get what you wanted, not to forget the tantrums you threw! You picked up the first language effortlessly, and later with the help of other adults learnt to read and write in that language.

In most Indian homes, a child first learns to speak his mother tongue or regional language and learns English only on joining school or perhaps even later while in middle school. In fact if you think about it, your thought process is in your language (mother tongue). Over the years you become very comfortable thinking and speaking in your mother tongue. Subsequently you learn English; you are comfortable writing and reading English but however hesitate to speak the language. English therefore becomes your second language. When force to speak in English you are hesitant and at a loss for words. This grammar translation method makes us dependent on our mother tongue besides which we often struggle for the right words to convey our thoughts.

English is a global language and most of us lack the confidence to speak in English because our form of expression is weak. We have to acknowledge and accept that in the business world particularly when mergers and acquisitions are happening between countries across the world, the link language continues to be English.

Can you give me some more reasons why you should learn English?

Students may put their thoughts down in the space provided below.

1. ._____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

The facilitator may instead engage the participants in a healthy debate, if need be, to convince them about the need to be able to speak fluently in English. The points presented can be listed out on the board.

Well, if you are convinced now about the necessity to be able to write and speak English, let us move on with our discussion.

What would you say are the differences between the spoken and the written language?

When speaking, people use contractions, slang, colloquial expressions and do not always adhere to rules. Would it be appropriate to begin a sentence with 'but' or 'because' when you write? You would often have often heard such usage in spoken language. If we were to look at grammar, we find that we are very particular with the syntactic structure when we write, but tend to ignore it at times when we speak.

The spoken language is immediate, repetitive and more communicative and therefore there are chances that one makes mistakes and instantly corrects them in the course of speech. Besides, we also tend to intersperse our language with words from the local language. Moreover, we in India are comfortable using Indianisms or words which are unique to Indian English. In spoken language one communicates not just with words, but also with tone, body language, intonation and stress. In short, spoken language is less formal but more communicative whereas the written language is precise, well – ordered and structured.

Try this:-

Students should work together in pairs and read the following dialogue, one student reading the part of caller, the other student reading the part of the receiver. Note the expressions used in the dialogue and the progression of the conversation.

Receiver: Hello

Caller: Let me talk to Radha.

Receiver: Radha? There is no one here by that name.

Caller: You sure? This is the number what she gave me.

Receiver: Quite sure. This is Sharma's residence.

Caller: Haan, what number did I call?

Receiver: what number you were trying to call?

Caller: 2543-3768

Receiver: wrong number. You must have misdialed. That is not this number. Disconnect and try again.

Caller: OK, thanks yaar! sorry for the trouble

Receiver: No problems, that's all right. Good bye.

Caller: Bye.

While speaking, we use simple everyday vocabulary. Besides, our speech is interspersed with words and expressions from the local language (notice the use of 'yaar, no problems') while writers use formal and elaborate words. Written language when read out sounds less effective. Try and recollect how often have you been distracted when chunks of text were read out to you in the classroom? It bored you and you looked around at other things to keep you amused.

As second language learners of the language, you are more exposed to the written words and perhaps, also practice the written skills a lot more. The situations and occasions for you to speak in English are limited since your interactions are with your family and friends. Your exposure to first language speakers of the language is also limited. As a result of this predicament you often find that when you speak, your speech sounds stilted and official and lacks the conversational edge. This, in turn impacts your tone and you sound condescending and officious, sometimes rude. The reverse is also true where you sound too informal or casual and inappropriate.

Have you noticed that sometimes you are quicker and more fluent with your expressions when you write, but feel tongue tied when you speak? You feel your vocabulary is good, you are not confused with grammatical structure and convey your thoughts fairly well. However, when you are asked to speak in front of an audience or you are asked to make conversation with someone, your hands sweat, your pulse races and your words are stuck in your throat.

Speaking as a skill involves not just the words but a lot more. The tone, body language, gestures, facial expressions and the environment, all play their part in making you feel the way you do. The only remedy for this is practice, practice and more practice. Just as Rome was not built in a day, language fluency cannot be achieved overnight. It requires constant and conscious effort, a willingness to bring that change in you. Please emphasize with the students, the need for constant practice.

To get over our initial inhibitions, let us try a simple activity. Remember when it is your turn to speak, do not get nervous. Take a deep breath, compose yourself and speak.

1.1 Activity 1: Story Circle:

Subject: Spoken versus Written English

Aim: To learn to speak the English language with ease

Props: None

Instructions:

Facilitator to make the participants sit in a circle.

Facilitator to explain to the participants the concept of telling a story.

The facilitator will tell the group that this is going to be a relaxed session where we are all going to contribute towards creating a story. The participants can also be made aware that working in a group helps to improve the learning experience and helps build the confidence to speak in front of a large group without inhibitions.

Once the facilitator has started the first line, the next participant in the circle continues where the facilitator has left off. The next participant picks up the thread of the story and continues it. The story continues through all the participants until it has reached a conclusion and everybody has contributed to the story.

A good idea would also be to record the story and use it for an exercise for correction of errors.

Some of the starting lines that the facilitator could use are:

I woke up this morning all cold and clammy and I wasn't in my bed
…………………………….

Last night I had the strangest
dream……………………………………………………………..

Crash! Bang! What was
that……………………………………………………………..

I remember a time not so long
ago……………………………………………………………….

Debrief: What have I learnt? :

Basics of Grammar

Here is a jigsaw. If you were to piece it together, what would you have? – A complete picture, that's right! In the same manner! I have here an assortment of words. What can you do with them? Let us put them into some order. What do you have? – A sentence.

In today's session we are going to look at the various parts of speech that make a sentence. In the sentence that you have just arranged, pick out the various parts of speech and put them in the respective columns.

The black cat ran **quickly** across **the road but it was** hit by **the truck.**

	Noun
	Pronoun
	Adjective
	Adverb
	Preposition
	Conjunction
	Verb
	Interjection

This was a very simple task and I would now like you to do this by yourself. Let us have a quick activity.

1.2 Activity 2: Meet and Create

Subject: Parts of Speech

Aim: Understanding the importance of the different parts of speech

Props: Squares of paper with words representing different parts of speech written on it.

Sample of words: Nouns – Mosque, Road, Mall , Luxor

Do the same with pronouns, prepositions, conjunctions, verbs, adjectives and maybe adverbs.

Instructions:

The facilitator will distribute a choice of the words to each of the participants. On a signal from the facilitator, the participants will move around the classroom and find at least two other participants with whom they can make a complete sentence with. When everyone in the class has found a partner and is a part of a sentence group, they are asked to come to the head of the class and read out the sentence.

The degree of complexity can be increased by asking the participants to work in larger groups to make longer sentences!

Debrief: What have I learnt? :

> **STOP ! GO BACK AND REFLECT !**
>
> I learnt ……….
>
> I would like to know more about ……………………………………………………………………………….
>
> Activities / tasks I liked / found useful……………………………………………………………………….
>
> Something I would adapt / do differently………………………………………………………………………

2. Nouns

Having identified the different parts of speech, we shall examine each of them individually. What shall we start with?

Nouns- A noun is a naming word. What do you understand by the term- naming word ?

It simply means a word that is used as a name for something. Take a look around the room. Aren't you able to identify every object around the room with a name ? Say aloud the names of all that you can see. You definitely don't use gestures to convey the name of an object. Do I draw pictures in the air or use hieroglyphics-certainly not ! In essence, a noun is therefore the name of a person, place, object or idea.

2.1 Kinds of Nouns

There are a variety of nouns and to simplify our understanding we classify them into groups. The primary classification is **Common** and **Proper** nouns**.**

A common noun refers to the name that everyone identifies that object by. For instance- a tree, a man and a shoe.

For most of us any plant with a thick trunk and leaves is a tree, while a covering for the feet is a shoe or a human being a person. How is this different from a proper noun ? A particular name, unique in a way, given to an object, person or place is a proper noun.

If you were to take the example of a shoe, you would have various brands like Nike, Adidas and Lee Cooper which would be proper nouns used to describe the shoe.

Let us look at yet another example. In our daily life as a human being, you play various roles. You are a daughter, a son or an employee, a parent, an aunt or a friend. Would these words you used to describe yourself be common nouns or proper nouns? Are these names particular to one person or does everybody share such similar relationships?

Yes- these are therefore common nouns. However if you were to use your name, say, Alia or Mostafa, would this be a common or a proper noun? This is a name unique to you, your individual identity and hence a proper noun.

Remember the singular form of a common noun in most cases must be preceded by an article; whereas it is alright to avoid the article in the plural form. It is incorrect to say "cat ate the food" while it is alright to say "cats are my favourite animals."

A proper noun on the other hand is not preceded by an article. Do we say, "Let us go the Egypt" or "The Irene has come". There are however exceptions to almost every rule and we can discuss it when you come across them.

What are other kinds of nouns?

So far you have looked at words to name things that you can touch, see or feel. What about objects that you cannot touch, see or feel like an idea or a concept, these are intangible. Such nouns are **abstract nouns**. Some such nouns are happiness, youth, grief and brevity.

Close your eyes and try to create an image of these words in your mind. Not an easy task. Right! Check with your partner. Do both of you have the same image? The image would differ. This is not so with common nouns where you will see a greater similarity in the images.

Often, we use single words to describe a group of objects. Such words not only add to your vocabulary but also enable easy communication. For instance, we use words like team, staff, to mean a collective group of like-minded people. These are **collective nouns**.

If I were to call five of you to conduct a discussion, I would address you as a panel of speakers, alternately if you were a group of people breaking into a house you would be called a gang of thieves.

What if you were birds ?- a flock of birds, a gaggle of geese, and a murder of cows !

Fill in the appropriate collective noun from the list below.

Agenda, House, Chain, Host, Convoy, School

Sparrows	
Fish	
Islands	
Tasks	
Trucks	
Senators	

Answers	
A host of sparrows A school of fish A chain of Islands An agenda of Tasks A convoy of trucks A house of Senators	

It is best to stick to the tried and tested collective nouns and not try to get too imaginative and create your own.

2.2 Activity 3: Noun Ping-pong

Subject: Correlating proper and common nouns.

Aim: Understand the difference between common and proper nouns.

Props: None

Facilitator to be store keeper.

Instructions: Facilitator to divide the class into two groups.

The first group will call out a word which is either a common or proper noun. Any participant from the second team will reply immediately with a corresponding proper noun that identifies the common noun. If the answer is correct, the team wins a point. The facilitator must mark the scores on the board. The next turn now goes on to the winning team. They will again come up with another word and the opposing team has to give a suitable reply.

For Example- if team A says Nike, team B must immediately say Shoes.

Remember, this has to be fast paced. A good idea would be to give them a couple of minutes at the beginning to put down at least 25 common nouns and a similar number of proper nouns. The proper nouns could ideally be brand names of products.

Debrief:
What have I learnt?

_____
_____
_____

_____
_____

2.3 Nouns-Number

One of the deciding factors that impact subject verb agreement which is fundamental to English grammar is the understanding is the singular and plural form of the noun. The plural forms of most nouns are created simply by adding an "s" to the singular form of the noun, e.g Book-Books, Cat-Cats. The list below is an easy reference for you to understand the changes in spellings when forming the plural forms.

Singular	Rule	Examples
Lamp, Table	Add-s to most nouns	Lamps, Tables
Inch, Fox	Add-es to nouns ending in s, sh, ch, x and z	Inches, Foxes
Radio, Stereo	Add-s to most nouns that end in O	Radios, Stereos
Echo, Hero	Add-es to nouns that end in O preceded by a consonant	Echoes, Heroes
Melody, Fly Monkey, Day	Change the Y to an i add es, if the vowel comes before Y add s	Melodies, Flies Monkeys, Days
Thief, Half	Change the fe to ve and add s	Thieves, Halves
Roof, Cuff	These exceptions just take an s	Roofs, Cuffs
Datum, Matrix	Words of Latin origin	Data, Matrices
Woman, Foot	Irregular forms	Women, Feet
Fungus	Change –us to i	Fungi

However when you have to create the plural form of compound nouns, remember to pluralise the first part of the compound noun.

For Example- A **passer-by** would in plural form, become **passers-by.**

2.4 Noun-Gender

When using English, we also have distinct noun to represent both the masculine and feminine gender.

For Example-   You says **tiger** and the feminine gender is **tigress**.
You have the **school master** and the **school mistress.**

However this distinction is slowly blurring in the current global work place, as it is politically incorrect to make any gender-based distinction. In fact, the use of "man" as suffix today is questioned and has been replaced with "person" which is neutral and does not carry any gender bias. So we should rather say 'chairperson' than 'chairman' and 'human kind' rather than 'mankind'.

Think of some more words that have been replaced with more politically correct words.

_____
_____
_____

2.5 Countable and Uncountable Nouns

Nouns are also classified into countable and uncountable nouns. An understanding of this kind of classification is very crucial to subject-verb agreement which we will deal with later.

Countable nouns are those we can count and take both singular and plural forms.

A **boy**, Four **Boys**
A **Book**, five **Books**.

Uncountable nouns are the ones, we cannot count. They don't have a plural form.

Air, Ice, Wisdom (You cannot say airs, ices, wisdoms)

Let us examine the rules that apply to countable nouns. Since it can take on both singular and plural form, it means that a countable noun can be preceded by articles. **a, an** or **the** as is relevant to the noun. It can also be quantified using modifiers like **some, many** or **few**.

For Example- I can say: an egg, the eggs, some eggs or few eggs.

In the case of uncountable nouns we can not use **'a'** or **'an'.** Instead, one can only use the definite article- **'the'**

For Example- I cannot say: "Give me an information" or "I need informations."
Instead I say "I need <u>some</u> information."

Uncountable nouns can be quantified using the modifier **much** and **some**.
For Example: "I need <u>some</u> rice."

In fact, you may indicate quantities through terms denoting measurements such as – a grain of sand, a glass of milk, etc..

Moreover, an uncountable noun being a singular form of the noun will always take on a singular verb.

For example- The sand is hot.

           The information is wrong.

There are some common words which are uncountable nouns, and English speakers often make mistakes with them. Remember that all the words in the box an uncountable and you should not try to make them plural:

advice, equipment, furniture, homework, information, luggage, transport, accommodation, baggage

STOP! GO BACK AND REFLECT!
I learnt……
I would like to know more about……………………………………………………………………………….
Activities/Tasks I liked/found useful………………………………………………………………………………
Something I would adapt/do differently………………………………………………………………………

3. Pronouns

Imagine trying to tell someone a story where you cannot substitute a noun with a pronoun. Listen to this story that I am going to read to you.

Radha listened keenly for sounds in the hall. Hearing no sounds in the hall Radha tiptoed out of Radha's room, slipped out through the kitchen door, quickly jumped into Radha's car and drove as first as Radha could. Radha had to find Shyam and warn Shyam about the mysterious message………

Lost your patience? I would not blame you. The thrill of reading the story is dampened to plod through the endless list of repetitive nouns.

Pronouns would make the story easier to read

Radha listened keenly for sounds in the hall. Hearing no sounds in the hall she tiptoed out of her room, slipped out through the kitchen door, quickly jumped into her car and drove as first as she could. She had to find Shyam and warn him about the mysterious message …………………..

"Pro" means acting for and therefore a pronoun <u>implies</u> a 'word' that <u>takes the place</u> of a noun. Without pronouns, both reading and writing would become a tedious process. You just had a taste of it! Like nouns, pronouns too come in several types. The ones we use most often, are the **personal pronouns** which refer to specific people and sometimes two things. In the example above, '**she**' and '**her**' refers to Radha, and '**him**' refers to Shyam. Like nouns, pronouns also take on singular and plural forms. However unlike the nouns, they change to show :

The first person (the one who is speaking)

The second person (the one who is being spoken to) and

The third person (the one who is being spoken about).

Study the chart showing the different forms of personal pronouns.

	Subject Pronouns
1st Person	**I**
2nd Person	**You**
3rd Person(M)	**He**
3rd Person(F)	**She**
3rd Person(Neutral)	**It**
1st Person(Pl)	**We**
2nd Person(Pl)	**You**
3rd Person(Pl)	**They**

	Object Pronouns
1st Person	**Me**
2nd Person	**You**
3rd Person(M)	**Him**
3rd Person(F)	**Her**
3rd Person(Neutral)	**It**
1st Person(Pl)	**Us**
2nd Person(Pl)	**You**
3rd Person(Pl)	**them**

	Possessive Pronouns
1st Person	**Mine**
2nd Person	**Yours**
3rd Person(M)	**His**
3rd Person(F)	**Hers**
3rd Person(Neutral)	**Its**
1st Person(Pl)	**Ours**
2nd Person(Pl)	**Yours**
3rd Person(Pl)	**Theirs**

	Possessive Adjective
1st Person	**My**
2nd Person	**Your**
3rd Person(M)	**His**
3rd Person(F)	**Her**
3rd Person(Neutral)	**Its**
1st Person(Pl)	**Our**
2nd Person(Pl)	**Your**
3rd Person(Pl)	**Their**

	Reflexive Pronouns
1st Person	**Myself**
2nd Person	**Yourself**
3rd Person(M)	**Himself**
3rd Person(F)	**She**
3rd Person(Neutral)	**Itself**
1st Person(Pl)	**Ourselves**
2nd Person(Pl)	**Yourselves**
3rd Person(Pl)	**themselves**

Ahmed (the first person) spoke to Anita (the second person) about Rita (the third person)

When we use personal pronouns, we would say:

Ahmed spoke about **her** to **her**

Look at the chart to understand under which column these pronouns would fall.

In case you use the plural form:

The boys spoke about the teachers to the parents

> **They** spoke about **them** to **us.**

Remember a subject pronoun which is ideally your first person, comes before the verb in the ordering of the sentence. When a pronoun is used as an object pronoun which is either direct, indirect or objects of preposition you used an objective form of the pronoun like- me, her etc.

> **She hates eating apples.**

> **Ali gave the book to me.**

The possessive pronouns show ownership, in a way they act as adjectives.

