

**Sri Satya Sai University of Technology
& Medical Sciences,
Sehore (M.P.)**



**Syllabus for Ph. D.
Entrance Test**

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Research Methodology

- Scientific principles of research inquiry. Steps in research process. Relevance of literature review. Hypothesis Testing (Directional Non-directional). Rationality of Experimental and Non-experimental research designs, Mixed designs, Factorial design, Correlational research design. Steps in writing of research reports.
- Types of research - Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical and Stages in Research Process, Concept of theory, empiricism, deductive and inductive theory. Characteristics of Scientific Methods. Ethical and Moral Issues in Research, Plagiarism, tools to avoid plagiarism - Intellectual Property Rights - Copyright laws - Patent rights, Reproducibility and accountability.
- Test, Measurement and Evaluation in Research. Data and its types, Methods of data collection (quantitative and qualitative). Population and sampling techniques. Classification of Test (Standardized and teacher made tests). Construction of test and its Standardization. Criteria of test Selection. Tests for general motor ability and Sports Skills.
- Concept of Statistical inference, Significance and application of parametric and nonparametric tests in research. Measures of central tendency and Variability and their uses. Normal probability curve. Reliability of statistics and test of significance. Correlational and regression techniques. Scaling techniques and criteria for selecting appropriate statistical test of analysis. Issues related to interpretation of quantitative and qualitative research findings.
- Application of computer in research. Generating charts/ graph in Microsoft Excel, power. Point presentation, Web Search: Introduction to Internet, Use of internet and WWW. Using search engine like Google, Yahoo etc.

BOTANY

1. MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

- Structure of atoms, molecules and chemical bonds.
- Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
- Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). F. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).
- Stability of proteins and nucleic acids.
- Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

- **Membrane structure and function**
(Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes).
- **Structural organization and function of intracellular organelles**
(Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).
- **Organization of genes and chromosomes**
(Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).
- **Cell division and cell cycle**
(Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).
- **Microbial Physiology**
(Growth yield and characteristics, strategies of cell division, stress response)

3. **FUNDAMENTAL PROCESSES**

- **DNA replication, repair and recombination**

(Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

- **RNA synthesis and processing**

(transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

- **Protein synthesis and processing**

(Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).

- **Control of gene expression at transcription and translation level**

(regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

4. **Cell communication and cell signaling**

- **Host parasite interaction**

Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behaviour by pathogens, virus- induced cell information, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

- **Cell signaling**

Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

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- **Cellular communication**

Regulation of haematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrin's, neurotransmission and its regulation.

BIOTECHNOLOGY

- **Cell Signaling, Cell Death, Cell Renewal and Cancer:** Cell Signaling pathways, apoptosis, role of cell survival factors, development and causes of cancer, tumour viruses, oncogenes, tumour suppressor genes, application of molecular biology for cancer prevention and treatment.
- **Genome Organization, Mutation and Site-Specific Recombination:** Genome size and complexity, Gene organization, Multigene families, Pseudogenes, Repetitive DNA, Hot spots, Signature Tagged Mutagenesis (STM), Gene trap vector, Gene conversion, Recombinases and their function, cre-lox recombination.
- **DNA Replication, DNA Repair, RNA and Protein Synthesis and Processing :** Prokaryotic transcription, Eukaryotic transcription: RNA polymerases and transcription factors, RNA processing and turnover, Protein folding and processing
- **Transcription Regulation in Prokaryotes and Eukaryotes :** Positive and negative control of transcription, Repression and activation, Organization and regulation of Lac, Trp and Ara operon in *coli.*, Eukaryotic activators, DNA binding domains, Transcriptional repressors, Gene silencing, Epigenetic gene regulation
- **Recombinant DNA Technology :** Tools and techniques- Restriction Endonucleases, DNA manipulating enzymes, Cloning vectors, Gene libraries, Screening strategies, DNA amplification (PCR and its types-RT-PCR, Real Time PCR, Allele specific.PCR, Multiplex PCR), DNA markers for genetic mapping (RAPD, RFLP, SSCP, SNPs, STS), Manipulation of Gene expression in *E.coli*, Heterologous protein production in Eukaryotes- *Saccharomyces cerevisiae* and Mammalian cell expression system; Gene Expression Regulation studies- Gel retardation assay, Reporter genes, DNA foot printing, HRT, HART; Regulatory RNAs (Interfering and antisense RNA) and gene expression
- **Microbial Growth, Fermentation and Improvement :** Isolation, Preservation and Improvement of industrially important microorganisms, Kinetics of microbial growth and product formation, Fermentation system; batch and continuous system, fed batch system, multistage system, solid state fermentation.
- **Bio-techniques:** Affinity chromatography, High pressure liquid chromatography (HPLC); Agarose gel electrophoresis, Pulse field gel electrophoresis, SDS-PAGE, Isoelectrofocussing, 2-Dimensional electrophoresis, ELISA, flow cytometry, Hybridoma technology
- **Bioinformatics:** Biological Databases, Information Retrieval from Biological Databases, Unique Requirements of Database Searching, Heuristic Database

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Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAS

- **Gene Cloning:** Tools and techniques-Purification of total cell DNA and plasmid DNA, Yield Analysis, Nucleic acid hybridization, Restriction Endonucleases, DNA manipulating enzymes, Cloning vectors- Plasmid, bacteriophage, phagemid, cosmid and YAC, Gene libraries- genomic library, cDNA library, Screening strategies- Colony and plaque hybridization, Abundancy probing, Heterologous probing, Immunological screening.

COMPUTER APPLICATION

1. Operating System

- **Operating system concepts**, Processor Management: Concepts, Algorithms for batch processing Memory Management, Concurrent Processes: Mutual exclusion and synchronization, Techniques of inter process communication, Deadlock handling File Management: Operations on a file, structure of a file system Free block list, directory structure, sharing and protection of files , file system Reliability, Unix file system.
- **Device Management:** Goals of input/output software design, Structure of device hardware and software. Layers of I/O software, structure of device drivers, Disk driver, disk arm scheduling algorithms, terminal driver, clock driver etc.

I/O devices. Introduction to network and distributed operating systems Case Studies: Unix/Linux, **Windows operating system**, Unix/Linux commands. File system and process management commands, Shell, Pattern matching, Navigating the File Systems. Unix editor. Shell programming, Adding and removing hardware. Performing backups and restore. Disk space management.

2. Programming Languages

- **Programming in C:** Elements of C, Identifiers, Data Types, Control Structures, Iteration, Structured Data Types: Array, Structure, Union, Strings, Pointers, Functions, Parameter Passing to Functions, Recursion.
- **Programming in C++:** Structures, Variables in C++, References, Function Overloading, Default Values for Formal Arguments of Functions, Inline Functions. Class and Objects: Introduction to Classes and Objects Constructors, destructors, friend function, dynamic memory allocation, Inheritance, Overloading, Polymorphism, Templates.
- **Programming in Java:** Features , Object -oriented programming overview, Introduction of Java , How to write Java programs, Data Types, operators, Naming Conventions Introduction to Class, Objects, Methods and Instance Variables, Initializing Objects with Constructors. Static Method, static field, String Handling , Arrays, Using Command-line Arguments. final Instance Variables, this reference, static import, Method finalize , Overloading methods, Parameter passing. Inheritance, Polymorphism, Packages and Interfaces, Exception Handling, Streams and Files, Multithreading, GUI in JAVA, Applets, Generic and Collection API, Database connectivity: JDBC

3. Data Structures and Algorithms

- **Data & File Structures:** Arrays, Linked Lists, Doubly Linked Lists, Circularly Linked Lists, Queues, Priority Queues, Stacks, Postfix, Prefix Representation

and Evaluation, Trees, Binary Search Trees, Heaps, Graphs, Records, Sequential Direct, Indexed Sequential, Relative Files, Inverted Lists, Multilist, Hashing, AVL Trees, B- Tree, B+ Tree.

- **Design & Analysis of Algorithms:** Asymptotic notation, Asymptotic analysis (best, worst, average cases) of time and space, Sorting, Searching, Recursion, Graph (Spanning tree, connected component, shortest path), Divide-and-Conquer, Greedy Approach, Dynamic programming, Basic concepts of complexity classes -P, NP, NP-hard, NP-complete.

4. Computer Networks

- **Basic of Computer Network:** Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), OSI model, TCP/IP model, Encoding and Modulation, Multiplexing, Switching, Transmission media, Flow control, Error detection and correction, Multiple access protocols, IPv4, IPv6, Routing algorithms, Multicasting, Congestion control,
- **Wireless Personal Area Network,** Wireless Local Area Network and Internet Access. Mobility management, Security. Cellular telephony, Mobile communication, Satellite Systems, Mobile IP, goals, assumptions requirements, entities & terminology, IP packet delivery, tunnelling and encapsulation, Feature & format IPv6, DHCP, TCP over Wireless. Ad Hoc networks, CODA,

5. Database Technologies

- **Database Management System:** Introduction to data base system concepts : An overview of a data base system , basic data base system terminology
- **Database Model :** ER-model, Relational model (relational algebra, tuple and domain calculus), Structured Query Language, Transactions and concurrency control, Distributed Databases.
- **Normalization:** functional dependencies, Normalization, Normal form and removing anomalies from the relations. De-normalization and merging relations. Database Integrity, Transaction Management, Concurrency & Recovery, Query processing, Query optimization, File Organization: File organization, Organization of records in files, basic concept of Indexing, ordered indices: B+ tree & B tree index files. RAID. Object Oriented Databases, Spatial Databases.

6. Logical Organization of Computer

- **Digital Logic Design:** Number System, Data Representation and Computer Arithmetic, Logic Gates, Combinational and Sequential Circuits.
- **Boolean Algebra:** Basic theorems and properties of Boolean Algebra, Boolean Functions, canonical and Standard Forms, Other logic Operations, IC Digital Logic Families.
- **Sequential Logic:** Introduction, FLIP FLOPs-RS Latches/FF, Master-Slave Flip-

Flop Level Clocking , D-Latches and flip flop, JK Flip-Flops, T-Flip Flop.

7. **Software Engineering:**

- **Introduction to Software Engineering:** System Development Life Cycle (Steps, Water Fall Model, Prototypes, Spiral model), Software Metrics(Software Project Management),Software Design(System Design, Detailed Design, Function Oriented Design, Object Oriented Design, User Interface Design, Design level metrics), Coding and testing .
- **DNA Amplification, Mapping and Sequencing:** Polymerase Chain Reaction-Principle, Types (RT-PCR, Real time PCR, Multiplex PCR) and applications of PCR; DNA markers for genetic mapping- RAPD, RFLP, SNPs, SSCP,STS; DNA sequencing techniques- Sanger's dideoxyribonucleotide, Automated DNA sequencing, Pyrosequencing
- **Gene Expression and Regulation:** Manipulation of gene expression in prokaryotes- Problems with production of recombinant proteins in *E.coli*, Optimizing expression of foreign genes in *E.coli*; Heterologous protein production in Eukaryotes- *Saccharomyces cerevisiae* and Mammalian cell expression system; Gene expression regulatory studies-Gel retardation assay, Reporter genes, DNA foot printing, HRT, HART; Regulatory RNAs (Interfering and antisense RNA) and gene expression

8. **Microbial Fermentation and Biotechnological Improvement of Industrially Useful**

- **Microbes:** Improvement of industrially important microorganisms, Fermentation system- batch, continuous and fed batch system; Microbial production of alcohol and their improvement by genetic engineering, overproduction of primary and secondary metabolites; Biomass production- single cell protein (SCP) production
- **Bioremediation, Biosensors, Bioleaching, and Biofertilizers:** Bioremediation of fuel oils and lubricants in soil and water. Microbial degradation of xenobiotics, Biosensors for environmental applications, Indicator organisms; Microbes in oil recovery and bioleaching; Bio fertilizers.
- **Enzyme Technology:** Enzyme immobilization and its importance; enzyme inhibitors and drug design; enzymes as biosensors, ribozyme, abzyme, Applications of enzymes in medicine, textile, leather and detergent industry.
- **Plant Genetic Transformation:** Organization of plant genome - Nuclear genome, Chloroplast genome and mitochondrial genome, Transposon and T-DNA tagging, Direct and *Agrobacterium* mediated transformation, Gene silencing in transgenic plants.

9. **Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance:** Viral resistance, fungal resistance, insect resistance, herbicide resistance, various abiotic stresses.

10. **Genetic Engineering of Plants for Molecular Farming/Pharming:** Production

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of medically relevant proteins in plants, nutritional enhancement of plants (carbohydrates, seed storage proteins, vitamins), manipulation of flower colors and other value addition compounds (like industrial enzymes). Concerns about GMOs-environmental, biosafety and ethics.

11. **Applications of Animal Cell Culture:** virology, cancer research, gene therapy, drug development and cytotoxicity, animal cloning, cryopreservation of cells.
12. **Stem Cell Technology:** Basics of stem cells, Embryonic, adult and amniotic fluid stem cells, Applications of stem cells.
13. **Gene Transfer into Animal Cells and Transgenic animals:** Direct and viral vectors for gene transfer into animal cells;. Transgenic animals: Transgenic mice: Methodology and applications; Transgenic cattle, Livestock transgenesis-production of drugs using animals.
13. **Animal Genomics:** Role of animal genomics for health and biomedical sciences. Models used in animal genomics, Functional genomics and livestock traits assessment, Livestock in the post genomic era of biology and medicine.
14. **Animal Cloning:** Principles and techniques of cloning, Applications of animal cloning.

CIVIL ENGINEERING

- Stiffness Method: Transformation of axes system, Representing the imposed loads as nodal loads, Elastic supports, Support displacements, Application to various type of structures e.g. Continuous beams, Trusses, Frames and grids, Temperature effects. Flexibility Method: Particular solution, Complimentary solution, Compatibility equations, Flexibility coefficients, Application to various type of structures, Elastics supports. Finite Element Method: Introduction, Elements stiffness matrix and load vector, Triangular element in plane stress and strain, Rectangular elements in plate flexure, Triangular element in plate flexure, Rectangular element in plane stress and bending combined.
- Flat Slabs: Elements of flat slabs, Behavior of flat slab in shear, Opening in flat slabs, Effect of pattern loading in flat slabs. Deep Beams: Flexural bending and shear stresses in deep beams. Concept of Plastic Design: Redistribution of moments, Computation of plastic moment, Shape factor, Overload factor. Plastic Design of Steel Frames: General design procedure, Design of continuous beams, Design of industrial building frames.
- Shallow Foundations – Types and choice of type. Design considerations of including location and depth, Bearing capacity – General bearing capacity equation, Meyerhof's Hnnsen's and Vedic's bearing capacity factors; Bearing capacity of stratified; soils; Bearing capacity based on penetration resistance, safe bearing capacity and allowable bearing pressure. Proportioning of shallow foundations- isolated and combined footings and mats, Design procedure for mats; floating foundation, fundamentals of beam on Elastic foundations. Pile foundations – Classification methods – Factors influencing their choice – Load carrying Capacity of piles by static pile formulae in clays and granular soils methods for piles in clays; Meyerhof's, Vedic's equations and Coyle and Castillo correlations for piles in sands; (Elastic settlement of piles)- Pull out resistance of piles –Load carrying capacity using Dynamic pile formula – Pile load tests – cyclic pile load tests. Laterally loaded vertical piles Modulus of sub – grade reaction – Pile in granular sols and cohesive soils subjected t lateral loading, Matlock & Reese analysis, Davisson & Gill analysis, Bromes' Analysis. Under – reamed pile foundations – construction techniques – design specifications – pile carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands. Negative skin friction in piles – typical field situations – Estimation of down drag in single piles and pile groups – methods of minimizing downdrag. Highway planning: Planning Service, Saturation System, Policies and goals of different road development plans, Salient features of Vision-2021 as per IRC recommendations. Geometric design standards of Highways: Controls and Criteria for geometric design, basic requirements, Design vehicle, Design of capacity, level of service, design of camber, design

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methods used in field, design of cross-section elements, design and analysis of different sight distances IRC specifications for design. 8 Design of Horizontal Alignment: Design and analysis of super elevation, methods for eliminating camber and super elevation in the field, design of extra widening, methods for providing extra widening in the field, design of transition, design of combined curve and IRC specifications for design. 6 Design of Vertical Alignment: Design of gradients, basic criteria and methods for designing summit and & valley vertical curves, IRC specification for design. 4 Geometric Designs of Intersections: Design of parking areas: Design of Bus terminals, loading and unloading zones 4Geometric design of high speed corridors: Concept and requirement of high speed corridors and design of high speed corridors.