My friend found **his** dog.

Their friend is a happy man.

That bag is **mine**.

What is the difference between **it** and **it's**? Which is the pronoun here?

 Let us look at **Relative** and **Reflexive** pronouns.

3.1 Reflexive Pronouns

A reflexive pronoun is used generally for emphasis and is also called emphatic pronoun. Here the action of the doer goes back to himself so that the subject of the sentence is the same as the object of the sentence.

I hurt myself.
She answered the phone herself.

Such pronouns end with the word 'self' and can be recognized easily. They are used in everyday speech along with your tone of voice to convey a sense of emphatic ownership they may also be used as intensive pronouns to add emphasis as in "Arun himself saw the ghost."

	Singular	Plural
First person	Myself	Ourselves
Second person	Yourself	Yourselves
Third person	Himself	Themselves
	Herself	Themselves
	Itself	themselves

3.2 Relative Pronouns

Look at these words – **who, which, that, whom, these.**

Are these also pronouns? Yes they are. They take the place of nouns and are used much like conjunctions to join two statements about the same person or object. Given a choice of these pronouns, how does one understand where to use each of these? Simply stated **who, which** and

whom are used to mix statements about people and **which** and **that** are used to make statements about animals and objects.

Look at these two sentences: **The girl is an actor. She danced for an hour.**

We join the two sentences using a relative pronoun – who

> **The girl <u>who</u> is an actor danced for an hour.**

The pronoun **whose** is used to show possession. For most learners of the English language, it is difficult to understand when to use **who** or **whom.** The use of **which** is fairly clear, since we use it to indicate objects and it follows the noun in terms of placement.

> This is the dress **which** costs USD 500. (follows the noun – dress)

> This is the camera **which** he bought.

> Here is the book **which** Tom borrowed from you.

So, you see '**which**' can be followed by a noun, pronoun or verb.

When does one use 'whom' / 'who' and how would you make a choice between the two.

Look at these sentences :

> The girl **who** is my sister, is a painter.

> The girl **whom** you met at the mall, is my sister.

A simple tip to remember is that '**whom**' is normally followed by a pronoun while '**who**' is followed by a verb.

3.3 Demonstrative Pronouns

Some pronouns like **this, that, these, those , none** and **neither** are used to substitute nouns and the nouns – they replace – can be understood from the context. These are **demonstrative pronouns**. Moreover, they also indicate whether they are replacing singular or plural nouns, as also state the location of the object. '**This**' is singular and indicates proximity to the speaker, while **that** though singular, indicates distance from the speaker. On the other hand, '**these**' and '**those**' are both plural, the former indicates proximity while the latter indicates distance.

You take **these** books and I will take **those.**

> We bought **this** house last year.

(This refers to one house, singular, near the speaker and is easily understood in the context of the conversation.)

3.4 Interrogative Pronouns

Questioning words starting with '**wh**' like **what, whom, which** and **who** are interrogative pronouns. We use these pronouns to ask questions. The interrogative pronouns that you use, represents the thing that we don't know. You use them at the beginning of a sentence to ask a direct question.

"**Whose**" can also be used as an interrogative pronoun.

"**What**" is your name ?

"**Who**" is in charge of this project?

"**Whose**" car has not arrived?

"**What**" do you mean?

Notice the word order in the formation of questions.

Using the suffix '**ever**' with whom or who as in – whoever – is just for the sake of emphasis and does not require any other rule!

3.5 Indefinite pronouns

We now come to the last of this lot which is **indefinite pronouns**. These pronouns refer to people or things without making a mention of who or what they are. When we spoke of personal pronouns, we had definite people whom we were referring to. But when we use indefinite pronouns, we <u>are not sure</u> of the identity of the person or thing we are speaking of.

Indefinite pronouns also have singular and plural forms.

Singular : another, anybody, no one, anyone, anything, either, everybody, everyone, everything, little, something, much, neither, nobody, nothing, one, other, somebody, someone, each.

The pronoun **one** for instance can refer to a person or thing.

> **One** of the boys is missing.

> **One** of the boxes is missing.

All such pronouns take the singular form of the verb.

> **Something** is missing.

> **Nobody** is answering the phone.

Either of the gifts is fine.

Is someone coming over today?

Plural : many, others, several, both, few.

These pronouns will always take the plural form of the verb.

Many bottles of water are required.

Both the chairs are dirty.

Several pictures were released by the press.

A good tip to remember is that, indefinite pronouns ending in **one** or **body** refers to the persons and those ending in **thing / things** refer to objects. Often we tend to misunderstand words like everything and everybody to mean the plural form and use a plural verb with these words. Just remember a word ending with – one, thing or body should be a clear indication of a singular form.

There are some others that fall into both categories, but we shall address them later, when we look at subject – verb agreement.

Let us now conduct an auction. Have all of you heard about the great Sotheby's auction held in Britain. Well, we are trying to do that on a smaller scale. The objects put up for auction are some sentences, which are highly in demand.

3.6 Activity 4: Sentence Auction

Subject: PRONOUNS

Aim: To understand the different kinds of pronouns.

Props:

Make believe currency – slips of paper with the amount printed on it

A bell to indicate that the sentence has been auctioned.

A sheet of paper with about 25 sentences with pronoun errors.

Instructions:

Divide the class into groups of 4 students.

Explain to the group that an auction of sentences is to be conducted.

The aim of each team must be to buy as many correct sentences as possible.

At the beginning, assign a sum of money to each team. This could be limited to INR 3000.

The bids begin at INR 200 and every subsequent bid increases by INR 50.

The sentence will be sold to the highest bidder.

The winning team is determined to be the one which has bought the most number of correct sentences.

Debrief:

What have learnt?

....
....
....
....
....
....

The sentences can be reviewed with the whole group for a better understanding of grammatical usage.

AUCTION SHEET

Sentences

1. **Everyone were singing from their books as they entered the room.**
2. **Either of the boys are acceptable to do the errands.**
3. **When one is ill, he is likely to be impatient.**
4. **Joe is one of the boys who is on time.**
5. **It is I who is to make a call**
6. **The dog has its bone.**
7. **I shall go bathing today if the water is warm enough.**
8. **The dog we always feed is the one who wags his tail furiously.**
9. **I shall speak to whomever is there.**
10. **Whom do you want to help you?**
11. **Harrison and I are the first in line.**
12. **Whomever it may be, I wish him success.**
13. **If I were he, I should not accept the post.**
14. **The principal put another group and us in the same room.**
15. **I had a swim, quickly dried myself and put on my clothes.**

16. She quickly dressed herself and went down for breakfast.
17. This is a newspaper whose circulation has risen rapidly.
18. The Johnsons and us are going swimming.
19. That was me whom you saw yesterday.
20. The leaders, Amrita and I had a score of 25.
21. We are not impressed by his speaking softly.
22. We pictured him shouting at the audience.
23. Mother detected his eating an apple.
24. She chose Basu and myself for the task.
25. Please read Rashmi and I that story.

STOP !   GO BACK AND REFLECT !!

 I learnt ……………………………………………………………………...……………………….

I would like to know more about ……………………………………………………………..

Activities / tasks I liked / found useful ………………………………………………………….

Something I would adapt / do differently…………………………………………………….

4. Adjectives

Would you all like to play a guessing game with me? Well lets start …I want you to look around the class and put down five attributes/qualities about any one person in the class room. Put down only the attributes and don't mention the name of the person. You may take two minutes to think that through, alright I would like any one of you to volunteer to read out the attributes you have put down, to the class. Well, the rest of you can make three guesses to identify the name of the person who the speaker has in mind. (You may do a couple of rounds to set the pace)

I suppose you found that fun to do. Now let us get to the topic that we intend working on today adjectives.

Tell me something, how you would like to accesssorise yourself when you are coming into college/ work in the morning. The question is addressed to both the boys and girls! You do take the trouble to do that don't you? In the same manner can we accessorise or adorn our sentences?

Yes, we do, and for this purpose we use a part of speech that we call the adjective. An adjective, technically speaking, is a part of speech that modifies a noun or a pronoun. By using adjectives, you not only provide more information about the noun, which is often the subject or object of your sentence, but also enrich your vocabulary. In fact, vocabulary building to a large extent is about using appropriate adjectives to describe something.

A lot of adjectives can be formed from nouns and verbs. Sit along with your partner and each of you put down a list of ten nouns. Having done that, exchange the sheets and try to convert the nouns into adjectives.

Here,s an example:

Destruction-destructive

Adjectives are wonderful addition to your vocabulary and give you a great sense of confidence when you speak. Let us work together on an activity.

4.1 Activity 5 : Picture perfect

Subject: Adjectives

Aim: using adjectives to increase vocabulary.

Props

- Sheets of chart paper
- Sketch pens

- Interesting photographs or pictures of crowded places that include a lot of people, object and colour. These can be cut out from magazines or brochures.

Instructions :

- Facilitator to divide the class into groups.
- Each group to be given a picture and a sheet of chart paper.
- The group has to settle on a theme name for the picture they have.
- Next they identify the main objects/people in the picture and within that context come up with adjectives.
- Within a given time span, say, five minutes they must write down as many adjectives as they can think of to describe the picture. For example, if they have a tall well built man in the picture they could have a series of adjectives to describe the man e.g. strapping, stocky, handsome, sober, thoughtful etc.
- At the end of the activity the faculty reviews the lists and puts them up on display. One could further build on this and proceed to list out the adjectives and get the participants to write down the comparative and superlative forms as well.

Debrief :

What have I learnt?

....
....
....
....
....
....

Adjectives fortunately do not take on any gender and that is surely a saving grace! You have a wide range of adjectives to choose from.

Give me a list of adjectives to show (ask the class to come up with the list)

Opinion: nice, beautiful, excellent

     e.g. She was a nice girl.

Numeric : eight, one

Quantitative : more, some, half

Qualitative: red, big , fragrant, square

     e.g. The big woman.

The square box.

Origin : German, Japanese

Material: cotton, tin,

Distance: long, short

Time: early, late

Purpose: sleeping, leaking (theses adjectives always end with -ing).

e.g. Sleeping bag.

Ownership: mine, yours

'which', 'whose', 'what', 'this', 'that' and 'those' also function as adjectives. In fact 'a', 'an' and 'the' are also adjectives of shorts since they qualify a noun!

4.2 Positioning of adjectives

Most adjectives appear immediately before the noun or noun phrase. Suppose you have an indefinite pronoun then the adjective comes after the pronoun.
Example:
The **big** balloon floated over the **arid** land.
Anyone capable of doing this should be rewarded.

4.3 Comparative Degrees of Adjectives

Adjectives, like adverbs can be used for the purpose of comparison. The degrees of comparison are positive, superlative, comparative. In reality only comparative and superlative show degrees, while positive show the adjective in its base form.

Take this example:

Mahima is a **rich** lady, but Ahmed is **richer** than Mahima. and Harish is the **richest** person in the community.

The comparative form is used to compare two things and you will find that the word 'than' frequently follows the comparative form. On the other hand, the superlative form is used to compare more than three objects and the word 'the' precedes the superlative form of the adjective.

Examples:

> She is **taller** than Maria.
> Alice is the **tallest** of the sisters.

Generally, the suffixes –er and –est are used to form the comparative and superlative forms respectively. You must remember that at times there can be a change in the spellings when these suffixes are added. However, when an adjective has more than one syllable, we use 'more' and 'most' respectively to form the comparative and the superlative.

Example:

> She is **more beautiful** than her sister.
> Tom is the **most eloquent** speaker in the group.

True to the nature of the English language most rules also have exceptions. Certain adjectives take on irregular forms when being compared.

Good	Better	Best
Bad	Worse	Worst
Much, Many	More	Most
Little	Less	Least
Far	Farther	Farthest

Certain adjectives like unique, perfect and ideal are incomparable and do not take on more or most. They can exist only in the positive form. Can you think up some more?

Example:

> This is a **unique** plan.
> I cannot say – This plan is more unique than that one.

A pitfall that most second language speakers of the English language should avoid is the tendency to use a double comparative or superlative. This is often the influence of the first language on our speech.

Have you often heard yourselves say, "This is more better" or "She is more prettier than her" ?

4.4 Order of Adjectives

Do I say a <u>little yellow car</u> or a <u>yellow little car</u> ? when a number of adjectives are to be placed before a noun what is the order you will consider? The order is a pre established one. This comes through practice and after a point it becomes instinctive. Till then follow the pattern and try saying it aloud. Hearing yourself say it will help you to determine whether you have the right order in place. It is based that you stick to using a maximum of three adjectives to describe something. The order follows this pattern:

Determiner	a/an/the
Observation	Beautiful/pretty
Size and shape	Large/rich
Age	Ancient/young
Colour	Red/yellow
Origin	Indian/Japanese
Material	Wooden/ metallic
Qualifier	Rocking chair/ book cover(part of noun)

STOP ! GO BACK AND REFLECT !!

I learnt ………

I would like to know more about ……………………………………………………………………………..

Activities / tasks I liked / found useful ………………………………………………………………………

Something I would adapt / do differently………………………………………………………………………

5. Adverbs

You just saw how an adjective modifies a noun; in the same manner an adverb primarily modifies a verb. Most of us are confused when we are told to distinguish between the adverb and the adjective. A simple primary school technique is to address questions to the noun and the verb. The '**Wh**' questions like **what**, **when** and **how** are the ones that you use. If you address a question the verb and you get an answer then, that answer is the adverb. On the other hand, if you address the question to the noun and get an answer, that is the adjective.

Sounds confusing, let us understand this through an example.

I have two sentences-

> The black cat ran across the road.

> The girl sang happily.

If I were to address the question to the noun-

> Which **cat** ran across the road?

My answer would be-

> The **black** cat.

This then, is the adjective of my sentence.

Alternately I address a question to the verb –

> How did the girl **sing**?

My answer would be –

> '**Happily**'

This then, is the adverb in my sentence.

You now have a basic understanding of adverbs. Adverbs give you more information about the way an action is done. They typically modify a verb, an adjective or sometimes another adverb.

  She walked **quickly**. (quickly describes the verb-walked)
   I accepted the gift **gracefully**. (gracefully describes the verb- accepted)
  He drove a **very** fast car. (how fast was his car? Modifies the adjective)
  She moved **quite** slowly down the ramp.(How slowly did she move? Modifies another adverb.)

The easiest adverbs to identify are those that end in – **ly, briefly, happily, sweetly**. Sometimes you may be confronted with adjectives which have a – **ly** ending; for instance- **lovely.**

Confused?

Simple, remember an adjective can qualify only a noun or a pronoun while an adverb qualifies most others!
Example:
>The **lovely** lady lives in a **friendly** neighborhood.

5.1 Kinds of Adverb

Adverbs cover a wide range based on their functions.

An adverb of manner answers the question- **How?**

>**I play well.**

An adverb of time answers the question- **When**?

>**He has not played golf recently.**

An adverb of location or direction answers the question – **Where**?

>**I will meet you outside.**

Adverbs of degree answers the question -**How Much**?

>**I am too tired to go to the party.**

Adverb of frequency answer the question – **How Often?**

>**He rarely visits his parents.**

Do not forget the connecting adverbs, which are a great help in our conversation and help us to establish continuity of thought and fluency.

>I want to sleep; however, I need to finish the task.

Some of the most common conjunctive adverbs that we use, are **: accordingly still, anyhow, furthermore, however, moreover, otherwise, therefore, also etc.**

5.2 Degree of Comparison
Like adjectives, adverbs too have degrees of comparison.

Positive	Comparative	Superlative
Clearly	More Clearly	Most Clearly
Happily	More Happily	Most Happily
Loudly	More Loudly	Most Loudly
Noisily	More Noisily	Most Noisily

Most adverbs that end in 'ly' form, their comparative and superlative forms are created by adding '**more'** and '**most'**, respectively.

An advantage that an adverb has over the adjective is in terms of positioning. The adverbs of manner <u>particularly</u> have this advantage.

It is acceptable to use any one of the three sentences listed below. Notice the positioning of adverbs in each of these sentences.

- <u>Solemnly</u>, the priest addressed his congregation.
- The priest <u>solemnly</u> addressed his congregation.
- The priest addressed his congregation <u>solemnly</u>.

Adverbs of frequency and time are ideally placed before the verb or between the auxiliary and the main verb.

- I <u>never</u> get up before nine o' clock.(before the main verb)
- I have <u>rarely</u> written to my brother without a genuine need.(between the auxiliary and the main verb)
- He has <u>recently</u> retired from service.

5.3 Word Order with Adverbs

Often thoughts flood our minds, and we are unaware of the word order when we speak. This can lead to serious errors that will make you the laughing stock of the group.
Take a look at these sentences. Read them once and read them again. Notice the mistakes?

They reported that Michael Jackson, an American pop star, has died <u>on the six o' clock news</u>.

Did the man die on television? Where could one place the underlined modifier?

Misplacement is also possible with simple modifiers like, **barely** and **only**

Sara <u>only grew</u> to be four feet tall.(not an appropriate usage)
<u>Only Sara</u> grew to be four feet tall.
She grew to be <u>only four feet tall.</u>

Word order in the sentence structure is very important and a culprit that often contributes to wrong word order is the adverb. You definitely need a lot of practice with adverbs. Let us work on this activity. Remember, speed matters!

5.4 Activity 6: Relay Race

Subject: Adverbs
Aim: Understand the positioning of adverbs in a sentence.
Props: multiple copies of task sheets

Instructions:
Facilitator to divide the class into groups of five.
Each group has three tasks that need to be done.
One person from the group to collect the first task from the facilitator.
On finishing the task, the task sheet to be returned to the facilitator and the second task sheet to be collected.

In the meanwhile, the facilitator will correct the first task sheet.
On returning the second task sheet, the third task is to be given.
The group that finishes all the tasks and reports to the facilitator, wins a prize.