- Building Construction: Orientation of buildings, planning of Hi-rise buildings, design of staircases/lifts & escalators, principles of planning, building planning (all types of buildings), inventories, Advance construction materials.

CHEMISTRY

1. Physical Chemistry:

- **Introduction to Quantum Mechanics:** Schrodinger equation and postulates of quantum mechanics. Discussion of solution of the Schrodinger equation to some model system viz., particle in a box, the harmonic oscillator, the rigid rotator, the hydrogen atom and helium atom. Molecular orbital theory: Hückle theory of conjugated system bond and charge density calculation. Application to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc. Introduction to extended Huckel theory.
- **Thermodynamics:** First law of thermodynamics, second law of thermodynamics, entropy, Gibbs-Helmholtz equation, relation between C_p and C_v , enthalpies of physical and chemical changes; temperature dependence of enthalpy. Third law of thermodynamics and calculation of entropy. Statistical thermodynamics; Maxwell-Boltzmann, Bose-Einstein and Fermi-Dries statistics. Non equilibrium Thermodynamics: Postulates and methodologies, linear law, Gibbs equation, Onsager reciprocal theory.
- **Chemical Kinetics:** Empirical rate laws, Arrhenius equation, theories of reaction Rates, determination of reaction mechanisms, activated complex theory, experimental technique for fast reactions. Theory of absolute reaction rates. Ionic reaction: salt effect. Homogeneous and heterogeneous catalysis and Michaelis-Menten kinetics.
- **Surface chemistry:** Basic of surface chemistry, surface tension and adsorption. Adsorption isotherm, Gibbs adsorption equation. Adsorption of gases by solid. Micelles and reverse micelles: solubilization, micro-emulsions. Surface active agent, capillary action.
- **Electrochemistry and solids:** Electrochemical cell reaction, Nernst equation, electrode kinetics, electrical double layer, electrode/electrolyte interface. Debye-Huckel theory. Electro-osmosis and Electrophoresis. Batteries, fuel cells. Dislocation in solids, Schottky and Frenkel defects, Electrical properties: insulators, semi-conductors, superconductors; band theory of solid.
- **Ideal and Non ideal reaction:** Excess function, concept of hydration number: activities in electrolytic solution; mean ionic activity coefficient; Debye-Huckel treatment of dilute electrolyte solution.

2. Inorganic Chemistry-

- **Chemical sciences:** Concept of hybridization. Molecular orbitals and electronic configuration of homo and heteronuclear molecules. VSEPR theory and Bent rule. Types of chemical bond (weak and strong)

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intermolecular forces. Bond lengths, Bond angles, Bond order, Bond energies, lattice energy.

- **Coordination chemistry and Redox reaction:** Introduction to basic coordination chemistry, metal complexes, isomerism. Crystal-field splitting of d-orbitals (octahedral and tetrahedral). CFSE, magnetism, colour of transition metal ions. Metal carbonyls. Oxidation numbers. Redox potential, Electrochemical series, Redox indicators.
- **Chemistry of transition elements :** Bonding theories, spectral and magnetic, properties, reaction mechanisms. Transitional metal catalyzed reaction; oxidation, elimination reaction
- **Inner transition elements–** spectral and magnetic properties, analytical applications. Organometallic chemistry of transition elements.
- **Acids and Bases:** Classification of acids and bases, bronsted and lewis acids and bases, pH and pKa, acid-base concept in non aqueous media. Buffer solution. HSAB concept and application.
- **Spectral Techniques:** Elementary principles and application of electronic, vibrational, nuclear magnetic resonance, EPR, Mass Spectral techniques for diatomic and polyatomic molecules, Moss Bauer.
- **Photochemistry:** Cis-trans Isomerisation, Paterno-Buchi reaction, Norrish type 1 and 2 reaction, photoreaction of ketones, photochemistry of arenes.
- **Bioinorganic Chemistry:** Metals ions in biology, mechanism of transport across membranes; ionosphere. Photosynthesis, nitrogen fixation, cytochrome and ferredoxins.
- **Inorganic rings, Cages, Clusters, polymers:** Phosphazenes, Cyclophosphazenes, Polyphosphazenes, metal clusters and the polymers derived from them. polysilanes

3. Organic chemistry-

- **Stereochemistry:** Configuration, concept of chirality, optical isomerism, enantiomers, diastereoisomerism in cyclic and acyclic system; E-Z isomerisms. Methods of resolution, conformational analysis of simple cyclic and acyclic system. Interconversion of fischer, Newman and Sawhorse projections.
- **Common Organic Reactions:** Reaction intermediates. Generation, structure and stability of carbonium ions, carbanions, carbenes, nitrenes, arynes and free radical reaction. Nucleophilic, electrophilic, substitution, addition and elimination reactions.

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- **Addition to carbon-carbon Multiple bonds:** Mechanism, direction and stereochemistry, addition to alkenes, alkynes, transitional metal organometallics.
- **Addition to carbon-hetero bonds:** Mechanism of metal hydrides, reduction of saturated and unsaturated carbonyl compounds, acids, esters, nitriles, addition to Grignard reagents.
- **Name Reaction:** Aldol condensation, Beckmann rearrangement, Cannizzaro reaction, Mannich reaction, Claisen condensation reaction, Birch reduction, Reimer Tiemann reaction, Fries reaction, Allylic rearrangement, Hofmann rearrangement, Oppenauer oxidation, Reformatsky reaction. Wittig reaction, hydroboration reaction. Diels-Alder reaction. Friedel-Crafts reaction.
- **Pericyclic Reaction:** Introduction, electrocyclic reaction, theoretical explanation, molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system, cycloaddition, antarafacial, suprafacial addition, $4n$ and $4n+2$ system, $2+2$ addition of ketenes, $1,3$ dipolar cycloaddition and cheletropic reaction. Sigmatropic rearrangements-suprafacial shift of hydrogen, sigmatropic involving carbon moieties, $3,3$ and $5,5$ sigmatropic rearrangement. Claisen, Cope and aza Cope rearrangement.
- **Heterocyclic Chemistry:** Synthesis and reactivity of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole, Fischer indole synthesis.
- **Aromaticity:** Hückel's rule and concept of aromaticity annulenes and heteroannulenes, fullerenes.
- **Mechanism of Organic Reaction:** Labelling and kinetic isotope effects, Hammett equation, (σ - ρ) relationship, non classical carbonium ions, neighbouring group participation.
- **Special Organic Reaction:** Favorskii reaction, Michael addition, Sharpless asymmetric epoxidation, Barton reaction Baeyer-Villiger reaction.

COMMERCE

1. Business Environment:-

Economic Environment of Business in India, Consumer Protection and Environmental protection, policy environment, liberalization, privatization and globalization, New Industrial policy and its implementation, foreign exchange management Act (FEMA), patent law, foreign capital investment in India, World Trade Organization (WTO), International monetary fund (IMF)

2. Cost and Management Accounting:-

Marginal costing & Break-even Analysis, Standard costing & Budgetary control, costing for decision making, Ratio Analysis, cash flow & Fund flow Analysis.

3. Business Statistics & Data Analysis:-

Types of Data, Collection & Analysis, Sample-needs of sample Methods and Errors of Sample, Normal Distribution, Hypothesis Testing uses of Statistical Average. Correlation & Small Sample Tests, T-Test, F-Tests and Chi-square Tests.

4. Accounting:-

Basic Accounting concepts, Accounting Standards, Capital & Revenue, Financial Statement. Partnership Accounts:- Dissolution & Amalgamation, Accounting of company – valuation of shares, Amalgamation, Absorption and Reconstruction of companies.

5. Business Management:-

Functions & Principles of Business Management, Planning, Organizing, controlling, Motivation and Interpersonal behavior.

6. Business Economics:-

Demand Analysis and Elasticity of Demand, Indifference Curve Analysis, Utility Analysis and Law of return. Business Cycle- Nature, Stages & Principles, Profit Management, Measurement of profit, Risk & concept of Uncertainty.

7. Income Tax & Tax Planning:-

Basic concepts, Tax free Income, Computation of Income from various Heads, computation of Taxable Income of individual & firms, Types of Tax Assessment, Appeal & Revision, Tax planning- Concept, Definition, Importance & problems, Methods of Tax planning.

8. Entrepreneurship:-

Definition of Entrepreneur and origin, Principles of Entrepreneurship, Innovation & Entrepreneurship, Role and achievements Nature and characteristics of Entrepreneur Development programme, Role of

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Government in Entrepreneurship development , Role of Entrepreneur in socio- Economic Growth.

9. Financial Management:-

Capital Structure, Financial & Operating Leverages, Capital costing & capital Budgeting, Working Capital Management, Dividend Policy.

10. Marketing Management:- concepts of marketing management, Marketing Mix, Consumer Behavior, Market segmentation-Concepts of Advertisement management, mediums of Advertisement and selection of medium.

11. Indian Financial System:-

Money & Capital Market, functions of stock Exchange in India, Stock Holding Corporation of India, Mutual fund, SEBI, Credit Rating, Reserve Bank of India, NABARD & Rural Bank, Reforms of Banking Sector in India, NPA in Indian Banking System

COMPUTER SCIENCE

1. **Basic Discrete Mathematics:** Counting principles, linear recurrence, mathematical induction, Equation sets, relations and function, predicate and propositional logic.
2. **Digital Logic:**
Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).
3. **Computer Organization and Architecture:**
Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.
4. **Programming and Data Structures:**
Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.
5. **Algorithms:**
Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.
6. **Operating System:**
Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems.
7. **Databases:**
ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

COMPUTER SCIENCES & ENGINEERING

1. **Digital Logic:** Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).
2. **Computer Organization and Architecture:** Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.
3. **Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.
4. **Algorithms:** Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.
5. **Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undesirability.
6. **Compiler Design:** Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.
7. **Operating System:** Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.
8. **Databases:** ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

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9. **Information Systems and Software Engineering:** information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.
10. **Computer Networks:** ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.
11. **Web Technologies:** HTML, XML, basic concepts of client-server computing.

ELECTRONICS AND COMMUNICATION ENGINEERING

1. **Analog and Digital Electronics:** Characteristics of diodes, BJT, FET; **amplifiers** - biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers - characteristics and applications;
2. **Communication Systems:** Basic Analogue and Digital Communication Techniques. Random Signal Theory. Correlation Techniques and Matched Filtering. Multi Carrier Modulation Techniques – OFDM. Multi-user Detection Theory. Spread Spectrum Techniques.
3. **Digital Signal Processing:** Theory, Techniques and Applications of Digital Filters and Fast Fourier Transforms. Architecture and Features of Different Digital Signal Processors.
Electromagnetic Theory, Microwave Techniques and Antenna: Maxwell's Equations and their Applications. Pointing Theorem, plane-wave propagation, polarization, reflection and refraction.
4. **Satellite Communication :** Communications Satellites - Architecture, Orbits, Frequency Bands. Satellite Power and Bandwidth Link Budget for Different Orbits.
5. **Optical Communication:** Loss and Dispersion Mechanism in Optical Fibers. Characteristics and Features of different Optical Wave Length Windows for Communication. Optical Sources, Detectors and Passive Devices & Components. Power and Data Rate Link Budgets. Optical Amplifiers. WDM and DWDM. Optical Networks.
6. **Wireless & Mobile Communication:** Cellular Concept and Engineering. Frequency Bands for Wireless and Mobile Communications. Propagation Models and Fading. GSM, CDMA and 3G Communication Systems. GPRS, Bluetooth, Wi-Fi and WIMAX. Wireless Data Networks and Standards.
7. **Telecommunication Networks:** Circuit and Packet Switching Techniques and Systems. Digital Telephone Networks. Digital Multiplexing Hierarchy. OSI Reference Model. Data Link, Network and TCP/IP Layers and their Standards.
8. **VLSI Circuits and Systems:** Building Blocks of VLSI and Simulation Tools. MOS, CMOS and MOSFET Transistors, Circuits and Applications. CMOS Logic Circuits. Semiconductor Memories. VLSI Digital ICs. Fabrication Techniques.

ELECTRICAL ENGINEERING

1. **Electric Circuits and Fields:** Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems
2. **Signals and Systems:** Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.
3. **Electrical Machines:** Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; auto-transformer; energy conversion principles;
4. **Power Systems:** Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis;
5. **Control Systems:** Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Nyquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation
6. **Electrical and Electronic Measurements:** Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers;
7. **Analog Electronics:** Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, Power Electronics and Drives: Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits; phase control rectifiers;

ECONOMICS

1. **Micro Economics & Macro Economics:** Demand analysis Marshallian, and Hicksian and Revealed preference approaches, Elasticity of demand, Theory of production and costs, pricing and output under different forms of market structure and factor pricing analysis.
National income meaning, measurement and relationship with economic welfare determination hypotheses, Determination of money supply high powered money, Money multiplier.
2. **Statically Methods :** Measures of central tendency, Dispersion and skewness , simple correlation and regression analysis, index Number and time series analysis, Sampling theory concepts methods of sampling and non sampling errors.
3. **Public Finance:** Public Expenditure effects of public expenditure, Measurement of Government Productive of Unproductive, The public budgets, public Expenditure Hypothesis effects and evolution, Canons of taxation, Public Revenue incidence and effects of taxation.
4. **International Economics :** Balance of payments - Composition and significance, causes and approaches for adjustment in BOP, foreign trade multiplier, Theory of international trade under imperfect competition terms of trade economics growth secular Deterioration of terms of trade hypothesis.
5. **Indian Economics :** Agriculture – New agriculture policy industry- New industrial policy and liberalization, Money and banking concepts of money supply inflation monetary policy and financial sector reforms. Basic economic indicators – national income performance of different sectors trends in prices and money supply.

EDUCATION

1. **Philosophical Foundation of Education:** - Relationship of Education and Philosophy.
2. **Western Schools of Philosophy:** - Idealism, Realism, Pragmatism and Naturalism.
3. **Indian Schools of Philosophy:** - Vedanta, Buddhism, Jainism. Contributions of Philosophy of Vivekananda, Tagore, Gandhi, and Aurobindo to educational thinking.
4. **Sociological Foundations of Education:** - Relationship of Sociology and Education Meaning and nature of Education sociology and Sociology of education.
Education and modernization, Education and democracy, Socialization of the child Meaning and nature of social change, Education as related to social equity and equality of educational opportunities Constraints on social change in India (caste, ethnicity, class, language, religion, and regionalism)
5. **Psychological Foundations of Education:** - Relationship of education and Psychology.
Process of Growth and Development v Physical, social, emotional and intellectual
6. **Individual differences-** determinants: role of heredity and environment: implications of individual differences for organizing educational programmes Intelligence – its theories and measurement Learning and Motivation.
7. **Theories of learning-** Thorndike is connectionism, Pavlov's classical and Skinner's operant conditioning Psychology and education of exceptional children- creative, gifted, backward, learning disables and mentally retarded Personality- type and trait theories- measurement of personality Mental health and hygiene- process of adjustment, conflicts and deference mechanism, mental hygiene and mental health. Sex Education Guidance.
8. **Methodology of Education Research:** - Nature and Scope of Education Research Meaning and Nature Need and Purpose Fundamental- Applied and Action Research Collection of Data Concept of population and sample various methods of sampling.
Tools and Techniques Characteristics of a good research tool Types of research tools and
Techniques and their uses Questionnaire- Interviews- Observations

ENGLISH

1. Literary Ages-

The age of Chaucer
The Elizabethan age
The Neo-Classical Age (1701-1770)
The Romantic Age (1798-1830)
The Victorian Age (1837-1901)
The Modern Age (1901 ...)

Main trends of each age, Representative poets, Books, and other literary moments.

2. The Literary Movements-

The Renaissance
Renaissance and the Reformation
Classicism
Neo-Classicism
Romanticism
Realism
Romantic Movement
Pre-Raphaelite Movement
The Aesthetic Movement
Naturalism
Symbolism
Imagism

3. Literary Forms-

Poetry - Its Literary Forms – Ballad, Elegy, Epic, etc.
Prose - Its Nature
Drama - Its Nature – Comedy, Tragedy, Problem Play, One Act Play Etc.