TASKSHEET 1: Unscramble the sentences below:

1. speaks fluently He five languages:
   _____

2. car new i bought. have a just sports:
   _____

3. became soon bored Susan with new boy friend her:
   _____

4. already three presents given has leaving We been:
   _____

5. hardly days at are home There ever these:
   _____

6. never to been He Chandpur before. had:
   _____

7. comes home after regularly midnight She:

    _____

8. some has food My mother only brought:

    _____

9. the house led later than to built had of a me that rest been room the he obviously:

    _____

10. India a days Generally letter it three to for reach takes:

Courtesy: http://www.johnsesl.com

TASK SHEET 2

Diana is unhappy at work and this is what she said when she came home.
Replace all the examples of 'quite' with either 'completely' or an adverb with a similar meaning or 'fairly' or an adverb with similar meaning.
Help list: wholly, absolutely, moderately, totally, fully
"It is quite (1) unusual for me to get annoyed but I was quite (2) appalled by my boss's attitude. He'd asked me to finish the report by next week. Well, even that would be quite (3) difficult. But then this morning he told me that he wanted it by tomorrow. He knew that it was quite (4) impossible for me to finish it by then. But he's quite (5) determined to have it. It's not fair. He knows I am quite (6) good at writing reports but he also knows I am quite (7) useless at working under pressure like that. My old boss was quite (8) different. He was quite (9) thoughtful and quite (10) brilliant at organizing people. I think it's quite (11) likely that I will start looking for a job elsewhere."

Answers:
2,4,5,7,8,10 should be replaced by completely or adverbs like totally, fully, entirely, wholly, absolutely, utterly
1,3,6,9,11 are to be replaced by fairly or adverbs like rather, reasonably, moderately, comparatively

TASK 3
Unscrambled the words below:
1. ylouisxna _____
2. yyatlbonu _____
3. yliylacnc _____
4. lldlfyuoe _____
5. haryazahpdl _____
6. oiyomdl _____
7. arwtlodyu _____
8. rylpta _____

9. ayiltplyc _____

10. rnyovuitlal _____

courtesy : www.teach-nology.com

Debrief:
What have I learnt?

....

....

....

....

....

....

6.Prepositions

What do you understand by the term 'preposition' ? The word by itself does not give you a clue. So how could you like to explain what prepositions are?

Take a look at the prepositions that you commonly use –

At , in , on , of , up , and , to

By itself a 'preposition' is meaningless and difficult to describe. It is pronounced *softly* in a sentence and not emphasized on.

Short words, but they play a very essential role in the sentence.

Prepositions show relationship between nouns, pronouns and other words. Often, they come before a noun.

After class, before noon

The prepositions stay the way they are and never change form, regardless of the gender or case of the words they are referring to.

A preposition helps to connect the object with the rest of the sentence. The preposition usually helps establish the chronological, spatial or logical relationship of its object to the rest of the sentence.

Example:

- **The book is on the desk.**
- **The book is beside the table.**
- **She read the book during class.**

In all these sentences, the preposition used, locates the noun **book** in relation to space and time.

There are more than a hundred prepositions. Though they appear simple, the use of prepositions is a little tricky. This is because most prepositions have more than one meaning. They can be used as adverbs and are also used along with verbs to form phrasal verbs and prepositional phrases. Besides, they are used in many idioms and along with adjectives and nouns, as well.

Think of this, we say :
We are **at** the hospital to visit an aunt who is **in** hospital.
We watch a movie **at** the movie hall but not **on** television.

Any wonder that these troublesome little words are a nuisance for most speakers? Prepositions can at times be used as adverbs or conjunctions. A word such as since or until functions both as a 'preposition' as also a 'conjunction'. Some prepositions are interchangeable and to add that, a preposition used in combination with another word may have different meanings.

What's more, prepositions do not have equivalent meaning in other languages.

Let us understand this through the use of Hindi prepositions "se". This preposition has a wide range of meanings and can be used differently each time.
Look at the following sentences and understand the meaning of the preposition "se".
1. Woh Dilli (Delhi) se aaya hai.(He has come from Delhi.)
2. Woh kal se gaayab hai.(He is missing since yesterday.)
3. Woh train se jaa raha hai. (He is going by the train.)

You have seen that "se" ends in the sentences above mean from, by and since. Under these circumstances can we apply the same logic to English prepositions? Not at all. Therefore, we face the problem of using the wrong preposition in the course of translation from one language to the other.

It is indeed difficult to state rules for using prepositions; however we could try and understand them in the context of the specific word meaning and also in the context of usage. Prepositions can be broadly categorized into three groups- prepositions of place, time and direction.

In this session, we shall not look at them in these separate categories but understand them with reference to the context of the sentence and the meaning of the particular preposition.

The only way to master your prepositions is by paying close attention to the spoken and written word. Practice, practice and more practice!!

One can broadly classify prepositions into prepositions of time, place and location.

6.1 List of Common Prepositions

Let us look at the most commonly used ones along with an example to understand its usage.

Above : higher than, earlier on a page,

  The plane flew <u>above</u> the roof.

  There is a title <u>above</u> each diagram.

About : on the subject of, approximately

  This is a a story <u>about</u> aliens.

  My mother is <u>about</u> sixty years old.

Against : opposing, touching something

  I am <u>against</u> this idea.

I leaned <u>against</u> the wall.

Across : from one side to the other, on the other side

We walked <u>across</u> the road.

Let us go to the store <u>across</u> the road.

After : later in time, later in series, to chase
I will meet you <u>after</u> lunch.
B comes <u>after</u> A in the sequence.
The cat ran <u>after</u> the mouse.

Along : follow the length of
I walked <u>along</u> the street.

Among : within a group (amid/ amongst)
We share the money <u>among</u> us.

Around : going around something, surrounding, in other direction, approximately
We walked <u>around</u> the garden.
There is a moat <u>around</u> the castle.
We turned <u>around</u> and went home.
He is <u>around</u> 5 feet.

At : a specific location, point in time, an activity, a condition
Turn right <u>at</u> the end of the street.
I will meet you <u>at</u> 6 o' clock.
The countries are <u>at</u> war.
She is <u>at</u> work.

Before : earlier in time, earlier in a sequence
We can meet <u>before</u> Christmas.
A comes <u>before</u> B.

Behind : at the back of, late, cause of
The girl hid <u>behind</u> the car.
I am <u>behind</u> in my assignment.
Who was <u>behind</u> this scheme?

Below: lower than, later on a page
The temperature is <u>below</u> freezing point.

Notes are provided <u>below</u> the text.

Beneath: lower than and making contact
    The earth <u>beneath</u> my feet is wet.

Beside: next to
    Angel sits <u>beside</u> me.

Besides: also, as well as
    There is no one in the room <u>besides</u> Aisha.

Between: an intermediate location, time series, within a group of two
    The building stands <u>between</u> the mall and the mosque.
    B comes <u>between</u> A and C.
    We have no holidays <u>between</u> Christmas and New Year.
    Please share it <u>between</u> the two of you.

Beyond: further than, farther, exceeding
    The mountain lies far <u>beyond</u> the horizon.
    This is <u>beyond</u> my expectations.

By: near, passed, not later than, through
    I live in a house <u>by</u> the sea.
    I waved as I drove <u>by</u> the house.
    Finish it <u>by</u> next week.
    Do you travel <u>by</u> the bus?

Down: in a lower position, further along
    The ball rolled <u>down</u>.
    He lives <u>down</u> the road.

During: throughout a period, sometime within a period
    She watched <u>during</u> the night.
    A mishap occurred <u>during</u> the night.

For: purpose, in the direction of, in favour of, considering, duration of time
    I walked <u>for</u> two hours.
    She left <u>for</u> Kanpur.
    We are <u>for</u> this proposal.
    I bought the sweater <u>for</u> you.

She is clever <u>for</u> her age.

From: place of origin, starting point of time, start of a range, cause and source
    We left <u>from</u> Allahabad .
    He comes <u>from</u> his home.
    <u>From</u> now on, please be on time.
    He suffers <u>from</u> anxiety.
    I first heard about it <u>from</u> you.

In: a general area, within a location, large units of time, within a certain time, by means of, condition, a member of, wearing, with reference to.
    I live <u>in</u> Egypt.
    The chair is <u>in</u> the room.
    I will return <u>in</u> an hour.
    This happened <u>in</u> December.
    The girl is <u>in</u> a white skirt.
    The Middle East is rich <u>in</u> oil.
    When <u>in</u> doubt call me.
    Speak <u>in</u> English.
Inside: within
    They are <u>inside</u> the room.

Into: to the inside of, changing conditions
    We stepped <u>into</u> the hall.
    The frog changed <u>into</u> a prince.

Near: close to
    I live <u>near</u> the mall

Of: location, possession, part of a group, measurement
    It is in the middle <u>of</u> the room.
    A friend <u>of</u> mine is visiting.
    One <u>of</u> you can do it.
    Give me a cup <u>of</u> milk.

Off: not on, away from, at some distance from
    Please keep <u>off</u> the glass.
    There are islands <u>off</u> the Hawaiian coast.

On: touching the surface of, a certain day, a certain street, about, a state or condition, by means of

    The clock is <u>on</u> the wall.
    I live <u>on</u> Cox Street.
    The house is <u>on</u> fire.
    The book is <u>on</u> aliens.
    My birthday is <u>on</u> the 6th of June.

Having run through a fair number of prepositions, let us practice some of these usages before we learn some more.

6.2 Activity 7: Treasure Hunt

Subject: preposition
Aim: to practice the use of prepositions.
Props:
Instructions:
The facilitator would hide a piece of paper (a clue) containing an important announcement of a surprise element in some part of the room, which is rather difficult to find. This must be done before the beginning of the session.

Build up the excitement to finding the clue.

Instructions:
    Participants are told to guess where the clue has been placed by using prepositions showing direction or location.

Any of the participants can guess, but ensure that everyone in the class participates.

Clues that the participants ask would be : is it on top of the table, behind the bag, etc.

As a facilitator, you are allowed to only reply saying yes or no.

Once any participant makes the right guess, you may pull out the clue and announce to the class what was on the sheet of paper.

Debrief:
What have I learnt?
....
....
....

....
....
....

Getting back to our list of prepositions:

Onto: to a position on

       The baby climbed <u>onto</u> the chair.

Opposite : facing

       The store is <u>opposite</u> my house.

Out of: to the outside of, from among, a motive, material, beyond

       She went <u>out of</u> the room.
       We won two <u>out of</u> three.
       We spoke <u>out of</u> courtesy.
       It is made <u>out of</u> waste material.
       We are <u>out of</u> danger.

Outside: on the outer side, beyond the limits of

       <u>Outside</u> our house, I have a garden.
       It is <u>outside</u> of my area of interest.

Over: higher than, covering, across, more than, during, by means of

       There is a bridge <u>over</u> the river.
       I spread the cover <u>over</u> the table.
       I jumped <u>over</u> the puddle of water.
       It cost <u>over</u> two dollar.
       I saw her several times <u>over</u> the past one week.
       We made plans <u>over</u> the phone.

Past: beyond, after

       I walked <u>past</u> her house.
       It was <u>past</u> two o' clock.

Since: from a specific time in the past, from a past time until now

       I have been waiting <u>since</u> 3 o' clock.
       I have been waiting here <u>since</u> you called.
       I have known him <u>since</u> January.

Through: cross, for a whole period, by means of
       The road <u>through</u> town is closed.
       I slept <u>through</u> the night.
       It will improve <u>through</u> hard work.

To: in the direction of, destination, until, compared with, with indirect object, as part of an infinitive, in order to
       Turn <u>to</u> the left.
       We are working from Monday <u>to</u> Saturday.
       They prefer tea <u>to</u> coffee.
       I am going <u>to</u> Alexandria.
       Please give it <u>to</u> me.
       I like <u>to</u> ski.
       We went to the store <u>to</u> buy a pen.

Towards: in the direction of, near
       We walked <u>towards</u> the bus stop.
       It rains <u>towards</u> late evening.

Under: beneath, less than, in circumstances of
       I lay down <u>under</u> the trees.
       <u>Under</u> ten people came in.
       The bike is <u>under</u> repair.

Underneath: below, making contact with
       The book was <u>underneath</u> the carpet.

Up: to a higher place, in a higher place
       We went <u>up</u> the stairs.
       She lives <u>up</u> the hills.

Up to: as far as, depending upon, as good as
       I have read <u>up to</u> the 55th page.
       The decision is <u>up to</u> you.
       His work is not <u>up to</u> the mark.

With: accompany, having manner, by means of, because of
       He came <u>with</u> her.
       Here is a book <u>with</u> a map.
       I washed <u>with</u> soap.

We read it <u>with </u>ease.

He was paralyzed <u>with </u>fear.

Within: inside of

Be here <u>within </u>ten minutes.

There are no hospitals <u>within </u>a kilometer.

Without: not having,

Do not leave <u>without</u> money.

6.3 Activity 8: Route Map

Subject- Prepositions

Aim- To gain an understanding of prepositions of place and direction.

Props-

Multiple copies of the printed maps of the layout of Harvard.

Instructions-

Study the map showing the layout of Harvard business school along with your partner. You have to give direction to your friend professor Yokogawa- a visiting professor from Japan who is waiting at the Gordon road entrance. Since you are busy and will not be able to escort him, please give him direction to the Dean's house.

You will join him there for a cup of tea. While you continue your meeting with the Dean, your friend would like to visit one of the blocks-Hamilton.

 After this, he would like to visit the Baker Library and then head for the parking lot.

Please put down the directions on paper from point so that your friend will not lose his way.

Directions would be in four separate groups-

1. Gordon Road entrance to Dean's house.

2. Dean's house to the Hamilton Bock.

3. Hamilton Block to the Baker Library.

4. Baker Library to the visitor section and finally to the parking lot.

Debrief:
What have I learnt?

....
....
....
....
....
....
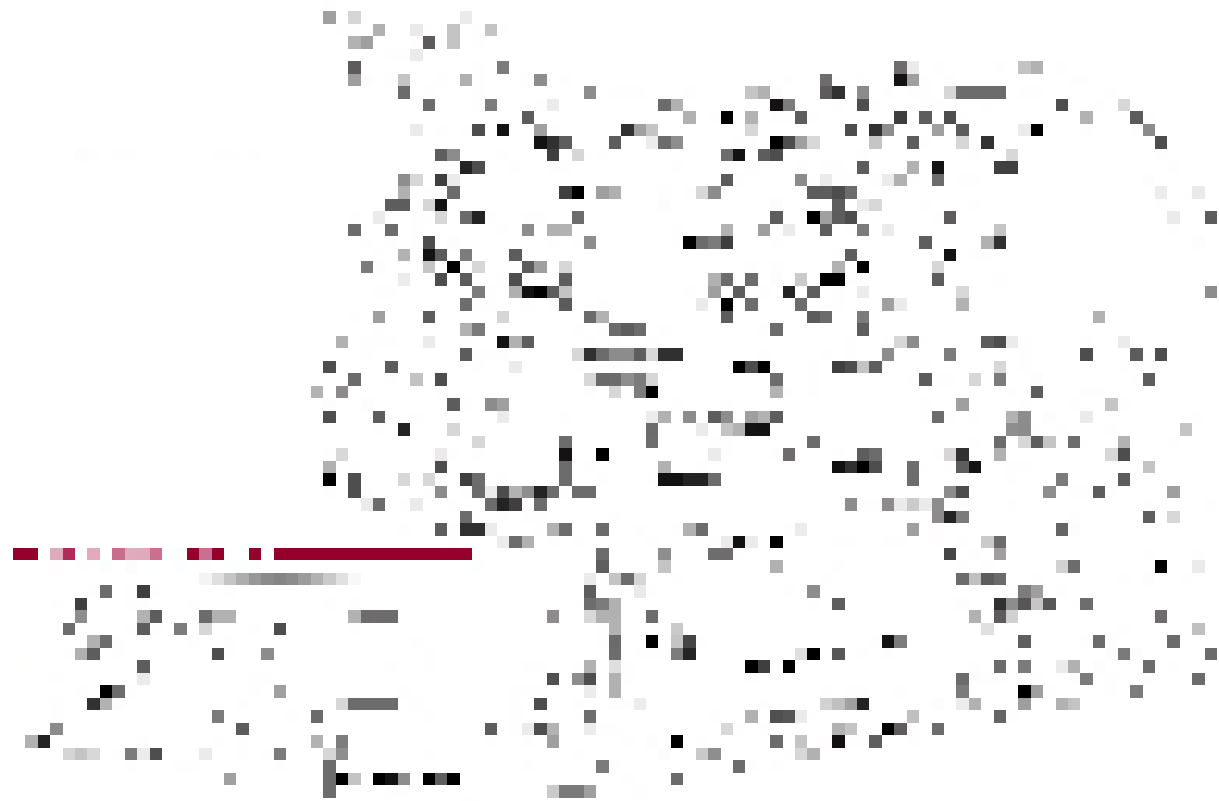
Prepositions cannot stand by themselves and must therefore exist along with another word, which could be an adjective, verb or noun. Certain prepositions at times are so firmly wedded to certain adjectives, nouns or verbs that they seem like one word.

6.4 Prepositions with Adjectives, Nouns and Verbs

Let us run through a list of such words to familiarize ourselves with these usages.

Adjectives and Prepositions	Nouns and Prepositions	Verbs and Prepositions
Afraid of	Precautions against	Complain about
Careless about	Insight into	Protest against
Familiar with	Example of	Stare at
Accustomed to	Faith in	Think about
Accused of	Evidence of	Apologise for
Parallel to	Impression on	Abstain from
Acquainted with	Animosity towards	Believe in
Resistant to	Siege to	Approve of
Suspected of	Connections with	Preside over
Intent on	Response to	Concentrate on
Oblivious to	Symbol of	Adhere to
Devoid of	Acknowledgement of	Comply with
Descended from	Respect for	Mingle with
Noted for	Understanding of	Succumb to
Torn between	Belief in	Refrain from
Isolated from	Hatred of	Abide by
Married to	Token of	Strive towards
Worried about	Pity on	Pry into
Jealous of	Dependence on	React against

```
 STOP !  GO BACK AND REFLECT !!

  I learnt …………………………………………………………………………..………………………………

  I would like to know more about ………………………………………………………………………….

  Activities / tasks I liked / found useful ……………………………………………………………………

  Something I would adapt / do differently……………………………………………………………………
```

7. Conjunctions

Connecting words are called conjunctions. They can join two parts of sentence, two independent clauses or two separate sentences to create a single sentence. So they are a very useful part of speech and play a very important role too.