4. Literary Terms-

Catharsis, Hamartia, Negative Capability, Objective Correlative, Satire, Image, Conceit etc.

5. Prosody-

Stanza forms of English poetry

6. English Literature: English literature as a whole.

7. Indians writing in English: Dr. Ravindra Nath Tagore, Sarojini Naidu, Raja Rao, Mulk Raj Anand, Manohar Mulgaonkar, Arundhati Roy, etc.

8. Main trends - Social commitment, liberty, fraternity, etc.

9. American Literature: Robert Frost, Emily Dickinson, O'Neil.

हिन्दी साहित्य

भारतीय और पाश्चात्य काव्यशास्त्र :

काव्य की परिभाषा, स्वरूप हेतु प्रयोजन, प्रमुख सिद्धांत रस और रस निष्पत्ति, अलंकार, रीति, ध्वनि और शब्द शक्ति, हिन्दी काव्य का इतिहास।

प्राचीन और मध्यकालीन काव्य एवं उसका इतिहास :

भक्ति काव्य का स्वरूप – निर्गुण और सगुण काव्यधारा, संत काव्य और कबीर, सूफी काव्य और जायसी, कृष्ण काव्यधारा और सूर काव्यधारा और तुलसी, भक्तिकाव्य की प्रमुख प्रवृत्तियां, भक्तिकाव्य की दार्शनिक अवधारणाएँ, रीतिकाव्य की प्रमुख प्रवृत्तियां, रीतिबद्ध काव्य और बिहारी, रीतिमुक्त काव्य और धनानंद भक्ति तथा रीति काव्य की भाषा।

आधुनिक हिन्दी काव्य और उसका इतिहास :

कविता में आधुनिकता का आरंभ और खड़ी बोली का प्रयोग। मैथिलीशरण गुप्त का काव्य और उसका रचना विधान। पंत के काव्य में प्रकृति चित्रण कल्पनाशीलता, सौंदर्यचेतना। महादेवी के काव्य में रहस्यवाद और वेदनाभाव। प्रगतिवादी और प्रयोगवादी काव्यधारा। आधुनिक का संक्षिप्त इतिहास।

हिन्दी साहित्य की गद्य विधाएँ :

हिन्दी उपन्यास: प्रेमचन्द के प्रमुख उपन्यास और उनकी विचारधारा, प्रेमचन्दयुगीन उपन्यास और उनकी विचारधारा, प्रेमचन्दयुगीन उपन्यास और उनकी प्रवृत्तियां, जैनेन्द्र, अज्ञेय, हजारीप्रसाद द्विवेदी, यशपाल, अमृतलाल नागर, फणीयवरनाथ रेणु के उपन्यास और प्रवृत्तियां। हिन्दी कहानी: बीसवीं सदी की हिन्दी कहानी और प्रमुख कहानी आंदोलन।

हिन्दी नाटक: हिन्दी नाटक और रंगमंच, विकास के चरण और प्रमुख नाटककृतियां – अंधेर नगरी, चन्द्रगुप्त, आधे-अधूरे, आठवां सर्ग।

हिन्दी निबंध : हिन्दी निबंध के प्रकार और प्रमुख निबंधकार – रामचन्द्र शुक्ल, हजारी प्रसाद द्विवेदी, विद्यानिवास मिश्र

हिन्दी आलोचना : हिन्दी, आलोचना का विकास और प्रमुख आलोचक – रामचन्द्र शुक्ल, हजारी प्रसाद द्विवेदी, रामविलास शर्मा

हिन्दी गद्य की अन्य विधाएँ – रेखाचित्र, संस्मरण, आत्मकथा, जीवन

भाषा विज्ञान – परिभाषा, स्वरूप, हिन्दी भाषा और संक्षिप्त इतिहास स्वर और व्यंजन हिन्दी की ध्वनियां, पद और वाक्य विज्ञान, देवनागरी लिपि और उसकी विशेषताएँ।

HISTORY

From the Indus Valley Civilization to the Mahajanapadas. Age, extent and characteristics of the Indus Valley Civilization. Vedic culture — Early and Late — Geography : Social and Political. institutions, Economic conditions. Religious and Philosophical ideas. Mahajanapadas, Republics, Economic growth — Emergence of Jainism and Buddhism — Rise of Magadha — Macedonian invasion and its effects.

History of India from 4th Century BC to 3rd Century AD . Foundation of the Mauryan Empire — Chandragupta, Asoka and his Dhamma, Mauryan administration, Economy, Art and Architecture, Disintegration of the Mauryan empire. Sangam Age. Sungas, Satvahanas and Kushanas : Administration, religion, society, economy, trade and commerce, culture — Art and architecture, Literature.

India from the 4th century AD to 12th century AD

Gupta—Vakataka Age—Harsha-Pallavas—Early Chalukyas — Rashtrakutas-Cholas — Pratiharas -Palas — A brief survey of the history of the Paramaras, Kalachuris, Gahadavalas and Chauhans — Administration. Feudalism. Society, Position of Women, Educational centres.' Economy. Religious trends, styles of temple architecture, art. Literature, An outline of scientific and technological developments. India's contacts with the outside world.

India from 1206 to 1526 Expansion and Consolidation — The Ghorids. The Turks. The Khaljis, The Tughlaqs, The Sayyids and the Lodis. Vijayanagar and Bahamani Kingdoms.State and Religion — Concept of sovereignty, Religious movements and Sufism. Economic Aspect — Urban Centres, Industries, Trade and Commerce, Land Revenue and Prices. Mongol problem and its impact. Administrative structure. Art, Architecture and Literature.Sources — Archaeological, Persian and non-Persian literature, Foreign travellers' account.

India from 1526 onward

Sources of Mughal period. Mughal Expansion and Consolidation — Babur's establishment of Mughal rule in India ; Humayun and Surs ;.Akabar, Jahangir, Shahjahan and Aurangzeb. Mughal relations With the nobility and the Rajputs. Jahangir — the period of stability and expansion 1611-1621 ; the period of crises 1622-1627 — The Nurjahan Junta. Decline of Mughal Empire -. Political, administrative and economic causes. The Maratha Movement* the foundation of Swarajya by Shivaji — its expansion and administration. Maratha Confederacy and causes of decline. Administration : Sher Shah's administrative reforms,

Mughal administration, land revenue and other sources of income, Mansabdari

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and Jagirdari.

Socio-economic and cultural life under the Mughals-Village society and economy Art, architecture and literature, Trade and Commerce ,Religious policy from Akbar to Aurangzeb , Urban centres and Industries, Currency, Position of women.

Foundation of the British Rule.

Rise of European powers — Expansion and Consolidation of the British rule. British relations with major Indian powers — Bengal, Oudh, Hyderabad, Mysore, Marathas and Sikhs. Administration under the East India Company and Crown, Paramountcy, Civil Service, Judiciary, Police and Army. Local Self-Government, Constitutional Development from 1909 to 1935.

Economic and Social Policies. Agrarian policy of the British, Land Revenue, Agriculture and Land Rights, Famine policy, Rural indebtedness Policy towards trade/and industries, Condition of Labour. Trade Union Movements, Factory Legislation, Banking, Transport, Drain Theory. Indian Society in transition, Christian missions, Socio-religious reform movements, Status of women. New educational policy, English language, Modern sciences, Journalism, Indian languages and literature.

National Movement and Post-Independent India

Rise of nationalism, Revolt of 1857, Tribal and Peasant Movements, Ideologies and Programmes of Indian National Congress, Swadeshi Movement, Indian Revolutionary Movement in India and abroad. Gandhian Mass Movements, Ideologies and Programmes of the Justice Party ; Left wing politics, Movement of the depressed classes, Genesis of Pakistan, India towards Independence, and Partition. India after Independence, Rehabilitation after partition, Integration of Indian States, the Kashmir Question. Making of the Indian Constitution, Structure of Bureaucracy and the police, Economic policies and the planning process, Linguistic reorganisation of the States, foreign policy initiatives.

LIBRARY & INFORMATION SCIENCE

- Information, Information Science, Information Society Information as a Resource/Commodity Information Transfer Cycle Generation, Collection, Storage and Dissemination Role of information in Planning, Management Socio-economic Development. Technology transfer Communication Channels, barriers. Intellectual Property Rights Concept, Copyright, Censorship Print and Non-print Media. Library and Information Policy at the National Level Laws of Library Science library Resource Sharing and Networking Library Movement and Library Legislation in India Library Extension Services. Library and Information Science Education in India. Library and Information Profession. Library Associations in India, UK and USA ILA, IASLIC. IATLIS. SIS, LA, ASLIB, SLA and ALA . library Associations Organisations at International level FID, IFLA and UNESCO
- Sources of Information Primary, Secondary and Tertiary Documentary and Non-documentary Reference Sources Encyclopaedias, /Dictionaries, Geographical Sources, Biographical Sources, Year-books/Almanacs, Directories, and Handbooks, Statistical (salient features and evaluation) Bibliographical Sources Bibliographies, Union Catalogues. Indexing and Abstracting Journals (salient features and evaluation) E-documents, E-books. E-Journals. Databases Bibliographic, Numeric and Fulltext Evaluation. Organisation of knowledge/information .Modes of formation of subjects. Library Classification Canons and Principles .Library Classification Schemes-DDC. UDC and CC Library Cataloguing Canons and Principles. library Cataloguing Codes CCC and AACR-II Bibliographic Records International standards ISBDs, MARC and CCF. Indexing Pre-coordinate, Post-coordinate Vocabulary Control Thesaurus. Lists of Subject Headings Databases Search Strategies, Boolean Operators, Knowledge Management.
- Management Principles, Functions, Schools of Thought Planning, Organisation Structure Decision making. System Study Analysis, Evaluation and Design. Collection Development Books, Serials, Non-book Materials-Selection, Acquisition, Maintenance; ISBN, ISSN. Cataloguing-in-Publication (CIP) Human Resources Management Manpower Planning, Job analysis. Job description. Selection, Recruitment, Motivation Training and Development, Staff Manual. Leadership and Performance Evaluation Delegation of authority.
- Financial Management Resource Generation, Types of Budgeting, Cost and Cost-Benefit analysis PERT. CPM, Library Buildings and Equipments, Performance Evaluation of Libraries/Information Centres and Services Marketing Information product and services Total Quality Management (TQM)
- Information Technology Components; Impact of IT on Society Computers Hardware, Software, Storage-Devices, Input/Output Devices Telecommunication Transmission media, Switching systems. Bandwidth, Multiplexing,. Modulation, Protocols, Wireless Communication, Fax, E-Mail, Tele-conferencing/Video-conferencing, Bulletin Board Service, Teletext, Videotex, Voice Mail Networking

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Concepts, Topologies, Types LAN,-MAN and WAN Hypertext, Hypermedia, Multimedia Integrated Services Digital Network (ISDN), Open Systems Interconnection (OSI) library Automation Areas of automation. Planning, Hardware and Software Selection, OPAC Networks ERNET, NICNET; DELNET, JANET. BLAISE, OCLC. INFLIBNET INTERNET Components, Services, Browsing Web Browsers, Search Engines Meta-Data, Digital Object Identifier (DOI). National and International Information Systems NISSAT, NASSDOC, INSDOC, DESIDOC, INIS, AGRIS, MEDLARS. INSPEC.

- Types of Research Basic, Applied, Interdisciplinary, Research Design, Scientific Method, Hypotheses, Data Collection, Sampling, Methods of Research Historical. Descriptive, Case Study, Survey, Comparative and Experimental. Statistical Methods, Data Analysis Report Writing, Research Methods in library and Information Science and Services Bibliometrics & Types of Libraries National. Public, Academic and Special Objectives, Structure and Functions Digital Libraries Concept Virtual Libraries Concept, Types of users, User studies. User education Role of UGC in the growth and development of libraries and information centres in institutions of higher education in India, Role of Raja Rammohan Roy Library Foundation (RRLF).

MATHEMATICS

- Algebra & Graph theory: Groups, homomorphism, Sylow theorems. Rings and fields. Vector spaces, Subspaces, Linear dependence, Basis and dimension. Linear transformation, Range space, null space, rank and nullity. Matrix representation of a linear transformation. Change of basis. Eigenvalues and eigenvectors. Inner product, orthogonality, Gram-Schmidt process, orthogonal expansion. Quadratic forms, reduction to normal form graph, subgraph, binary tree, spanning tree cut-set, degree of vertex, Euler's formula for connected graph, minimal spanning tree planner graph & their properties, connectivity, complete regular and bipartite graph .
- Complex & Real Analysis: The real number system. Sequences, series and uniform convergence. Continuity and differentiability of functions of real variable. Riemann and Lebesgue integrals. Analytic function, Cauchy Riemann equations, Cauchy's theorem and integral formula, singularities, Taylor's and Laurant's series. Cauchy's residue theorem and applications. Metrix spaces. Cauchy sequences and convergence. Completeness. Normed space. Banach space. Inner product space. Hilbert space, residue and poles, contour integral
- Differential Equations: Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations. Second order linear differential equations. Variation of parameters. Systems of linear differential equations. Solutions of second order differential equations (removable of first derivative, changing of independent variable method) Solution by matrix method.
Laplace transform methods. Applications. Sturm- Liouville problem. Green's function.
- First and second order partial differential equations. Method of separation of variables for Laplace, heat and wave equations, solution of linear and non linear partial differential equation.
- Operations Research: Linear programming problems, convex set, convex functions, Simplex method and its variants, duality, sensitivity analysis. Transportation problems, initial basic feasible solution and optimal solution, degeneracy.
Assignment problems, applications of TP and AP. Nonlinear programming problems, Kuhn-Tucker conditions.
- Numerical Analysis: Approximation of functions, their derivatives and integrals by interpolation. Finite and divided differences. Iterative methods for solving nonlinear and linear equations, convergence. Power method for largest Eigen value. Numerical Solution of ordinary differential equations. Initial value problems by Runge-Kutta and predictor-corrector methods. Boundary value

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problems by finite difference methods. Numerical Solution of Laplace and Poisson equations Fourier series, Fourier transform and its application.

- Probability and Statistics: Sample space, events and probability axioms. Random variable and probability distributions. Mean and Variance. Binomial, normal and Poisson distributions. Random sampling, confidence intervals, testing hypotheses, goodness of fit. Correlation & Regression.

MECHANICAL ENGINEERING

- Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.
- Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts.
- Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.
- Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts. Design: Design for static and dynamic loading; failure theories; *principles* of the design of machine elements such as bolted, riveted and welded joints, spur gears, rolling and sliding contact bearings.
- Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation;
- Heat-Transfer: Modes of heat transfer: Basic Laws, Conduction, Extended Surface Conduction, Convection, Thermal Radiation, Heat exchangers performance.
- Thermodynamics: Zeroth, First and Second laws of thermodynamics; Thermodynamic system and processes; Carnot cycle.
- Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat.
- I.C. Engines: Combustion in S.I. & C.I. Engines, Gas Turbines
- Refrigeration and air-conditioning: Vapor refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychometric chart, basic psychometric processes.
- Turbo machinery: Peltonwheel, Francis and Kaplan turbines - impulse and reaction principles, velocity diagrams.
- Metal Cutting: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear.