Using conjunctions enables to give continuity to your narrative, set a logical flow to your line of thought and most importantly combine two ideas into one.

Broadly speaking, conjunctions fall into 3 categories :

- **Coordinating**
- **Subordinating**
- **Co-relative**

But let us not limit ourselves by these classifications; instead let us look at the vast cache of words that can come to our aid.

Let us look at our first list of joiners. These are mostly short words.

7.1 Coordinating conjunctions

For	And	Nor	But	Or	Yet	So

Represented by the mnemonic (memory aid) FANBOYS, these are easy to remember. These conjunctions join two similar grammatical constructions, for example, two subjects, two clauses or two phrases.

Let us see how we can use them:

He was poor. He was honest.

We have joined two sentences together by using the conjunction **but**

He was poor **but** honest.

In this example, we used the conjunction **and**

Ashita wrote the letter. Anita posted it.

Ashita wrote the letter **and** Anita posted it.

Look at the sentences below and you will see that not only two conjunctions join sentences together; they also show how they are related.

    a. He is slow **but** steady (Contrast)
    b. Angel wrote the essay **and** the teacher read it (Addition)
    c. She sent in her application **and** waited for a response (Sequence of action)
    d. Take it **or** leave it (alternative / possibility)
    e. He is very rich, **yet** very unhappy (Contrast)
    f. Abhinay thought he had a good chance to get the job, **for** his uncle was on the board of directors (reason for preceding clause- italicized)

Remember when a coordinate conjunction joins two verbs which share the same subject, you need not repeat the subject.

She tried and **she** succeeded can be replaced with " **She tried and succeeded".**

7.2 Subordinating Conjunctions

This word is usually placed at the beginning of the dependant or subordinate clause and establishes the relationship between that part of the sentence and the rest of the sentence. It joins two unequal parts of the sentence. In fact, it makes the clause depend on the rest of the sentence for its meaning.

Analyse this sentence:

As he was not there, I left the package with his mother.

The conjunction in this sentence is **as** and is placed at the beginning of the dependent clause which is – **He was not there**. This is now connected with the use of the conjunction to the second half of the sentence which is – **I left the package with his mother**.

Listed below are some of the common subordinating conjunctions.

After	If	Though
Although	**If only**	**Till**
As	**In order that**	**Unless**
As if	**Now that**	**Until**
As long as	**Once**	**When**
Though	**Rather than**	**Whenever**
Because	**Since**	**Where**
Before	**So that**	**Whereas**
Even though	**Than**	**Wherever**
Even if	**That**	**While**
Supposing	**Provided**	**As long as**

Examples :

Answer the question **before** you move further.

I have not seen her **since** she was a baby.

I have to go **as** I have a meeting.

You will win **if** you practice everyday.

He plays hard **though** he is weak.

My brother takes me to school **when** I am late.

I couldn't buy a gift **because** I have no money.

Supposing she is late, she will miss the interview.

Although it was raining, I walked to the shop.

She passed the exam **while** I had to do it again.

Neelima got the job **even though** she wasn't qualified.

Having listed examples of the usage of some of these conjunctions, practice with your partner to confirm your understanding of the others. With such a wide variety of choices, remember to choose a conjunction that makes your sentence crisp and concise.

7.3 Correlative Conjunctions

Certain conjunctions can be used only in pairs. They join grammatically equal sentence elements and are used to express the relationship between ideas in different parts of the sentence.

Both …......and
Neither …….nor
Not only ……But also
Either ………..or
Hardly ………when
No sooner ……..than
Scarcely………than
Rather………..than
If…………….then

Examples-

> **Neither** Nancy **nor** Tina could give me the answer.

> He is **both** friendly **and** affectionate.

> She will **either** stay **or** take the late train.

> She is **not only** pretty **but also** intelligent.

> **No sooner** had I come out of the building **than** she rushed at me.

> **Scarcely** had I opened the cupboard **when** the body fell out.

> I would **rather** stay at home **than** go out.

> **If** that is false **then** I am not to blame.

When you use co-relative conjunctions, remember to maintain the parallelism of construction.

You do not say:

> He has both a good job and he has a good salary.

> She turned the car neither right nor to the left.

> The chateau is spacious, charming and not expensive.

Instead, use the correct form of punctuation:

> **He has both a good job and a good salary.**

> **She neither turned the car right nor left.**

> **The chateau is spacious, charming and inexpensive.**

Some words in the list like **until, since, after** and **before** – function as both prepositions and conjunctions.

7.4 Connecting Adverbs

Similarly connecting adverbs also function as conjunctions. We had made a mention of this in the chapter on adverbs.

These are some of the connecting adverbs listed along with their meanings.

Accordingly	So
Nevertheless	But
Consequently	So
However	But
Moreover	In addition to
Otherwise	If not, else

Many connecting adverbs have meaning similar to the conjunctions- and, but and so.

And: also, moreover, besides, furthermore, likewise.

But: however, nonetheless, still, nevertheless.

So: accordingly, consequently, hence, therefore.

These are good additions to your vocabulary and using them to join or start sentences, helps to avoid delays and hemming and hawing, while speaking.

7.5 Activity 9: The Socks Story

Subject: Conjunctions

Aim: To understand the replacement of conjunctions in a sentence.

Props: A puppet, if needed.

Instructions:

Announce to the class that it is story telling time and that you have an interesting story to share with them.

Outline of the story: Two men on a journey on a train – settle down – talk – decide to rest a while – takes off shoes and socks – oversleeps – train reaches destination – have to rush out – mistakenly exchange their socks

Carry the story up to this point and then tell the participants that they now have to come up with reasons why the two men exchanged socks.

The sentence should start with : The two men exchanged socks…………………………………

Participants will work in pairs and complete the sentence with a reason as to why they exchanged their socks by using a suitable conjunction.

Example: The two men exchanged socks since they couldn't exchange their visiting cards.

Each pair will come up with 10 reasons.

Tell them it is alright to be whacky and funny.

The focus is on the appropriate use of conjunctions.

The facilitator may ask the participants to read out their sentences and make the corrections where needed.

Debrief:

What have I learnt?

_____
_____
_____
_____
_____

<table>
<tr><td>

STOP ! GO BACK AND REFLECT !

I learnt ……………………………………………………………………………………………………

I would like to know more about ……………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………….

Something I would adapt / do differently……………………………………………………………

</td></tr>
</table>

8. Verbs

Can one imagine the English language, or for that matter any language without verbs? As the axis is to the earth, or the sun to the solar system, so is the verb to the English language. One cannot form a sentence without a verb. You saw that in the very first lesson we started with. You would not have a phrase without a verb.

So, what are verbs? Most of us understand verbs as action words. They give an idea of action, of doing something. But how would you explain this, a little further?

- Verbs are that part of speech which denote action or an idea of existence or a state of being.
- A verb always has a subject. A verb tells you what the subject is doing.
- Verbs change form.
- A verb must agree with the subject in terms of number- singular and plural.

Let us take an example of a simple sentence.

Aswin speaks English.

A simple sentence of three words, let's see if it confirms to our description illustrated above.

The subject in this sentence is Aswin and the verb "speaks".

While Aswin is the subject of the verb- speaks, Aswin being singular, we use a singular form of the verb- speaks and not the plural form – speak. This explains the agreement of the subject to the verb.

8.1 Verb Classification

Verbs are divided into two basic groups

- Helping verbs
- Main verbs

A helping verb by the very term implies something that provides assistance. In other words, it assists something else. It may also be called as auxiliary verb.

Let us take a helping verb and put it into a sentence.

People are.

Do you understand anything from this sentence? I guess not. The sentence has both a subject and a verb. In spite of which you fail to make sense of it. This is simply because a helping verb cannot exist by itself and needs to accompany or support a main verb. They don't mean anything when they are by themselves; however, they are absolutely essential to complete the grammatical structure of the sentence. They go hand in hand with main verbs.

The main helping verbs are:
> **Be** and its forms.
> **Have** and its forms.
> **Do** and its forms.

There are other helping verbs called modal verbs. These are helping verbs which modify the meaning of the main verb in some way and express possibility or necessity. We shall examine them separately in a later chapter. Similarly, you also have yet another group of verbs called **linking verbs**. These verbs connect a subject with an adjective or a noun that describes the subject.

Example:
> The flowers smelled wonderful.
> The students felt delighted.

The common linking verbs are :
> **Be, appear, become, sound, taste, smell, remain, seem, feel, grow, look, go,turn**

Let us expand on our earlier sentence.

> People are walking.

By adding the main verb walking, there is a greater clarity to the sentence. It is complete by assisting the main verb, the helping verb has played its role of providing assistance.

A main verb can exist by itself and does not need the assistance of a helping verb, at all times.

In this example:
> **People eat.**

We have the subject and the main verb. They agree with each other in number and are complete in their meaning.

There are thousands of main verbs and similarly, there are different kinds of classifications as well. Essentially, it needs to be remembered that a verb can take a direct object as in the sentence-

I saw an elephant.
Or it may stay without one as in the sentence-
He has arrived.

A classification that is both interesting and confusing is that of regular and irregular verbs. If you are not fluent in the language, this could be an area of improvement that you would need to look at.

An understanding of verbs and their forms is essential as we would need to deal with tenses later.

In the English language, regular verbs consist of three main parts: the root form which is expressed in the simple present form of verb, the simple past and the past participle form.

The easiest way to remember or identify a regular verb is to look out for – ed ending added to the root form to create the past and past participle form of the verb.

Example:

Root form(present)	Simple past	Past participle
dance	danced	Danced
create	created	created
Play	played	Played
Act	Acted	Acted
walk	walked	Walked

Irregular verbs also have the same three forms; however, they are not formed in the same manner. The past and past participle forms differ and one can learn this only through practice. Some irregular verbs do not change at all in all three forms, while some change across all three.

8.2 List of irregular verbs

Study the list below and identify the common patterns. A point to remember is that there are no fixed rules for the formation of irregular verbs. You may identify a sort of pattern but just when you think you have mastered it, you will come across an exception.

Root form	Simple past	Past participle
Awake	Awoke	Awaken
Send	Sent	Sent
Bring	Brought	Brought
Freeze	Froze	Frozen
Creep	Crept	Creep
Make	Made	Made
Blow	Blew	Blown
Drive	Drove	Driven
Break	Broke	Broken
Write	Wrote	Written
Rise	Rose	Risen
Weave	Wove	Woven
Teach	Taught	Taught
Bite	Bit	Bitten
Slide	Slid	Slid
Weep	Wept	Wept
Fly	Flew	Flown
Know	Knew	Known
Meet	Met	Met
Drink	Drank	Drunk
Flee	Fled	Fled
Leave	Left	Left
Deal	Dealt	Dealt
Swell	Swelled	Swollen
Dream	Dreamt/dreamed	Dreamt/ Dreamed
Shrink	Shrank	Shrunk

Go	Went	Gone
Forgive	Forgave	Forgiven
Spend	Spent	Spent
Lend	lent	lent
Fling	Flung	Flung
Grind	Ground	Ground
Ring	Rang	Rung
Mean	Meant	Meant
Forget	Forgot	Forgotten

That was an exhausting list. Don't get fazed by it. Go through the list very slowly and see whether you can identify a pattern which will help you understand and remember the forms. Let me give you a clue.

Look at the words which end with- nd, what is the pattern you see?

The –nd changes to-nt in the past and past participle forms. Try and establish similar patterns.

Let us try using these in some sentences so you understand the need to learn them.

I write my diary every day.

Last evening I wrote a long mail to my friend.

She had not written to me for many months.

Or let us see an irregular verb that does not change form. Observe its usage whether used in the present, past or future.

She cut the cake last evening.

We will cut the cake later in the evening.

I cut her hair this morning.

Here is a more complicated example.

She spoke to me and said that if I speak behind her back she will have me spoken to, by the principal.

8.3 Activity 10: Word Search

Subject: Verb forms
Aim: To practice using various verb forms.
Props: Multiple copies of word search and filling sheets.
Instructions: Facilitator to distribute copies of word search.
Time allotted for participants to find the 20 words and put them in the columns along with the corresponding forms. – 15 minutes.

Debrief:

What have I learnt?

_____
_____
_____
_____
_____

STOP ! GO BACK AND REFLECT !

I learnt ………………………………………………………………………………………………….

I would like to know more about …………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………….

Something I would adapt / do differently…………………………………………………………………

---

9. Subject and verb agreement

Communication is the key to success. In the global business world, the language that links people from across the globe is English. There are many dialects to any language. Pronunciation, phraseology and turn of phrases will vary from country to country. However there is a common consensus on one aspect and that is the grammatical structure of the language. There is no debate on this score, I am sure!

Having understood the various parts of speech, the challenge that lies ahead is to string these parts together in a manner that makes what you say coherent, logical and fluent.

Recollect the process of learning any new language. You have learnt the alphabet, the syntactic structure, some vocabulary-all separately. Moreover you have also scored very well in your written test, yet you are not able to converse with ease. Fluency seems like a distant dream.

Professionalism at the work place is reflected to a large extent through your communication. Being able to convey your thoughts and ideas effectively in English will help you clinch the deal. However, English which is a language that has evolved through the influences of various languages through the ages is fairly confusing and has more exceptions to the rules that govern the syntactic structure then the rules themselves!

The idea is not to scare you, but to make you realize that subject-verb agreement which is the topic of our discussion today is very crucial to understanding English. In addition, if you understand and analyze each of these rules in a very logical and mathematical manner it is actually very simple and can be a lot of fun too!

The rules of English grammar are quite straight forward and logical, it's definitely not rocket science! For a sentence to exist you know that it must have a subject and verb. So what is the subject and what is the **verb**?

The **subject** in a sentence is the **doer** of the action which is represented by a part of speech- the noun or the pronoun.

Some sentences will also have an **object**. This is the **receiver** of the action again a noun or pronoun.

The verb signifies the transmission of the action from the **doer** to the **receiver**.

The basic rule for forming a correct sentence is

Singular subject takes a singular verb and a plural subject takes a plural verb. Simple isn't it!

Example:

The **boy** reads a book.
The **boys** read books   .

So where is the problem?

Well, the first part of the problem is in knowing whether the subject is singular or plural and the next is in knowing whether the verb is singular or plural.

Knowing whether a subject is singular or plural is basic and cones through practices. We have observed this and learnt about it in the chapter on nouns.

So you have:
Chair-chairs
Student –students
Right! But verbs do not form their plurals in this manner. The reverse logic works here. A singular verb takes an's' at the end of the verb and the plural verb stays the way as it is!

DANCE + S = SINGULAR VERB
DANCE = PLURAL VERB
CHAIR = SINGULAR NOUN
CHAIR + S = PLURAL NOUN

This table will help you see the difference in the formation of plurals of the verb and the noun.

Let me take you back to your school days. The focus in your grammar class was   on   teaching you the plurals of nouns. Am I right? Somewhere the mind at that point registered that the formation of the plural was simply a process of adding- s to the word. Subsequently you learnt about verbs. Grammar was then your dreaded subject and you push the rules away to the far corner of your minds. Somewhere along you failed to analyse that the plural of the verb is formed differently. In fact, in direct contrast to the formation of nouns!

At a later stage, you adopted the process the generalisation and formed a blanket rule.

Plurals- **add s**

> **One of my friend is sick.**
> **The friends is very important in our life.**
> **They makes me happy.**

Therefore you made mistakes in your subject verb agreement! Does that sound plausible?
Look at the example of the verb.

> **Talk**
> **Talks**

Which one is the singular form? Which form of the verb would you use with "he".
.

> **He talks**

Therefore "talks " is a singular form of the verb .

They talk.

Therefore talk is the plural form of the verb.

Be conscious and hear yourself speak, it makes it easier to identify errors in your own speech.

Le t us look at some more examples.

> **She <u>does</u> her work**
> **They <u>do</u> their work.**
> **The students <u>come</u> late.**
> **The student <u>comes</u> late.**

This is the cornerstone rule that forms the basic concept. There are about 20 or 24 rules of subject verb agreement of which 12 are crucial to our understanding.

Let us try and approach this topic in very logical manner.

In the sentences above, you had one subject in your sentence. These were – **she, they, students, student.**

You have now understood what the rule of agreement when you have singular subject.

SINGULAR SUBJECT- SINGULAR VERB
PLURAL SUBJECT- PLURAL VERB

So you now know what to do when you have one subject in the sentence.

What if you were to have two subjects in a sentence?

If both your subjects are singular and connected by **'or' 'nor' 'either/or'** or **'neither/nor'** you use a singular verb.

My **brother** or my **sister** is arriving today.

Neither **Mohammed** nor **Amrish** is available.
Either **Asha** or A**ngel** is coming for the meeting.
Either / Angel is
Either/ Asha is

An exception to this usage is the use of the pronoun 'I'. If 'I' is one of the subjects – place it 2nd and follow it with the verb that agrees with 'I' which is 'am'.
Neither <u>she</u> nor <u>I</u> <u>am</u> going to the Park today.

Instead if both your subjects were in the plural form and connected by **'or' 'nor' 'either/or'** or **'neither/nor'** then the verb that follows will naturally be a plural form of the verb.

 Neither we nor they <u>are</u> going to the office today.
The participants or the faculties <u>are</u> answerable for the delay.
In the sentences above, you see. That the subjects used, were in their plural form and therefore the verb that follows, is also in the plural form.
Let us now change the situation slightly. If one of the subjects were altered, what would happen? What is the form of the verb that has to be used in this context?

The simple rule to follow in this case is the rule of proximity.