MANAGEMENT

1. **Fundamentals of Management:** Concept of Management:- Introduction to management & Organizations, Functions and Responsibilities of Managers, Fayal's Principles of Management, Management Thought; the Classical School, The Human Relations School and systems theory.
2. **Planning:** - Nature and purpose of planning process, principles of Planning, Types of planning, Advantages and Limitation of planning. **Organizing:** - Nature and Purpose of Organizing, Bases of Departmentation, Span Relationship, Line staff conflict, Bases of Delegation, Kind of delegation and Decentralization, Methods of Decentralization. **Management by objective (MBO)** **Controlling:** - Concept and Process of Control, Control Techniques. **Human Aspects of Control.** Control as a feedback system, types of control, IT as a control tool. **Decision Making:-** Decision Making process, Individual Decision Making Models.
3. **Managerial Economics:** Demand Analysis, Production Function, Cost-output relations, Market structures, Pricing theories, Advertising, Macro-economics, National Income concepts, Infrastructure-Management and Policy, Business Environment and Capital budgeting.
4. **Organizational Behavior:** The concept and significance of organizational behavior- Skills and roles in an organization-Classical, Neo-classical and modern theories of organizational structure-Organizational design-Understanding and Managing individual behavior personality-Perception-Values-Attitudes-Learning-Motivation. Understanding and managing group behavior, Processes-Inter-personal and group dynamics-Communication-Leadership-Managing change-Managing conflicts. Organizational development.
5. **Human Resource Management:** Concepts and perspectives in HRM; HRM in changing environment Human resource planning-Objectives, Process and Techniques Job analysis-Job description selecting human resources induction, training and development exit policy and implications performance appraisal and evaluation potential assessment job evaluation Wage determination industrial relations and trade unions dispute resolution and trade unions dispute resolution and grievance management labor welfare and social security measures
6. **Financial management:** Financial management-Nature and Scope valuation concepts and valuation of securities capital budgeting decisions-risk analysis capital structure and cost of capital dividend policy-Determinants long-term and short-term financing instruments mergers and acquisitions.

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7. **Marketing Management:** Marketing environment and Environment scanning; Marketing Information systems and marketing research; Understanding consumer and industrial markets; Demand measurement and Forecasting; market segmentation-targeting and positioning; product decisions, product mix, product life cycle; new product development; Branding and packaging; pricing methods and strategies. Promotion decisions- Promotion mix; Advertising; personal selling; channel management; Vertical marketing systems; Evaluation and control of marketing effort; marketing of services; customer relation management.
8. **Production Management :** Role and scope o production management; Facility location; layout planning and analysis; production planning and control- production process analysis; demand forecasting for operations; Determinants of product mix; production scheduling; work measurement; time and motion study; statistical; quality control. Role and scope of operations research; linear programming; sensitivity Duality; transportation model; inventory control; queuing theory; decision theory; Markova analysis; PERT/CPM.
9. **Quantitative Techniques:** Probability theory; probability distributions- Binomial, Poisson, normal and Exponential; correlation and regression analysis; sampling theory; sampling distributions; tests of hypothesis; large and small samples; t,z,F, chi-square tests. Use of computers in managerial applications; technology issues and data processing in organizations; information systems; MIS and decision making; System analysis and design; trends in information technology; internet and internet based applications.

MICROBIOLOGY

1. **General Microbiology:** History of Microbiology, Microbial Evolution, Classification of Microorganisms, Bergey's Manual of Systematic Bacteriology, Cell Architecture of microorganisms, Growth of microorganism, Microbial Diversity.
2. **Environmental Microbiology:** Concept of Habitat and Ecosystem, Flow of energy and Biogeochemical cycles, Microbial Interactions, Biological Nitrogen fixation, Aeromicrobiology, Soil microbiology and Aquatic microbiology.
3. **Food and Industrial Microbiology:** Food as a Substrate for Microorganism Importance and use of microbes in Food and Beverage production, Food Spoilage and Food Borne Infections, Principles and methods of Food Preservation, Oriental food and mushroom cultivation.
4. **Microbial Genetics and Molecular Biology:** Structure and functions of nucleic acids, Superhelicity in DNA, DNA Replication, Genetic code, Transcription, Translation, Regulation of Gene Expression, Mutations, Transposable elements, Various repair system for DNA, Transformation, Conjugation and Transduction in bacteria, Bacterial Plasmids.
5. **Cell Biology:** Cell Division and Chromosome Segregation, Relationship between DNA replication and cell cycle, Protein trafficking, Signal transduction and Apoptosis.
6. **Biochemistry and Microbial Physiology :** Chemistry and Metabolism of Protein, Carbohydrates, and Lipids, Photosynthesis, Vitamins and their role as coenzymes, Respiratory Metabolism, Chemoautotrophy, Bioenergetics, Enzymes.
7. **Bacteria:** Cyanobacteria and Prochlorophytes, Mycoplasma and Planctomyces, Archaea, Photosynthetic Eubacteria, Chemolithotrophs and Methophytes, Gram-negative Aerobic Eubacteria, Enteric Group and Related Eubacteria, Gram-negative Anaerobic Eubacteria, Spirochetes, Rickettsias and Chlamydias, Gram-positive Endospore Forming Bacteria, Gram-positive Nonsporulating Eubacteria, Actinomycetes.
8. **Fungi :** Significance of Fungi to Human Welfare, Somatic structure, Vegetative growth and Reproduction, Parasexual cycle. Classification of fungi, General structure, Life cycle of typical members of Chytridiomycota, Zygomycota, Ascomycota, Deuteromycota, Basidiomycota, Oomycota[^] Hypochytridiomycota, General Account of Slime Moulds.
9. **Viruses:** Brief History of Viruses, Extraction, Purification, Assay of Viruses

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10. **Growth and Cultivation Viruses** Bacteriophages, *Lytic* and *Lysogeny* Cycles, Classification of viruses, Mechanism of replication of viruses.
11. **Immunology:** Cells and tissues of immune system, Adaptive and Innate immunity, Soluble mediators of immunity, Immune response, Inflammation, Vaccination, Antigens, Antigen processing and presentation, Immunoglobulins, Antigen-antibody interaction, Major Histocompatibility *Complex*, T-cell and B-cells, Cell Mediated Cytotoxicity, Immunological Tolerance, Autoimmunity, Hypersensitive Reactions, Tumour Immunology, Transplantation Immunology.
12. **Medical Microbiology:** Mechanism of Pathogenesis, Clinical Microbiology, Serological Techniques, Skin and Respiratory System Infections, Alimentary and Urinogenital System Infection, Nervous System; Blood, Wound and Lymphatic System Infection.
13. **Fermentation Technology:** Isolation, preservation and improvement of Industrial strains, Media for industrial fermentation and development of inoculum, Microbial growth kinetics, Design and types of fermentaor, Control of Fermentation, Downstream processing, Industrial production of SCP, Baker's yeast, Enzymes , Organic acids, Polysaccarides, Alcoholic beverages and Antibiotics.
14. **Recombinant DNA Technology:** Restriction enzymes, Recombination of DNA fragments. Vectors, Cloning Strategies, Shotgun cloning, cDNA cloning, DNA sequencing, Gene libraries, cDNA, Genomic libraries, DNA microarray, Direct DNA Transfer, Application of recombinant DNA technology in plants, animals and bacterial cell, medicine etc.
15. **Biotechniques and Instrumentation** Microscopy, Spectroscopy, Chromatography, Centrifugation, Electrophoresis, Nanotechnology, Radioisotopes, Immunological Techniques, Immunoflourescence (FACS), Direct-indirect, Immunoassay (ELISA), Immunoblotting and immunoprecipitation, Isolation of pure antibodies, Monoclonal antibody production. , PCR, Electrophoresis (DNA, Proteins) DNA, RNA & Protein blotting.

PHYSICAL EDUCATION

- Introduction to and definition, aim and objectives of Physical Education and other terms—health education and recreation. Philosophies of Education as applied to Physical Education—Idealism, Naturalism, Realism, Pragmatism, Existentialism, Humanism. Biological basis of physical activity—benefits of exercise, growth and exercise, exercise. and well-being sex and age characteristics of adolescent, body types. Psychological basis of Physical Education—Play and Play theories, general principles of growth and development, Principles of motor—skill acquisition, transfer of training effects. Sociological basis of Physical Education—socialization process, social nature of men and physical activity, sports as cultural heritage of mankind, customs, traditions and sport, competition and cooperation. Physical Education in India.
- Physiology of Muscular activity, Neurotransmission and Movement mechanism.
- Physiology of respiration. Physiology of blood circulation. Factors influencing performance in sports. Bioenergetics and recovery process. Athletic injuries—their management and rehabilitation. Therapeutic modalities. Ergogenic aids and doping.
- Joints and their movements—planes and axes. Kinetics, Kinematics—linear and angular, levers. Laws of motion, principles of equilibrium and force, spin and elasticity. Posture, Postural deformities and their correction. Muscular analysis of Motor movement. Mechanical analysis of various sports activities. Mechanical analysis of fundamental movements—(running, jumping, throwing, pulling and pushing). Massage manipulation and therapeutic exercises.
- Learning process—theories and laws of learning. Motivation, theories and dynamics of motivation in sports. Psychological factors affecting sports performance—viz., stress, anxiety, tension and aggression. Personality, its dimensions, theories, personality and performance. Individual differences and their impact on skill learning and performance. Group dynamics, team cohesion and leadership in sports. Sociometrics, economics and politics in sports. Media and sports.
- Development of teacher education in Physical Education. Professional courses in Sports and Physical Education in India. Professional Ethics. Qualities and Qualifications of Physical Educational Personnel. Principles of curriculum planning. Course content for academic and professional courses. Age characteristics of pupils and selection of activities. Construction of class and school Physical Education time table.
- Health—Guiding principles of health and health education. Nutrition and

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dietary manipulations. Health-related fitness, obesity and its management. Environmental and occupational hazards and first aid. Communicable diseases—their preventive and therapeutic aspect. School health programme and personal hygiene. Theories and principles of recreation. Recreation programme for various categories of people.