What do you understand by this?
Identify the noun that is placed closest to the verb. Your verb has to agree with the subject that is closest to it.

Example:
>   The textbooks or the **pencil is** on the table.
>   The pencil or the **textbooks are** on the table.
>   Neither the professor nor the **students are** available.
>   Neither the students nor the **professor is** available.
>   Either the children or the **parent is** coming to meet you.

Either the parent or the **children are** coming to meet you.

However, the two subjects in your sentence are joined by **'and'**, as a general rule it takes plural verb. The parents and the children are attending the concert today.
The exception to this rule is the usage of two nouns which may look like two different subjects but in reality refer to one entity. An understanding of this usage comes through practice and a lot of additional reading.

Examples:
> **His companion** and **friend** is devoted to him.
> **His friend** and **fellow worker** is very knowledgeable.
> **Our cook** and **housekeeper** is on a holiday.

In these sentences the two subjects refer to the same person.

How would you understand the difference?

Simple-the subjects in these sentences refer to two individuals, you would find a modifier or a determiner preceding the noun.

> **My friend** and the **fellow worker** are very knowledgeable.
> Our cook and our **housekeeper** are ill.
> His **companion** and his **friend** are devoted to him.

By placing the word **his/ the/ my** before two nouns respectively, you clearly indicate that they are two different individuals.
Sometimes the subject is followed by prepositional phrases or expressions such as **along with, as well as, besides, together with**. Remember the subject in these sentences does not get affected by these intervening phrases.

Ignore these phrases when determining which form of the verb to use. The nouns that follow these phrases is not the main subject. They provide additional information which is not a pre-requisite for determining the form of the verb.

Materials (for the building have been transported)
In this sentence the subject is the word **Materials**. The subject is plural and the verb must be plural. The prepositional phrase for the building does not affect the number of the subject.

Let us take another example

> My **cousin** with her children **has** flown to Spain.

In this sentence the phrase **with her children** does not affect the number of subject. The subject is **cousin** which is singular and the verb is **has** which is singular. So the agreement of the subject and the verb is complete.

You could review some more examples

> **My sister**, together with her husband and sons, **lives** here.
> The **politicians** along with the president **have** disappeared.

Singular indefinite pronouns always take on a singular verb.
> **Each** of these boxes **has** been examined.
> **Anyone has** the right to offer an opinion.
> **Somebody** is **responsible** for the theft.

The same rule applies to other singular, indefinite pronouns.
Someone, something much, neither, each, nobody, nothing, everything, everyone, every

Indefinite pronouns like **many a** and **many an** may be misleading because of the presence of the word many. These are singular and take on a singular verb.

> **Many a** man **wishes** that he had better education.

Plural indefinite pronouns like several, few, both and many take on plural verbs.

> **Several were** called to the stage.
> **A few were** opposed to the idea.
> **Both were anxious** to receive the award.

Let us now take a look at the fence sitters! Indefinite pronouns like **some, more, most, none** and **all** are singular or plural according to the meaning of the sentence.

A good technique to use to understand this is to remember that if a pronoun refers to an uncountable noun or a quantity or a mass then it takes on a singular verb and if it refers to a countable noun or a number, it takes on plural verb or in the words, these pronouns refer to a quantity or mass there considered singular and when they refer to a number they are considered plural in meaning.

You will understand this better through a series of example.

Some of the officers **are** going by plane. (More than one- plural)

The indefinite pronoun **some** refers to a countable quantity-**officers**. It is plural and so the verb is also plural.

Some of the **ice cream** is left. (Mass or uncountable quantity)

The indefinite pronoun **some** refers to an uncountable quantity- **ice cream**. It is singular and so the verb is also singular.

More chairs are needed in this room. (More than one- plural)

The indefinite pronoun **more** refers to countable quantity- **chairs.** It is plural and so the verb is also plural.

Is there **any milk** in the freeze? (Mass or uncountable quantity)

The indefinite pronoun **any** refers to an uncountable quantity- **milk**. It is singular and so the verb is also singular.

All of the children **have** brought gifts. (More than one- plural)

The indefinite pronoun **all** refers to countable quantity- **children.** It is plural and so the verb is also plural.

All of the gasoline **has been** sold. (Mass or uncountable quantity)

The indefinite pronoun **all** refers to an uncountable quantity- **gasoline.** It is singular and so the verb is also singular.

Look at how the indefinite pronoun none is used. It can be used to mean both singular and plural and you use the appropriate form of the verb by basing it on the context of the sentence.

None of these mangoes **are** ripe. (More than one- plural)
We needed a book but **none was** available. (Not one – singular)

With indefinite pronouns neither and either, remember to use a singular verb even though they may seem to refer to two things. Neither and either fall under the category of singular indefinite pronouns and take on a singular verb.

Neither of the bags is useful.
Either of the coats is fine.

In the sentence such as these the element of confusion lies in the choice between the pronoun and noun as the subject of the sentence. Remember that the first thing to do is to be clear about the

subject of the sentence. The subjects in the sentences above are **either** and **neither**. These are singular indefinite pronouns and naturally take a singular verb.

We have covered some of the important rules of subject and verb agreement. A little practice will help you reinforce the concepts that we have covered, so shall we have an activity now?

What about making some salad? Are you game for it?

9.1 Activity 11: Tossed Word Salad

Subject: subject verb agreement.
Aim : To practice creating sentences.
    Practice subject- verb agreement.

Props: Blank paper, pencil, scissors
  Paper cut into small squares.

Instructions:

Facilitator to list out the various parts of speech covered so far, on the board.
As the facilitator calls out each part of speech participants (could work in pairs) put down two words belonging to that category on the squares of paper.

Vary the degree of difficulty by asking them to put down- past participle form of the verb or a correlative conjunction.

A square can contain only one word.

There is no restriction on using any tensed form with the verbs.

Once the participants or the pairs have a sufficient number of words ask them to toss the word salad mixing up all the words.

Now allot a span of time – say 15 minutes and ask them to put down as many correct sentences as they can.

The pair that comes up with the maximum number of sentences within the given time can be suitably rewarded.

Debrief:

What have I learnt?

_____
_____
_____
_____
_____

Words that indicate parts or portions- **per cent, part, majority, some** and **half** are singular or plural, according to the meaning of the sentence. When these words refer to a mass or section, they are singular. When they refer to a number of individuals or things they are plural.

In the examples look at the noun in the '**of phrase**' which is the object of your preposition. This helps you determine whether to use a plural or a singular verb. If the object of the preposition is plural – use a plural verb and if the object of the preposition is singular- use a singular verb.

Fifty percent of the **cake** has been eaten. (Cake is the object of the preposition **of** and you are referring to a single unit of cake)

Fifty percent of the **cakes** have been eaten. (Cake is the object **of** the preposition of and you are referring to a number of units of cake).

> Half of the **boys** are in the class. (Boys- plural)
> Half of the **cake** is left. (Mass or section of one unit.)

In a similar fashion, when the word **number** is preceded by the article **a**, it takes a plural verb and if it is instead preceded by the article **the**, it takes a singular verb.

In other words a number refers to a countable quantity and the number refers to an uncountable mass.

> **A number** of men **were** working under project. (Plural- countable)
> **The number** of men present **was** small. (Singular – refers to one group)

A plural noun which shows weight, quantity or extent is always singular and takes a singular verb.
Alternately, you could say that units of measurement are always expressed in the singular.

> Ten **miles** is a long distance to walk.
> Five hundred **pounds** is a big price to pay for this.
> Ten **inches** is the correct length.

Words like **scissors, pants, tongs and spectacles** indicate a unit that has two parts. It is incorrect to say scissor, pant or tong. Whether you use it to mean a singular or a plural unit it always takes a plural verb. But if the word **pair** is used to donate the subject, it is then considered as singular and takes a singular verb.

> The **scissors are** very sharp. (Plural)
> A **pair** of scissors **was** left on my table. (Singular)

Analyse these two sentences in greater detail. In the first sentence, we do not indicate whether we are speaking of an individual or multiple units. As a rule, such words are considered plural and take on a plural verb.

In the second sentence what would be the subject of your sentence? Obviously, the word– pair. Do not mistake scissors as the subject of your sentence. A good tip to remember here is that a noun that follows a preposition is not the main subject. It only adds further information to the main subject.

Look at a few more examples:
    The **pants are** long but this **pair** of black pants is short.
    The new **pair** of spectacles is too expensive but the **spectacles are** an important part of my wardrobe.

Think over these sentences. Why is it possible to use these in the singular form?

> My **eyes are** hurting.
> My left **eye hurts**.

Yes, those regular exceptions which have become more the rule, than an exception!!
Sometimes a sentence begins with the word **here** or **there.** It is often tempting to assume that these are subjects of the sentence, since in most sentences the subject is usually placed in the first part of the sentence.

There **are ten** members on the committee.

These words like here and there are not the subjects of the sentence but as considered as adverbs of place. In such sentences, the subject normally follows the verb. To determine whether the subject is singular or plural, transpose the adverb so as to bring it in the middle of the sentence.

Ten members are there on the committee. (Plural subject – plural verb)

Here **comes** the **teacher** with her staff.

The **teacher comes** here with her staff. (Singular subject and singular verb)

You still remember your collective nouns, don't you?

Collective nouns represent a collection of objects – **jury, board, committee, flock, pack,** and **herd** - and is considered is one unit. Therefore, the verb that goes with a collective noun is a singular verb.

Ideally, when a collective noun in a particular sentence represents the individuals acting as unit, the noun is singular.

> The **team is** playing.

> The **herd** of elephants **is** grazing.

If the sentence indicates that the individuals are acting separately, the noun is considered plural.

> The **jury is** opposed to the plan. (Jury is projected as one unit)

> The **families have** given their approval for the project. (As individual – as members of the family)

> The **staff** is in a meeting. (Acting as a unit – a group of personnel)

> The **staff are** in disagreement about the project. (As individual members of staff)

Correctly speaking, it would have been better to use the following
> **The members of the family have given their approval.**

> **The members of the staff are in disagreement about the project.**

However, the earlier usage is universally accepted.

Some nouns are plural in form but singular in meaning. Take the example of subjects like Mathematics and Physics or diseases like measles and mumps.

> **Physics is** a very interesting subject.

Measles is an infectious disease.

The addition of **S** may indicate that it is a plural noun but as a noun it refers to a single subject or one kind of disease.

Look at these sentences and see why they are different

Politics is an interesting subject.

The **politics** of the ANZ party **are** pro-democracy.

In the first sentence the word politics refers to the subject – Politics, but in the second sentence the word politics refers to the political views or beliefs. This rule bears resemblance to that of the collective nouns. It would have been better to say:

The political **views** of the ANZ party **are** pro-democracy.

The relative pronouns **who**, **that** or **which** – can at times become the subject of a verb in the middle of the sentence. The pronouns **who**, **that** and **which** become singular or plural, according to the noun directly in-front of them. So, if that noun is singular, use a singular verb. If it is plural, use a plural verb.

Harsha is the scientist **who** writes the reports.

The word in front of **who** is **scientist**, which is singular. Therefore use the singular verb **writes**.

He is one of the men who do not work.

The word in front of **who** is **men** which is plural, therefore use the plural verb – do.

So that in short, covers the important rule of subject – verb agreement. It may seem very dense and confusing to you, not to worry, a little practice and you should be fine.

We have an interesting activity that we will do together. It is going to be a lot of fun and a big challenge too.

9.2 Activity 12: The Sentence Pageant

Subject: Subject and verb agreement

Aims: To practice and detect errors in subject and verb agreement.

Props: Slips of paper cut into small squares to represent currency

Instructions: This is an all group – activity based on the popular game- Just a Minute.

This game involves all the participants and keeps them on their toes. Inform the class that the focus of this activity is grammar (all aspects of subject and verb agreement). Tell the participants to be alert to any errors that the speaker may make.

Each group to be given ten squares of paper at the start of the game. These would be their currency.

- One participant from the group will be asked to speak without long pauses on a topic provided by the facilitator or another participant from the class. The topic should relate to daily life as this would enable easy flow of thought. All the other participants need to listen keenly for any grammatical errors that either the speaker or the challenger could make.

- As soon as a participant hears a mistake, the participant indicates this, by raising a hand and the speaker stops speaking, at this point.

- The challenger at this point of time does not reveal the error that he has noticed but keeps it in mind till he is asked so by the facilitator.

- The members of the group vote by placing money on either the speaker or the challenger. No fence sitting is allowed. The participants' choice to choose between the speaker and the challenger is based on his understanding of the grammatical structure. The faculty now, goes around the group and collects the currency slips in two different boxes- one marked "speaker" and the other "challenger".

- The challenger now identifies and states the mistake and corrects it as well.

- The facilitator then gives the verdict. The facilitator is the judge in this activity and his/ her verdict is considered final.

- If the correction is right the money collected, both for the challenger and the speaker goes to the challenger. In turn, the challenger now becomes the speaker and starts the next round with yet another new topic.

- In case the challenger corrects the speaker wrongly, he loses all the money and additionally needs to give one unit of his currency as well to the speaker. In case, the challenger makes a bogey call (a bogey call happens when the challenger stops the speaker and is unable to identify or has forgotten the error) he still needs to give a unit of currency to the speaker, but the speaker can carry on with his topic.

- Supposing the challenger proposes a wrong correction but some other participant from the group gives out the right correction, the person who gives the right correction wins the money placed and becomes the new speaker.

- Errors that the group can lookout for

  - Syntax, structure errors

- Wrong agreement of subject and verb
- Word order
- Wrong word: vocabulary out- of –context
- Long pauses of more than five seconds

STOP ! GO BACK AND REFLECT !

I learnt ………

I would like to know more about ……………………………………………………………………………….

Activities / tasks I liked / found useful…………………………………………………………………………….

Something I would adapt / do differently……………………………………………………………………………

10. Determiners and Modifiers

While we were discussing nouns, you may remember that we made a mention of articles that preceded common nouns. Articles fall in the category of determiners. Determiners may not be a familiar term to most of us, since they include more than just articles.

Determiners are the words that are used along with nouns to clarify an understanding of the noun. The Oxford dictionary defines a determiner in this manner: **a modifying word that determines the kind of reference a noun or noun group has, for example a, an** and **the.** It is therefore a word belonging to a group of noun modifiers, which includes articles, demonstratives, possessive adjectives and words such as <u>any</u>, <u>both</u>, or <u>whose</u> and in English, it occupies the first position in a noun phrase or follows another determiner.

10.1 Kinds of determiners

Determiners are of various kinds. The ground rule states that all singular nouns must be preceded by a determiner but it is optional in the case of plural and uncountable nouns.

Determiners are used for the following purposes:
- To define something or someone
- To define the number of people or things
- To define something or someone specific
- To state possessives
- To show the difference between nouns
- To show distribution of nouns

There are about 50 determiners in the English language. You will find them referred to, as determiners, quantifiers or modifiers. They refer to the same category of words. Essentially, they modify a noun like an article, show the possessive adjectives or quantify a noun.

Demonstratives: Words that point to one or more particular things or persons. E.g: This, that, these, those, which etc (this has already been addressed in the chapter on pronouns.)

Possessives: Words such as – my, your, our, their, his, her, whose, my friend's, our friends' etc (discussed earlier in the chapter on pronouns.)

Quantifiers: Words used to state the amount or quantity. They answer the questions- How many/ how much? We have addressed the use of these words when we spoke of indefinite pronouns, however, we will go into further details when dealing with subject and verb agreement. E.g.: few, a few, many, much, each, every, some, any etc .

- There are a few apples.
- They know little English.

Cardinal Numbers: refer to the number of items in a group , E.g.: one, two, three, twenty, forty.

- Three women were waiting at the hospital gate.

Ordinals: refer to the order of items within a group, E.g. first, second, 1st , 2nd, 3rd, last, next etc.

- Tina's story won the first prize.
- The sixth chapter describes the plot.

Articles: a, an, the

- The story was short.
- A black cat ran across the road.
- Give me an ice-cream cone.

Seem a little confused? Are you wondering why we are harping on the same topic, if it has already been covered? Is it confusing to understand why the same words are categorized under two different heads? Not to worry. The intention was to remind you that certain words play a range of roles in English language. In addition, these are words which most of us find difficult to use appropriately. Though the error in slight, it impacts your overall fluency.

10.2 The Definite and the Indefinite Article

Articles are again very small words, probably inconspicuous not just in speech but also perhaps, in writing. However they contribute greatly to the overall understanding and intonation of speech.

Articles are three in number- **a, an & the,** however, we have a large number of rules governing their usage. They are very simply classified into two groups:

Definite article: the

Indefinite article: a, an: these are used before any noun that is singular, countable and indefinite.

Example:

A woman earns more than **a** man, who does the same job.

An apple fell on my head.

Both these articles are used before a singular countable noun. The choice of a/an is made based on the sound of the word that follows it. If a word starts with a <u>consonant sound</u> then it must be preceded by **a,** and if it starts with a <u>vowel sound</u> then it must be preceded by **an**. Note the

insistence on the sound rather than the mere choice of vowels and consonants. You will soon see the difference. In the examples above, the word woman starts with **W** and the word apple starts with **A**.

You also use **an** when the first letter of the word that follows it starts with **H** and is **followed** by a vowel.

> An hour
>
> An heir
>
> An honest man

'A' or 'an' should never be used before an uncountable noun:

I asked my friend for an advice. ✕

She was awarded the medal for a bravery. ✕

I want an accommodation. ✕

Similarly, do not use **a/an** before a plural noun:

> A paperback books are available at the mall. ✕
>
> Paperback books are available at the mall.

Omitting an article where required is equally serious an offence:

> Antony Gomez was brilliant scientist.
>
> Antony Gomez was a brilliant scientist.
>
> She studies variety of subjects.
>
> She studies a variety of subjects.

Some of the exceptions to the use of a/ an, are words that start with a vowel but do not have a vowel sound: Instead – they have a consonant sound. Such words take on **a** and not **an** before it.

Take the example of the word once. It starts with O. Say the word aloud – **won-s.** What does it sound like? The sound that it starts with is a consonant sound – **w** and not a vowel sound. Therefore it takes the article **a** before it.

Example:

> That is a once in-a lifetime opportunity.

A European friend of mine is in town.

Fortunately, words of this kind are limited in number. Here are some of them:

Words starting with 'E' but sound like the consonant Y: European, Europe

Words starting with 'U' but sound like Y: universal, unicorn, university, unit, usual. Notice how they differ in pronunciation from umbrella and uncle which also start with U.

A university student met me at the gate.

The mobile phone is a useful device.

I have an umbrella in the bag.

10.3 Definite Article: The

The article '**the**' is used before nouns, that refer to one or more specific things or persons.

She gained **the** sheet on her own, in **the** elections.

The men from **the** factories came out in large groups.

We may also use '**the**' before superlative form of the adjective.

This is **the biggest** balloon I have seen.

I chanced upon **the most** beautiful sight.

When an adjective functions as a noun, use '**the**' before it.

The rich and **the poor** do not share much in common.

The sick and **the suffering** all need your help.

The is used with specific nouns that about things which are one of its kind.

The earth is round.

The sun rises in **the** east.

Certain nouns that refer to places of primary purpose don't use an article at all. For instance, words such as school, college, church, prison and court.

I go to college.

She goes to church every Sunday.

Most children go to school at an early age.

Proper nouns which are names of people or brand names of products do not take on articles.

The Maria came late to the office.

Maria came late to office.

Are those Nike shoes?

Talking of geographical locations, the use of the definite article <u>can</u> get a little confusing. When we talk of political and economic unions, rivers, mountain ranges and geographical regions we use '**the**' before these names. We also use it before the names of monuments and oceans.

The European Union.
The Arctic.
The Mississippi.
The Himalayas.
The Caspian Sea.
The Pacific Ocean
The Eiffel tower.
The Sphinx

When we talk of names of countries, names of towns or cities, lakes or bays we don't use the definite article.

I live in **Cairo**.

Lakshadweep is a beautiful place to visit.

However there are certain exception to this rule. When we talk of countries that are a united group under a single entity the article precedes it.

The United States of America

The United Arab Emirates

These nouns omit the use of the article before it.

- Names of languages under nationalities like Spanish, Chinese.
- Names of sports like football and volleyball.

- Names of academic subjects like History and Computer science

Abstract noun may or may not take an article.

It was **a grief** that she had never experienced before.

Her body was racked with **grief**.

So you see how these little words have an important role to play. In spite of learning all the rules related to the use of articles, you will still find situations where you are wondering about the choice of articles. Only practice and keen ear will help you master the language.

Activity 13: Proof Reading

Subject: Determiners and Articles

Aim: To practice appropriate use of determiners and articles

Props: Multiple copies of the speeches

Instructions: Facilitator to distribute multiple copies of the speech

Participants to work alone and fill in the required articles.

Here is a copy of the letter that Ashima wrote to her daughter, however when she was typing it out on her PC, a certain virus on her computer deleted all the articles from her letter. Ashima is frustrated as she does not speak or write English fluently and had got her friend Alisha to translate this letter into English. Please help Ashima put in the articles at the appropriate places so that she can mail out the letter to her daughter.

My dear little one,

I have not written letter to you for quite while. Six months have passed since that fateful day when your father left us – six months of sorrow, pain and tears. World goes on, oblivious of the trials and tribulations in our life. I do not know where to begin. Would your tender mind even understand repercussions of void created by your father's departure from our lives?

That day was great day for us; your father had landed himself new job. Pay pocket that he would bring home would change our lifestyle. I remember your eyes lighting up with excitement, incessant prattle between your brother and you: many plans that both of you were drawing up – travel, holidays, gizmos, works. Sitting out on terrace with his arms around two of you, your father had promised that he would see that all your plans see light of the day.

But fate dictated otherwise. Your dreams turned to dust in the flash of second when that unknown intruder shot at your father at point – blank range from house across. You screamed, your brother cowered in fright behind me while I looked on unwilling to believe what my eyes saw.

The police have yet to find killer or worthwhile motive. Wheels of bureaucracy turn slowly and life time may go by with questions unanswered. I have done all that I possibly can, running from one office to another to nail killer, but my attempts have been in vain.

I have a lot of explaining to do, amends to make and answers to give. You may not understand and I will not explain. Staying with your aunt was perhaps only rightful thing I did at that point of time. I do not know what both of you will make of it.

When the time is right and pain has eased little I will sit both of you down and explain in my clumsy manner why I made choice to send you away to my sister. Till then, bear with me, my little one. Stoical as you are, you have accepted everything with equanimity. May God continue to give you strength to bear the crosses that he has in store for you.

Mom

My dear little one,

I have not written a letter to you for quite a while. Six months have passed since that fateful day when your father left us –six months of sorrow, pain and tears. The world goes on, oblivious of the trials and tribulations in our life. I do not know where to begin. Would your tender mind even understand the repercussions of the void created by your father's departure from our lives?

That day was a great day for us; your father had landed himself a new job. The pay packet that he would bring home would change our lifestyle. I remember your eyes lighting up with excitement, the incessant prattle between your brother and you: the many plans that both of you were drawing up – travel, holidays, gizmos, the works. Sitting out on the terrace with his arms around the two of you, your father had promised that he would see that all your plans see the light of day.

But fate dictated otherwise. Your dreams turned to dust in the flash of a second when that unknown intruder shot at your father at point – blank range from the house across. You screamed, your brother cowered in fright behind me while I looked on unwilling to believe what my eyes saw.

The police are yet to find the killer or a worthwhile motive. The wheels of bureaucracy turn slowly and a life-time may go by with questions unanswered. I have done all that I possibly can, running from one office to the other to nail the killer, but my attempts have been in vain.

I have a lot of explaining to do, amends to make and answers to give. You may not understand and I will not explain. Staying with your aunt was perhaps the only rightful thing I did at that point of time. I do not know what both of you will make of it.

When the time is right and pain has eased a little I will sit both of you down and explain in my clumsy manner why I made the choice to send you away to my sister. Till then, bear with me, my little one. Stoical as you are, you have accepted everything with equanimity. May God continue to give you the strength to bear the crosses that he has in store for you.

Mom

Debrief:

What have I learnt? : --

```
┌────────────────────────────────────────────────────────────────────────┐
│                                                                        │
│  STOP ! GO BACK AND REFLECT !                                          │
│                                                                        │
│  I learnt ………………………………………………………………………………………………………….           │
│                                                                        │
│  I would like to know more about ……………………………………………………………………….      │
│                                                                        │
│  Activities / tasks I liked / found useful……………………………………………………….     │
│                                                                        │
│  Something I would adapt / do differently……………………………………………………………    │
│                                                                        │
└────────────────────────────────────────────────────────────────────────┘
```

Let us do a quick recapitulation of verb forms. Would you agree that a verb is the most important word in any sentence? Verbs have a number of properties which other parts of speech do not have; besides, most grammatical constructions depends upon the verb than any other part of speech.

The exclusive property that verbs enjoy is tense. In the context of grammar what do you understand by the word tense? Tense means time. Verbs have six tenses which show differences in the time of action or the time of the state of being or conditioned.

Let me illustrate this for you with a couple of examples.

I see a bird on the fence. (Present time)

I saw a bird on the fence. (Past time)

I shall see a number of birds when I go out into the countryside. (Future tense)

Do these sentences mean the same thing? No they don't. The commonality is the verb used in these sentences which is –"**see**". The meaning of the sentence has changed in each of these sentences based on the verb forms used to show the time of the action.

The first sentence means that the action expressed by the verb- **see** is going on now.

The second sentence means that the action expressed by the verb form **saw** happened at some time in the past. The third sentence means that the action expressed by the verb form **shall see** will occur at some time in the future.

Let us through a table understand the forms of tenses that we will deal with.

PRESENT	PAST	FUTURE
Simple present tense	Simple past tense	Simple future tense
Present progressive tense	Past progressive tense	Future progressive tense
Present perfect tense	Past perfect tense	Future perfect tense
Present perfect continuous tense	Past perfect continuous tense	Future perfect continuous tense

If I were to create tables of the same forms using a verb instead, along with a subject let us see how it works.

My choice of subject is **he / she** and the verb – **walk**.

PRESENT	PAST	FUTURE
He/ she walks	He/ she walked	He/ she will walk
He/ she is walking	He/ she was walking	He/ she will be walking
He/she has walked	He/she had walked	He/she will have walked
He/she has been walking	He/she had been walking	He/she will have been walking

Observe the changes in the verb forms- walks, walking, walked.

Do you notice how easy it is to form the future tense of a verb? It is simply a matter of adding the verbs "**will or would**" to the present form of the verb (will walk). This has in fact given rise to a lot of debate, questioning the very existence of the future tense form.

Observe the addition of the auxiliary verb forms of- **be** like **is, was, been**, that has been used.

Before we proceed any further, let us get familiar with the forms of verb- **to be**. It is the most irregular and most commonly used as well. Besides being an independent verb, it also functions as an auxiliary verb. It is used to form the progressive forms as also the passive voice.

11.1 Reference Table

Present Tense

Singular	Plural
I am	We are
You are	You are
He, she, it is	They are

Past Tense

Singular	Plural
I was	We were
You were	You were
He, she , it was	They were

Future Tense

Singular	Plural
I shall be	We shall be
You will be	You will be
He, she, it will be	They will be

Present Perfect Tense

Singular	Plural
I have been	We have been
You have been	You have been
He, she, it has been	They have been

Past Perfect Tense

Singular	Plural
I had been	We had been
You had been	You had been
He, she, it had been	They had been

Future Perfect Tense

Singular	Plural
I shall have been	We shall have been
You will have been	You will have been
He, she, it will have been	They will have been

Let us try and work out one, individually.

The choice of the subject is- '**They**' and the verb form is **'ing'**

PRESENT	PAST	FUTURE

11.2 Present Tense

Simple Present Tense

So you see, the simple present tense denotes the present time. Let us the various uses of the present tense.

It is used to refer to actions which are part of a routine or those that happen at regular intervals.

Helen **works** in an airline office. (Habitual Action)
Geese **fly** south every autumn. (Part of a routine)

The present tense is used to express general truths like proverbs and accepted facts.

The sun **rises** in the East. (Accepted truth)
A stitch in time **saves** nine. (Proverb)
Honesty **is** the best policy.

Headlines in newspapers are always stated in the present tense. Note that the news being reported has already happened the day before!!

Government **explores** increases in IT exemptions limit.
Cement companies **see** dip in profit margins.

Occasionally, the simple present form may be used **to express future time**. The ground rule to be remembered in this context is that this incidents that you are reporting in future should be something which is in the immediate future and which you are sure will happen.

I leave for Mumbai tomorrow night.
Our lease on the factory **expires** tomorrow.

The simple present is also used **to give instructions**. Read any instruction booklet or a recipe and you will see it for yourself.

11.3 Activity 14: Instruction Manual

Subject: Simple Present Tense

Aim: To practice the use of simple present tense.

Props: Paper and pen

Instructions: Students to work individually.

Facilitator to revise the use of simple present tense.

In this context, the participants are asked to prepare an instruction leaflet with about 8 to 10 instructions.

Handouts may be created on any of the following:

Starting of the laptop

Recipe for a successful career

Preparing for an interview

Debrief:

What have I learnt? : -- --- --- --- -----------------------

Present Continuous Tense

The continuous or progressive form of a tense indicates that the action is continuing at the time stated by the particular tense.

The progressive form of the verb is made by using some form of the verb- **to be** with the- **ing** form of the principal verb. This form is called the present participle.

For example,**" I am studying."**

In this sentence the progressive form of the verb is – am studying. It is made up of the verb from of be which is – am to match with the pronoun- I and the present participle of the principal verb, which is **studying.**

The present continuous tense is used to express an action that is continuing to happen at the moment of speaking or writing.

> I **am cooking** breakfast.

> I **am working** on my assignment.

At times, this form of the tense like the simple present is used to express a future event.

> I **am going** to America next week.

> We **are leaving** for Greece next week.

11.4 Activity 15: Commentary

Subject: Present continuous tense
Aim : To practice the use of present continuous tense.
Props : none
Instructions:

Participants to work in group of four.
Each group should have one person give a commentary to the group. The person should speak as if he or she is currently observing the activity.

Topics that they can give a commentary on:

A police man at the traffic signal reporting on traffic movement
A football match
A beauty pageant
An accident on the over bridge

Debrief:

What have I learnt? : --

Present Perfect Tense

 In English grammar, the word perfect implies that an action has been perfected or completed at the time of the action.

Look at these sentences:
    I **have done** the assignment.
    She **has answered** half of the tricky questions.

In the first example, the use of the perfect tense (have done) states that at the time of speaking the assignment has already been completed. While in the second example, (has answered) it indicates that at the time of speaking half the tricky question have been answered.

The present perfect is used to talk about experiences:
    Arpita has never broken a bone.
    Have you ever eaten pasta?

To talk about an action in the past that has a result in the present.
    I have lost my identity card.
    Have you finished your assignment?

Present Perfect Continuous Tense

This form of the tense is used to express continuous action which have already been completed.

Look at this sentence:

    The cab **has been waiting** for two hours .

  This indicates that the time of writing or speaking the sentence, the cab has completed two hour of waiting.

The present continuous tense uses two auxiliaries- **have** or **has** and **been.**

11.5 Past Tense

Simple past tense

The formation of the verb in the simple past requires you to familiarize yourself with the irregular verb forms. Please go through the verb form chart given in the chapter on verbs.

The simple past states actions that have occurred at regular intervals in the past.

Last year, **I drove** to electronic city everyday.

It can also be used to describe situations which existed for a span of time in the past.

Millions of years ago, the mammoth **inhabited** the earth.

It can also be used to talk about certain actions which happened at a definite time in the past.

I **graduated** from school in 1998.

It can be used to list a series of actions completed in the past.

I finished reading, walked to the market and bought some books.

11.6 Activity 16:The Chain List

Subject: Simple past
Aim : To practice the use of simple past tense
Props:
Instructions: Facilitator to tell the participants that this activity involves both grammar and memory power as well.

The focus is on using the appropriate form of the verb in the simple past.

Facilitator to start the activity with a sentence such as

"I woke up in the night".

Following this she points to another participant.

This participant has to repeat the sentence and follow up with one of his/ her own.
For example:

"I woke up in the night and drank a glass of water."

He / she now points to another participant, who continues with the repetition and adds one of his/ her own.

Continue till all participants have had a chance. Chances can be repeated again and names called out at random to prevent anticipation of terms and prior preparation.

Debrief:

What have I learnt? : --- --- --- --- ----------------------

Past Continuous Tense

This form of the tense indicates a continuous action in the past.

They **were playing** billiards last afternoon.

He **was holidaying** in Mauritius last summer.

It can also be used to indicate an ongoing action which was happening when something else occurred in the past.

For example:

I **was cleaning** the room when the door bell rang.

In this sentence the use of the past continuous indicates that the action of cleaning the room was happening when the door bell rang.

Past perfect tense

This is used to indicate an action in the past which was already completed by the time or before another action took place in the past.

She **had seen** the car before **I saw** her.

I **had finished** my homework before **I prepared** dinner.

In both these examples the verbs- **had seen** and **had finished** are in the past perfect tense while the verbs **saw** and **prepared** are in simple past. The use of the perfect tense here, indicates that the action of seeing the car and finishing the home work were already completed by the time the actions expressed by the verbs in the simple past happened.

It is also used to talk about a past conditional.

If she had **studied harder**, she **would have** passed the exam.

I hope this is clear to you.

Subject: simple past and past progressive

Aim: to practice using tense forms

Instructions: show the class a short movie clip of about five minutes.

While they are watching the movie clip, the participants must be told to make notes.

Divide the class into groups of four and ask them to compare notes.

Working as a group they write the summary using the simple past and the past progressive.

The clip is played once more if it helps to fill in the missing gaps.

The participants then read out their summaries to the class while the facilitator checks for errors.

Debrief:

What have I learnt? : -- -- -- -- -----------------------

Past Perfect Continuous

This form of tense refers to a continuous action in the past, already completed by the time another action also in the past took place.

I **had been waiting** for two weeks before I received the offer letter.

He **had been thinking** about his manager shortly before he called.

As in the previous example the verbs **had been waiting** and **had been thinking** refer to a continuous action and are in the past perfect continuous tense. It indicates that the actions were completed by the time the action denoted by the verbs **received** and **called** in the simple past were completed.

11.8 Future Tense

Simple Future Tense

This is used to express actions which may take place in the future.

      They **will finish** the test tomorrow.

      He **will arrive** in Delhi on Saturday.

Like we discussed earlier, the simple future is formed from the auxiliary verb- **will and shall** – **followed** by the simple present form of the verb.

Future continuous tense

This is used to express ongoing actions which may take place in the future.

      She **will be waiting** for them.

      They **will be coming** tomorrow.

11.9 Activity 18: This Week for You

Subject: Future tense

Aim : To practice the use of future tense

Props: Sheets of paper.

Instructions: Facilitator to explain to the participants that they will write the week's prediction on a slip of paper and deposit it in a basket in front of the class. Remind them to use the forms of future tense. (explain how most magazines or newspapers have a horoscope column.)

The prediction should be pleasant and have an element of fun. Keep away from morbid predictions.

The prediction could be about 6 to 8 sentences.

Once everyone has submitted their slips of paper, juggle it.

Everyone picks up a slip and that is your forecast for the week.

The facilitator can discuss any errors that have come up in the writing.

Debrief:

What have I learnt? : --

Future perfect tense

This is not an oft used form of tense. It refers to an action which will be completed by a certain time in the future. It shows an action that has started sometime in the past or is starting in the future and will also get completed at some point of time in the future.

She **will have started** the project by Thursday.

I **will have cleaned** up the house before the family arrives.

The use of these verbs indicates that the action of starting the project and cleaning the house will have been completed before Thursday and before the family arrives.

Future perfect continuous tense

This form is used to express a continuous action which will be completed by a particular time in the future.

By next March, you **will have been training** for a year.

He **will have been working** for two years by the time he finishes his studies.

The action of training and working would have been completed before the coming of March and before two years is completed.

11.10 Activity 19: Verb Grand Prix

Subject: Verb tense

Aim: To practice all forms of tense

Props:

Instructions: Ample space for movement.

Divide the group into four teams.

Allocate each group- a section of the blackboard and give each team a marker.

The facilitator calls out three words at a time relating to time, gender and activity.

For example- She, basketball, yesterday. The facilitator shouts- go- immediately following this.

One student from each group runs to the board and in the space allocated writes a sentence using the three words given.

For example-

- She played basketball yesterday.
- She watched a game of basketball yesterday.

Participants cannot write out a sentence on paper and then copy it onto the board.

They can ask for assistance from the team if needed.

Allot points to the teams based on which team finishes first.

Debrief:

What have I learnt? : --- --- --- --- ----------------------

STOP ! GO BACK AND REFLECT !

I learnt ………………………………………………………………………………………………….

I would like to know more about …………………………………………………………………………….

Activities / tasks I liked / found useful……………………………………………………………………

Something I would adapt / do differently……………………………………………………………………

Evaluation papers

Paper 1

Basics of grammar

Choose the correct option from the choices listed below each question. You have 15 minutes to complete the 30 questions.

1. The crowd _____ restless as the day got hotter.
    a) was getting
    b) were getting
    c) is getting
2. People _____ running away in all directions.
    a) was
    b) is
    c) were
3. Her _____ must have cost her a lot of money.
    a) jewellery
    b) jewelleries
    c) jewelers
4. I have always wanted to own _____silver coloured car.
    a) a
    b) an
    c) the
5. Close _____ and then the other.
    a) a
    b) an
    c) one
6. _____telephone has had an enormous impact on the way we communicate.
    a) A
    b) An
    c) The
7. The _____faulty.
    a) equipments are
    b) equipment was
    c) equipment were
8. "We need new curtains." Okay let's buy_____
    a) ones
    b) one
    c) some
9. I asked James to clean the car and he did_____

a) a well job

b) the job good

c) a good job

10. I still feel very tired _____ in the morning.

a) when i wake up

b) as i wake up

c) while i will wake up

11. My mother was the first person I saw_____ the hospital

a) by leaving

b) on leaving

c) in leaving

12. It is Vijay's birth day some time _____ the middle of June.

a) in

b) on

c) at

13. Your writing is bad but mine is _____

a) badder

b) worse

c) worst

14. The waitress _____ an extra cup of tea.

a) give

b) gave

c) giving

15. The enemy _____ of the public buildings.

a) has bombed

b) had bombed

c) will have bombed

16. They _____ the train if they don't hurry.

a) are missing.

b) will miss

c) will have missed

17. Each year we_____ to Istanbul for a holiday.

a) are going

b) go

c) went

18. If you look carefully, you _____ find writing scratched on the window pane.

a) can

b) shall

c) are going to

19. She speaks French _____.

a) fluent
b) fluently
c) more fluently

20. What have we got _____?
a) for the dinner
b) for a dinner
c) for dinner

21. I try to visit my relatives in my home town_____other month.
a) every
b) each
c) some

22. The _____ notice the boy lying on the pavement.
a) passer by
b) passers by
c) passer bys

23. A number of refugees _____turned back at the border.
a) has been
b) have been
c) will have been

24. As I walked, the dog _____ towards me.
a) came charging
b) is charging
c) had charged

25. He based his calculation _____ survey statistics.
a) on
b) in
c) by

26. _____ of the countries voted against the sanction?
a) Who
b) Which
c) What

27. I can't get the laptop to work. _____ have you done to it?
a) what
b) which
c) where

28. The storm _____ have a damaging effect on the crops.
a) did
b) make
c) do

29. An important file _____ from the office.

a) disappear

b) went

c) had disappeared

30. The men worked _____ they were underpaid.

a) although

b) as if

c) because

Answers

1	a	16	b
2	c	17	b
3	a	18	a
4	a	19	b
5	c	20	c
6	c	21	a
7	b	22	b
8	c	23	b
9	c	24	a
10	a	25	a
11	b	26	b
12	a	27	a
13	b	28	a
14	b	29	c
15	a	30	a

Paper 2

Listed below are 25 sentences that need to be corrected.

1. All the dogs in the settlement were /was barking when the burglar entered the house.

2. The Recession, not to mention the falling dollar influence/influences the voting turnout during elections.

3. The monotonous sounds of the constant pounding of the waves is/ are calming.

4. The team along with the band is/are on the field.

5. Jenna or Doris writes/write to inform us about the change in interest rates.

6. Neither Irene nor Vijay was/were excluded from the meeting.

7. Neither the fruits nor the wrapping was/were inexpensive.

8. Either the nurses or the doctors was to be held responsible for the death of the patient.

9. Either Tejas or Suren is/are to attend the budget meeting in building number 36.

10. Either you or Manya is/are late for the session.

11. Neither Manya nor you is/are early for the trip.

12. The hardest hit in the tsunami was/were the farmers.

13. Each of them take/takes a good portion of the produce.

14. Five Million liters of petrol is/are a lot of oil to be illegally suctioned out of the tanks.

15. Each dog and each cat is given its own toy to play with the new kennel on Church Street.

16. Every piece of furniture has/have to be counted.

17. The jury vote/votes at 11 o' clock and the verdict will be out at five in the evening.

18. The joint planning commission is/are meeting today for a final sitting before sharing the report with the ministry.

19. The number of new recruits is/are very less.

20. A number of students has/have taken the CET this year.

21. Statistics is/are an interesting subject if you are inclined to Math.

22. The census statistics is/are often misleading.

23. The majority of us is/are in favour of the trip to Andaman.

24. Bread and butter is/are my staple for breakfast.

25. My mentor and guide is/are Mr. Thomson who was my English teacher at school.

Answers

a) All the dogs in the settlement were barking when the burglar entered the house.

b) The Recession, not to mention the falling dollar influences the voting turnout during elections.

c) The monotonous sound of the constant pounding of the waves is calming.

d) The team along with the band is on the field.

e) Jenna or Doris writes/write to inform us about the change in interest rates.

f) Neither Irene nor Vijay was excluded from the meeting.

g) Neither the fruits nor the wrapping was inexpensive.

h) Either the nurses or the doctor was to be held responsible for the death of the patient.

i) Either Tejas or Suren is to attend the budget meeting in building number 36.

j) Either you or Manya is late for the session.

k) Neither Manya nor you is early for the trip.

l) The hardest hit in the tsunami were the farmers.

m) Each of them takes a good portion of the produce.

n) Five Million liters of petrol is a lot of oil to be illegally suctioned out of the tanks.

o) Each dog and each cat is given its own toy to play within the new kennel on Church Street.

p) Every piece of furniture has to be counted.

q) The jury votes at 11 o' clock and the verdict will be out at five in the evening.

r) The joint planning commission is meeting today for a final sitting before sharing the report with the ministry.

s) The number of new recruits is very less.

t) A number of students have taken the CET this year.

u) Statistics is an interesting subject if you are inclined to Math.

v) The census statistics is/are often misleading.

w) The majority of us is in favour of the trip to Andaman.

x) Bread and butter is my staple for breakfast.

y) My mentor and guide is Mr. Thomson who was my English teacher at school.

Paper 3

Put a/an, the or zero article where necessary.

1. Are you going to party with _____ Johnsons?
2. She usually stays in _____ bed till late in the weekend.
3. There's _____ Dr. Suresh Raghavan on the phone.
4. The car has been stolen from outside ___ house.
5. Jenna bought ___ fridge and a washing machine for her mother.
6. They offered to sell her mother _____ smaller one.
7. I must buy _____ paper cutter.
8. What is in _____ sauce? It really tastes lovely.
9. There's _____ bus coming but does _____ go to MG Road.
10. What _____ great idea!

Choose the correct option from the adjectives listed.

1. Alia's dress today is _____ (pretty, prettier, prettiest) than the one she wore last Sunday.
2. This has, by far, been the _____ (bad, worse, worst) birthday ever.
3. This lecture has been _____ (useful, more useful, most useful) then Mrs. Whiteney's.
4. You are a _____ (bold, bolder, boldest) little girl.

5. I can tell you which university offers the _____ (good, better, best) courses.
6. The second half of the match was _____ (little, less, least) interesting.
7. What is the _____ (far, farther, farthest) you have ever walked?
8. She has _____ money left in her bank. (little, less, least)
9. This show is not as _____ (funny, funnier, funniest) as the previous one.
10. The priest was the _____ (tall, taller, tallest) person in that room.

Fill in the blanks with suitable Personal Pronouns

1. The manager said to his team, "When _____ (you, they) complete the tasks, please mail _____ (it, us) to me".
2. Mohammad works in the Chocolate factory. _____ (him/ he) says_____ (they/ it) is an interesting place.
3. I met Rasha at the mall yesterday. _____ (she/ they) invited me to _____ (her/ they) grandmother's house.
4. I am sure _____ (they/ them) bought the laptops from _____ (we/ us).
5. President Obama welcomed _____ (they/them) to _____(his/him) office for the cultural event.
6. I hope _____(him/he) knows that _____(me/I) was present for his class.
7. The police told_____(we/us) that due to the cyclone_____(we/us) need to vacate the house.
8. Please inform _____(she/her) that _____(I/me) have finally obtained a degree in Anthropology.
9. I am sure _____(it/they) cannot be used since _____(it/I) is broken.
10. The dog chased him and _____(him/he) ran as fast as _____(him/he) could.

Answers

Put a/an, the or zero article where necessary.

1. Are you going to party with _____ Johnsons? **the**
2. She usually stays in _____ bed till late in the weekend.   **zero**
3. There's _____ Dr. Suresh Raghavan on the phone.   **a**
4. The car has been stolen from outside ____ house.   **the**
5. Jenna bought ____ fridge and a washing machine for her mother.   **a**
6. They offered to sell her mother _____ smaller one.   **a**
7. I must buy _____ paper cutter.   **a**
8. What is in _____ sauce? It really tastes lovely.   **the**
9. There's _____ bus coming but does _____ go to MG Road.   **a, the**
10. What _____ great idea!   **a**

Choose the correct option from the adjectives listed.

1. Alia's dress today is **prettier** (pretty, prettier, prettiest) than the one she wore last Sunday.
2. This has, by far, been the **worst** (bad, worse, worst) birthday ever.
3. This lecture has been **more useful** (useful, more useful, most useful) then Mrs. Whiteney's.
4. You are a **bold** (bold, bolder, boldest) little girl.
5. I can tell you which university offers the **best** (good, better, best) courses.
6. The second half of the match was **less** (little, less, least) interesting.
7. What is the **farthest** (far, farther, farthest) you have ever walked?
8. She has **little** money left in her bank. (little, less, least)
9. This show is not as **funny** (funny, funnier, funniest) as the previous one.
10. The priest was the **tallest** (tall, taller, tallest) person in that room.

Fill in the blanks with suitable Personal Pronouns

1. The manager said to his team, "When <u>you</u> (you, they) completes the tasks, please mail <u>it</u> (it, us) to me".
2. Mohammad works in the Chocolate factory. <u>He</u> (him/ he) says <u>it</u> (they/ it) is an interesting place.
3. I met Rasha at the mall yesterday. <u>She</u> (she/ they) invited me to <u>her</u> (her/ they) grandmother's house.
4. I am sure <u>they</u> (they/ them) bought the laptops from <u>us</u> (we/ us).
5. President Obama welcomed <u>them</u> (they/them) to <u>his</u> (his/him) office for the cultural event.
6. I hope <u>he</u> (him/he) knows that <u>I</u> (me/I) was present for his class.
7. The police told <u>us</u> (we/us) that due to the cyclone <u>we</u> (we/us) need to vacat the house.
8. Please inform <u>her</u> (she/her) that <u>I</u> (I/me) have finally obtained a degree in Anthropology.
9. I am sure <u>it</u> (it/they) cannot be used since <u>it</u> (it/I) is broken.
10. The dog chased him and <u>he</u> (him/he) ran as fast as <u>he</u> (him/he) could.

Paper 4

Choose the right option from within the brackets.

1. We set _____ the Cairo office a year ago. (up, in, on)
2. We are not interested _____ your family problems. (on, in, of)
3. I am quite contented listening _____ what you have to say to me. (to, for, through)
4. I need a room to myself _____ that I can do my work quietly. (so, as, although, because)
5. _____ you left the atmosphere at Aunt Sheila's home has not been nice .(although, since, because)

6. _____ we would like to open a new branch in Mumbai, we would probably wait for another year. (since, although, when)
7. She is just _____ (a silly old woman, an old silly woman).
8. He bought a _____ (new powerful bike, a powerful new bike).
9. The weather in Africa _____ than the weather in Europe. (more humid, humider, most humid).
10. I am not keen on the burgers they serve in _____ school canteen.(a, an, the)
11. Since the monsoon is going to start I need to buy _____umbrella. (an, a, the).
12. Most wedding rings are made of _____gold.(a ,an , the ,none).
13. The flower _____ into bloom.(bursted, burst)
14. Do you know someone _____could help me fix my laptop.(who, whom, which)
15. Can you return the pen _____ you borrowed yesterday?(who, whose, whom, that)
16. The lady to ____ you sent the parcel has moved to a new address. (who, whom, whose, that).
17. She has _____ around here for a long time. (be, been, are, is)
18. Three_____ and a dozen _____ walked past my window. (mouses, mice, sheep, sheeps.)
19. The dentist cleaned my _____ with some floss.(tooth, teeth)
20. How ____ loaves of bread do we need for the party?(many, much)
21. I didn't see _____ (anyone, no one)
22. It was _____ hot to drink at once. (too, much, so)
23. Everything ____ she did that night was just right. (what, that)
24. It is considered _____ the best hotel in town. (as, to be)
25. Take _____ books and pencils with you when you go. (this, these)

Answers

    .
1. Up
2. In
3. To
4. So
5. Since
6. Although
7. A silly old woman
8. A powerful new
9. More humid
10. The
11. An
12. None
13. Burst
14. Who

15. That
16. Whom
17. Been
18. Mice, sheep
19. Teeth
20. Anyone
21. Many
22. Too
23. That
24. To be
25. These

12. Punctuation

Punctuation is used to ensure clarity, to make sense of what is being said and to structure and organise the meaning of language.

Forms of Punctuation

Full- stop, comma, semicolon, colon, question mark, capitals, quotation mark, dash, parentheses, exclamation mark

Lets see how some of the most important ones are used:

The Full Stop

The full–stop is one of the simplest punctuation marks to use. It is used:

1. To indicate the end of a logical thought in a sentence
    a. E.g.The rays of the morning sun are good for health.
2. To mark the end of a statement.
    a. E.g. We just returned from the concert.
3. To indicate an abbreviation.
    a. E.g. Inc.   Ltd.   Misc. No.
4. At the end of formal titles
    a. E.g. Mr.   Mrs.   Ms.   Dr.

However:

1. Do not use a full- stop:
    a) After a heading or a title
        30 Leadership Secrets
        Managing Change
    b) For organizational names that are abbreviated.
        FBI, FDA, IBM,
    c) At the end of brief bullet points

The Comma

A comma is used to indicate a pause or separate blocks of thought and to :

1. Separate a series of words, phrases or clauses in a list.
    e.g. Her breakfast usually includes bread, butter and jam.
    To celebrate her promotion, we went out for dinner, watched a movie and then went dancing.

2. Set off an appositive- i.e. a word or group of words that are not really essential to the meaning of the subject that they modify

   e.g. The manager, who was 35 years old, was asked to give evidence for the case.

3. After an introductory phrase in a sentence,

   e.g. while I was at work, the workmen came to the house and cleaned it.

4. With introductory words or phrases,

   e.g. On the contrary , In addition,   For instance,   As a matter of fact   etc.

5. For explanatory expressions : e.g. degrees or titles that follow a person's name, state following a city, the year from the month

   e.g. Alan Hertz, M.D.;Denver, Colorado, October, 1988

The Semi – Colon

A semi colon is used between two independent clauses that are related or closely connected. It is usually used in a place where one could use a full – stop, but chooses to use a semi – colon to show a close relationship between the two independent clauses. It is used

1. When the conjunction is omitted

   e.g. The stationery has been ordered; it will arrive on Saturday.

2. When conjunctive adverbs are used to join two sentences

   e.g The match will be played in the morning; however, the rules will remain the same.

3. To separate items that have commas in them and are in a series

   e.g. Our new offices will come up in Arcadia, Los Angeles; Jacksonville, Florida; and Denver, Colorado.

The Colon

A colon is used for material that follows as a list:
2. Before a formal list in a sentence

e.g. Your performance will be judged by: attendance, punctuality, grades.

2. Before a quotation

e.g. As Martin Luther King said: At the centre of non-violence stands the principle of love.

3. After a salutation in a business letter (in the US format)

e.g. Dear Mr. Patton:

4. Between a title and sub-title

e.g. GE Capital: The Growth Engine

5. Between the hour and minutes of a time reference

e.g. 10:45 AM

The Question Mark

A question mark is used at the end of an interrogative sentence.

1. At the end of an direct question:

e.g. Where is the office located ?

2. At the end of a statement that has a question tag:

e.g. This is not the way it is to be done, is it?

Capitals

Capitals are used:

1. At the beginning of a sentence

e.g.The sun is now behind the clouds.

2. With proper nouns

e.g.Matilda is a very bright student.

3. For words that denote a title

e.g The office held a farewell for Mr. Brown.
This year the prizes will be given out by the Principal.

4. With adjectives that are formed from proper nouns

   e.g. Her favorite gift was the Japanese fan.

5. With the names of organizations and institutions

   e.g. He started the Heather View Medical Association in 1986.

6. With days of the week, months of the years and names of holidays

   e.g Every Thursday in July, will be commemorated as Women's Day.

Quotation Marks

Quotation marks are used

1. To enclose a quotation or the exact words of a speaker

   e.g. He said, "I will see you tomorrow."

2. As a symbol for inches

   e.g. 5'6" (5 feet 6 inches)

Apostrophe

The apostrophe is used

1. To show possession

   e.g. Mathew's bicycle ; the vendor's cart ; my mother-in-law's opinion

2. As a single quotation mark to indicate a symbol for feet

   e.g. 6'2" (Six feet, two inches)

ACTIVITY

Steps: Give the class the following instruction. Re-write the passage with the punctuation you think is appropriate**.**

Concept check: To make sure that the participants have understood the usage of the various punctuation marks ask questions to check understanding along with an example.

Re-write the passage below making sure to insert the correct punctuation

The first generation to come of age in an era of widespread divorce has now grown up because they lived it these men and women know that even a good divorce carries away a heavy burden that shapes their moral identities for years they also know what they want a home a strong marriage and a sense that society understands what it's like to grow up as they did above all they want a secure world for their own children one world not the two they grew up flying between like footballs kicked high in the summer sky

KEY

The first generation to come of an age in an era of widespread divorce has now grown up. Because they lived it, these men and women know that even a good divorce carries away a heavy burden that shapes their moral identities for years. They also know what they want: a home, a strong marriage, and a sense that society understands what it's like to grow up as they did. Above all, they want a secure world for their own children. One world, not the two they grew up flying between like footballs kicked high in the summer sky.

ACTIVITY

Steps: Get the participants to read the sentences given below and re-write them using correct capitalization and punctuation.

Concept check: Ensure that the participants are thorough with the usage of both capitals and punctuation marks.

1. When astronaut Neil Armstrong stepped out of the lunar module he said one small step for man one giant step for mankind

   …………………………………………………………………………………………
   …………………………………………………………………………………………

2. I enjoyed mark bunyans column the sonorous snore in the people magazine

……………………………………………………………………………………………
……………………………………………………………………………………………

3. The forum mall in Bengaluru Karnataka is listed as one of the Asia's largest malls.

……………………………………………………………………………………………
……………………………………………………………………………………………

KEY

1. When Astronaut Neil Armstrong stepped out of the lunar module, he said," One small step for man; one giant step for mankind."

2. I enjoyed Mark Bunyan's column: "The Sonorous Snore" in the People magazine.

3. The Forum Mall in Bengaluru, Karnataka is listed as one of the Asia's largest malls.

Evaluations

1. **Write an email to renowned celebrity in your town to invite him/her to a meeting or event at your college**

   Suggestions
   - Explain the function that you would like them to attend
   - Would he be required to speak?
   - Preparations needed
   - Details of time /venue and date
   - Arrangements to pick and drop the celebrity
   - Directions to the venue
   - Confirmation of acceptance or rejection

2. **Write a paragraph of 300 words on any one of the following topics.**

a) India in 2050
b) My life
c) A memorable holiday (vacation)
d) An ideal weekend getaway

3. **Read the paragraph below and make a list of synonyms which you can use to replace the words in bold**

He **ran** away quickly down the street. He looked anxiously, left and right. He felt **tired** and unhappy to be running away from home. He stopped on reaching the crossroads. He knew he would miss the **wonderful** food at home. Life was going to be **difficult**, he knew it. Yet, he felt **good**, knowing that he was not answerable to anyone.

Ran:

Good:

Difficult:

Wonderful:

Tired:

KEY:

Darted, dashed, sprinted, scurried, rushed

Great, wonderful, fine, all right, okay

Hard, tricky, not easy, complicated, risky, complex

Appetizing, yummy, scrumptious, tasty, mouth watering

Worn out, drained, exhausted, weary, fatigued

UNIT-III: READING COMPREHENSION

Reading – A 7 Step Process

1. **Recognition** - of the alphabet, the words and punctuation symbols.
2. **Assimilation** - of what is read and communicated through the eyes to the brain.
3. **Integration** - or basic comprehension of the matter being read.
4. **Association** - with previous knowledge connecting ideas appropriately.
5. **Retention** - storing the facts effectively.
6. **Recall** - being able to retrieve the stored information, especially when required.
7. **Communication** - being able to put the information to use immediately in a form that is easily and completely understood.

Therefore, what is necessary to be able to read effectively?

- **Vocabulary practice**
- **Instruction or reading comprehension**
- **Reading practice**
- **Reading aloud**
- **Oral summary – of the text that was read**
- **Noting of key facts**
- **Prediction , summary , questioning , clarification of parts of a text**
- **Written summary - after every paragraph**
- **Promoting remembering**

Techniques to enhance students' reading skills

Prior knowledge – Using what we already know of a topic or subject to understand something new is a good way to give a background to reading any text.

Making connections with other related text or experiences – Similar to having prior knowledge, understanding text through some other text that they have already met or relating it to an experience they have had, will help to give a wide-ranging appreciation of the context of what is being read.

Questioning – Asking relevant questions will help to reinforce the text.

Testing understanding – Testing a reader's understanding is important with the help of exercises that would be indicative of how much was grasped.

Evaluating – Evaluating or making judgments about what is read and explaining why the judgments were made is a good way of analyzing the text.

Application – Any learning must be application – oriented to be successful. Readers should be able to read any text, follow the same steps and be able to comprehend what they have read.

Visualizing while reading – Creating an image or a movie in their minds while reading is a very good memory technique. It ensures that the content is not easily forgotten.

Making inferences – Readers do actually make sense of clues in the text to understand the meaning of what is written. Figuring out what is meant from clues given in the text, is much like being a detective and solving a mystery.

Discussing the text – Higher level thinking can be promoted by discussing what has been read. Group discussions on the topic that is read will add a larger dimension to the text.

Making judgments – Gauging how well, the text covers the topic or understanding the stand taken by the author and whether the text is truth or fiction related, is an essential part of reading to understand. It also gives the students a questioning mind and helps them to better appreciate the nuances of reading.

Types of reading skills

Skimming

This technique is used to understand the main idea of the text. The way to do it is to run your eyes over the text and make a mental note of the important information. It is not necessary to make sense of every word.

When do we use the skimming technique?
While reading newspapers, magazines, pamphlets or brochures. We do not take in the entire text.

Scanning

In this method, it is only specific information that is being sought. We run our own eyes over the text, looking for numbers, words, phrases, etc.
E.g. While looking for dates or amounts on an Accounting Sheet, Names of people, places , or certain key phrases from the Newspaper or Travel brochures, Timings or names of Places in a Train or Air Travel Schedule.

Again, there is no need to try and understand each word while scanning.

Extensive reading

We generally use this method while reading for fact or fiction for pleasure. Longer texts are read at length, but again it is not necessary to understand every word of every line.

E.g. We do extensive reading of self – help and business books, magazine articles, or fiction that one may read at night or to relax.

Intensive reading

Normally, intensive reading is done for shorter books or text that needs to be studied for examination or detailed understanding.

Here it would be crucial that every word is understood. The process of reading is far slower and more laboured.

E.g. For more important documents where understanding every word matters: reports, contracts, sale deeds, legal documents etc.

Reading Cues

Three important cues must be kept in mind for a reader to be successfully independent.

An integration of the three cues will help a reader to efficiently predict words and thoughts from the text. Getting a confirmation of the accuracy of what one has understood and being able to correct one if one goes wrong is also a key factor to reading well.

1. **Meaning (Semantics)** : Background knowledge of the vocabulary and understanding of words used in a text is necessary. The context of the sentence or the paragraph or even the whole text is important to be able to figure out what the text is really about. A reader has to constantly evaluate the information he / she takes in and analyze whether it makes sense.

2. **Syntax or Language Structure:** Knowledge of English grammar is required to make sense of the text.

3. **Visual information**: A reader has to use all the information in the text to make sense of what he/ she is reading. E.g. details of formatting, letter- to – sound associations and punctuation.

   As a reader moves towards his / her goal of being more efficient and accurate readers, he / she could be encouraged in the process. All readers, in the initial or advanced stages of reading, do tend to make errors of judgment in the cues for reading.

However, unless the error changes the meaning of the sentence giving the text a totally different context, it is preferable to overlook small errors of misjudgment which could be termed as Miscues. Readers may substitute their own words for the actual words that appear in the print, yet the goal is to get them to make sense of what they read by understanding the meaning of the text. Hence, unless this is compromised, the small errors can be ignored.

Some of the ways in which a reader can be helped along in the journey of reading are:

1. Ask the reader to look at the picture. If there is no picture, get the reader to draw upon his / her imagination of the scene.
2. Encourage him / her to re-read the sentence if the meaning of the sentence was not understood. It improves the word prediction ability.
3. Check with the reader whether what he / she is reading makes sense.
4. If a word is not understood the reader can move on to the end of the sentence leaving out the difficult word. This would help the reader to get a sense of the context and maybe figure out a word that may fit as a substitute.

A reader should be able to identify the main ideas in the text he/ she reads.
What are some of the ways in which a reader can do this?

Being able to infer - i.e. deduce or understand the context of what he / she reads is another important point.

One way to ensure understanding is to get the reader to summarise the text that has been read.

Questions should be asked about the text that has been read to unable the deeper understanding of the context of the subject.

Three levels of Reading
The reader should use the three levels of reading to be able to completely understand what he / she reads:

1. **On the lines -** This is the sense made at the literal level of the text. It is what the author has said and it is clear what opinion the reader should have. This requires the reader to have previous knowledge of the language the text is in, to be able to recognize and make sense of the grammatical structure and the meaning of the words in the text.
   This level is the basic level of reading. A reader should at least be able to understand the literal meaning of the text.

2. **Between the lines -** At this level, the reader is making inferences about the interpretation of the text by trying to understand what the author meant. The reader would have to draw on his / her own prior knowledge and experience to be able to construct the meaning of the text.

   This could be considered a secondary level of reading where the reader is able to draw meaning from the text which is deeper than the literal or obvious meaning.

3. **Beyond the lines -** This is where the connections are made outside of and within the text. The reader has to critically evaluate the text in order to identify if he / she is able to understand what the author is trying to say. The reader is expected to differentiate between the information in the text which is the author's opinion against his / her own.

   This is an advanced level of reading. It will take time and a lot of reading practice for a reader to get to this level.

   Speed Reading

   Speed Reading is a method of rapid reading where we skim through the text and read only words that are relevant to the context. With practice, the speed with which we can do this could be improved. However, the rate of comprehension should not be compromised.

   Earlier it was believed that our reading speed was like our adult height or the colour of our eyes – unchangeable. However, appropriate mental and visual exercises can improve our speed of reading. This can be achieved with focussed practice and the correct method of Speed Reading.

   According to Tony Buzan, in his book, 'Speed Reading', he says that "Reading is to the mind as aerobic training is to the body". He adds that if a reader improves his / her reading speed, he / she would be able to think a lot faster and more creatively.
   While studying, he / she could take better notes and pass exams with greater ease because he / she was able to study more effectively. All this would save time not just in days but perhaps, even months.

   Barriers to speed reading

   Reading word by word – Initially , this is how we learn to read – one word at a time. This method reduces speed and comprehension. However, with time, we need to be able to take in a few words in a glance.

Reading aloud - Most of us have a tendency to read aloud, and if not, we tend to read the text ' aloud' in our minds – sub- vocalizing the text. This habit also reduces reading speed.

Re – reading - Going back to what one has read is a waste of time. This could happen because something was not understood, or not absorbed the first time due to a lack of concentration. Increasing vocabulary and noting down a word that was not understood and checking it later is a good way to proceed. It would be better to go by the general meaning of the word from the context.

Reading too fast - If the text is being skimmed faster than it is being understood, the reader will miss the main points of the matter and his / her ability to process the information being read would be diminished. This would make the exercise pointless. Besides, it will require the reader to re-read the text and hence slow him / her down.

Improving your reading speed

How could one improve one's reading speed? This is a question that is often asked. Here are some tips:

1. Check your normal reading speed and comprehension – Read a passage. Time yourself while you do this and then ask yourself questions about what you read to check for comprehension.
2. Repeat the process and in time you will see a difference in the quantum of material that you are able to assimilate in shorter time spans.
3. Your concentration, memory, creative thinking, imagination and ability to assimilate new information will improve drastically as you keep practicing speed reading.
4. Constantly check your comprehension ability to ensure that you get the most of the reading you are doing.
5. Practice chunking. Read a group of words or a phrase at a time. Move your eyes from the left to the right and then diagonally to the next line.
6. Ensure that you only stop to glance at the words once. Hence, you have two stops per line.
7. In time your eyes will get used to absorbing the text in chunks and will begin to make sense of the text. You will find yourself reading larger chunks in shorter span of time.
8. Use your mind to concentrate on the reading. Concentration is key to understanding, retaining, and recalling what you read.

```
┌─────────────────────────────────────────────────────────────────┐
│  STOP !  GO BACK AND REFLECT !                                    │
│                                                                   │
│                                                                   │
│  I learnt ……………………………………………………………………………………………….          │
│                                                                   │
│  I would like to know more about …………………………………………………………………………  │
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```

Reading Comprehension Practice Exercises

Activity 1: Read the passage and answer the questions that follow:

Play outdoors for better sight

According to Kate Johnson, children are ending up spending more time inside the house doing homework on computers, and playing video games, and less time on outdoor activities. This is taking a toll on children's eyes. Kate, an optometrist who lives in Brisbane, says that children as young as six now need glasses. In her view, these children are sporting glasses due to their indoor lifestyle. The occurrences are more in children with no family history of myopia. They spend so much more time in close work with computers and reading doing the damage.

Her recommendation is that children need to be encouraged to run outdoors and look more at objects in the distance for better eye – health. Parents have to enforce a balance in the time spent indoors.

Research findings of Kara Schmidt, Associate Professor, are that it is not simply looking into the distance that prevents myopia, but actually being outside in the sunlight. Sunlight helps in the release of high amounts of retinal transmitters. One of these is dopamine which prevents the eye elongation that is caused by spending long periods doing intense 'near' work.

1. Playing outdoors causes eyesight to go weak.
   (a) True
   (b) False*

2. What does the word 'sporting' mean in line 5 ?
   (a) games   (b) spotted   (c) wearing *   (d) for sports

3. What does Johnson say is helpful about looking at objects in the distance?
   (a) Children can do their homework better on computers.
   (b) It would have a beneficial effect on children's eyesight.*
   (c) Playing video games would be more fun.
   (d) It would improve their balance problems.

4. Katrina Schmidt explains that sunlight releases high transmitters for retina.
    (a) True*
    (b) False

5. What is the role of dopamine that is released by exposure to sunlight?
    (a) It prevents eye elongation*.
    (b) It reduces the history of myopia.
    (c) It will reduce the time spent indoors.
    (d) It will increase the time spent outdoors.

6. What does the phrase 'taking a toll' in line 3 mean? Choose the answer that most closely fits the meaning.
    (a) Taking a fee for spending time indoors.
    (b) Taking a nap in the afternoon would help.
    (c) Causing damage to their eyesight*
    (d) Causing them to lose in the video games.

7. What does the term 'as young as six' in line 4 mean?
    (a) Six young children play sports with glasses.
    (b) Six children have changed their lifestyle and wear glasses.
    (c) At the young age of six, children are wearing glasses.*
    (d) The optometrist has six young children who wear glasses.

8. What does the passage recommend for young children?
    (a) Children should spend more time outdoors playing in the sunshine.*
    (b) Children should spend more time indoors doing their homework.
    (c) More children should begin wearing glasses at the age of six.
    (d) Children should learn how to balance themselves on the see-saw.

9. What is the reason that children's eyes are being damaged?
    (a) Doing homework near the computers.
    (b) Playing video games inside the house.
    (c) Spending time reading indoors.
    (d) Spending more time working closely with computers.*

Activity 2: Read the passage and answer the questions that follow:

The Coming of Fire

One of the most important things the men of long ago found out was how to make and use fire. No one knows who first discovered this. Perhaps they found fire burning on the edge of a peat moss, and at first they were frightened. But when they knew how warm and comfortable fire made them feel, they wanted to make it for themselves.

We are not sure what they did to make fire. Perhaps they rubbed two dried sticks together until they became alight. When once the fire had begun they fed it with wood, and kept it going all day and all night.

Just try to think what a difference having fire made to these early people. It warmed them, it roasted the raw meat, and it frightened away the wild animals. All animals fear fire. Watch your dog or cat when a spark jumps out of the fire.

Extract from " The Stream of Time" by S.O. Ambler & The Coatman

1. What was one of the most important things that man found out long ago?
   (a) The burning edge of peat moss.
   (b) How to make and use fire*.
   (c) That they could be frightened.
   (d) They knew who discovered how to make fire.

2. How did man first react to fire? Which of the following was the most significant reaction?
   (a) They were surprised that it made them warm and comfortable.
   (b) They discovered how to keep a fire going all day and night.
   (c) They found their dogs and other animals afraid of fire.
   (d) They wanted to make fire for themselves.*

3. What more would be a good substitute for the adjectival phrase " of long ago"?
   (a) Longest   (b) Ancient *   (c) Aged   (d) Omniscient

4. Look up the dictionary for the meaning of the word 'alight'. Do you know if it has more than one meaning?

   Alight   -
   ……
   ………………
   [Answer -: Alight- verb forms
   i.   To come down and settle as after flight: a bird alighting on a twig.

ii.   To get down, as from a vehicle; dismount: the lady alighted from the train.
iii.   To come by chance(archaic form): alight on a successful alternative.
                    Alight- adjective forms

iv.   .Burning; lighted: the match he threw out of the window was still alight.
v.   Illuminated : the tiara was alight with a million starry diamonds.]

5. Write down 3 things that fire would be useful for, in the lives of the early men?

   (a) …………………………………………………………………………….
   (b) …………………………………………………………………………….
   (c) …………………………………………………………………………….

*******************************END*****************************