- Characteristics and principles of sports training. Training load and periodization. Training methods and specific training programme for development of various motor qualities. Technical and Tactical preparation for sports. Short-term and long-term training plans. Sports talent identification—process and procedures. Preparing for competition—(build up competitions, main competition, competition frequency, psychological preparation). Rules of Games and Sports and their interpretations.
- Skill test for Badminton, Basketball Hockey, Lawn-tennis, Soccer, Volley ball. Testing psychological variables—competitive anxiety, aggression, team cohesion, motivation, self-concept. Anthropometric measurements and body composition.

PHARMACY

- **Pharmaceutics:** Designing of dosage forms, Kinetics & Drug Stability; Accelerated stability study, expiration dating. Pre-formulation studies, Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant. Stability studies, Protocols for Stability testing of various pharmaceutical products.
- **Pharmaceutical Microbiology and Biotechnology:** Nutrition, cultivation, isolation of bacteria, fungi, and viruses ;Stains & types of staining techniques; electron microscopy; Sterilization; Sterility testing of pharmaceutical products. Microbial assays of antibiotics, vitamins & amino acids; Immunology & Immunological Preparations; Enzyme immobilization: Techniques and applications.
- **Pharmaceutical Jurisprudence:** A brief study of- Pharmacy act 1948, Drugs and cosmetic act, Patent act 1970, Drugs and magic remedies act (objectionable advertisement act), Prevention of cruelty to animal act 1970, Narcotic drugs and Psychotropic substances (Excise Duties) act 1955.
- **Medicinal Chemistry:** Basic Principles: Physico-chemical & stereo isomeric (Optical, geometrical) aspects of drug molecules & biological action, Bioisosterism, Drug- receptor interactions; Concept of Prodrugs; Principles of Drug Design (Theoretical Aspects)
- **Synthetic Procedures, Mode of Action, Uses, Structure Activity Relationships including Physicochemical Properties of the Following Classes of Drugs:** Local Anesthetics, General Anesthetics, Hypnotics & Sedatives, Anticonvulsants, Opioid analgesics, CNS stimulants, Diuretics; Cardiovascular drugs, Insulin & oral hypoglycemic agents: Chemotherapeutic Agents: Antibiotics- β -Lactam, macrolides, tetracyclines;;Anti-metabolites (including sulfonamides); Anti-neoplastic agents; Anti- viral agents (including anti-HIV); Immunosuppressive & immunostimulants.
- **Pharmaceutical Analysis:** The Theoretical Aspects, Basic Instrumentation, Elements of Interpretation of Spectra, & Applications (quantitative & qualitative) of the Following Analytical Techniques: Ultraviolet & visible spectrophotometry, Fluorimetry, Infrared spectrophotometry, Nuclear Magnetic Resonance spectroscopy [proton technique only], Mass Spectrometry, Radioimmunoassay.
- **Chromatography:** Theory of chromatography. The following chromatographic techniques (including instrumentation) with relevant examples of products official in pharmacopoeia: TLC, HPLC, GLC, HPTLC, Paper Chromatography & Column Chromatography.

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- **Quality assurance:** GLP, ISO 9000, TQM, Quality Review & Quality documentation.
- **Pharmacology:** Dosage forms & routes of administration, mechanism of action, combined effect of drugs, factors modifying drug action, Absorption, Distribution, Metabolism & Excretion of drugs, Adverse Drug Reactions.
- **Pharmacology of Cardiovascular System:** Drugs used in the management of congestive cardiac failure, Antihypertensive drugs, Anti-anginal & Vasodilator drugs, including calcium channel blockers & beta adrenergic antagonists, Ant arrhythmic drugs, Anti-hyperlipedemic drugs.
- **Chemotherapy:** General Principles of Chemotherapy, Bacterial resistance; Sulfonamides & cotrimoxazole, Antibiotics; Chemotherapy of tuberculosis, fungal diseases, viral diseases, HIV & AIDS.
- **PHARMACOGNOSY:** Phytochemical Screening: Preparation of extracts, Screening of alkaloids, saponins, cardenolides & bufadienolides, flavonoids & leucoanthocyanidins, tannins & polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Standardization of herbals.

PHYSICS

- **MATHEMATICAL PHYSICS:** Vector algebra and vector calculus, linear algebra, matrices, linear differential equations of first and second order, Fourier series, Fourier and Laplace transforms, elements of complex analysis, analytic functions, elementary probability theory, elementary idea about tensors.
- **CLASSICAL MECHANICS:** Elementary principles, Mechanics of system of particles, Central forces, Keplers problem and planetary motion, Collision and scattering in laboratory and center of mass frames, rigid body dynamics , noninertial frames of reference, variational principle, langrange's and hamilton's formalisms, small oscillations, normal modes, special theory of relativity – lorentz transformations , relativistic kinetic and mass energy equivalence.
- **QUANTUM MECHANICS:** Physical basis of quantum mechanics, uncertainty principle , Schrodinger equations; one, two and three dimensional potential problems, particle in a box, harmonic oscillator , hydrogen atom linear vector and Hilbert space, angular momenta and spin, time dependent perturbation theory, WKB approximations penetration through a potential , α -decay ,stark effect Fermi's golden rule, interaction of an atom with electromagnetic radiation, the Einstein's A & B coefficients.
- **ELECTROMAGNETIC THEORY:** ELECTROSTATICS:-Gauss's law and its application, laplace and poission equations boundary value problems.
- **Magnetostatics:-** Biot-sevart law ampere's laws maxwell's equation scalar and vector potential s, diffraction and, coulombs and Lorentz gauges; electromagnetic waves and their reflection, refraction, interference, diffraction and polarization , pointing vector.
- **THERMODYNAMICS & STATISTICAL PHYSICS:** Laws of thermodynamics and their consequences . Thermodynamics potential, Maxwells equation phase space, macro states and micro states ;micro canonical, canonical and grand canonical ensembles and partition function. free energy and its connection with thermodynamics quantities, classical and quantum states. Bose-Einstien Condensation, first and second order phase transitions, critical points.
- **ATOMIC & MOLECULER PHYSICS:** Spectra of one and many electron atoms, LS and JJ coupling, hyperfine structure , Zeman and stark effects ,

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electric dipole transition and selection rules, X-ray spectra of diatomic molecules ; electronic transition in diatomic molecules, Frank –condon principle, raman effect, NMR and ESR lasers.

- **CONDENSED MATTER PHYSICS:** Bravais lattices, reciprocal lattice, bonding of solids, elastic properties , phonons, hall effect , band theory of solids :metals, insulator and semi conductor, superconductivity, I &II types of superconductors, defect and dislocations, nano particles and its properties.
- **NUCLEAR & PARTICLE PHYSICS:** Basic nuclear properties : size, shape and change distribution, binding energy , liquid drop model-semi empirical mass formula, nuclear shell model , nuclear force and two nucleon problems; α -decay , β -decay, Rutherford scattering nuclear reactions conservation law, fission and fusion, particle accelerators and detectors, elementary idea about photons, baryons, mesons and heptons; quark model.
- **ELECTRONICS:** Semiconductor devices (diodes , junctions, transistors, field effect device, homo-and hetro-junction devices), device characteristics, frequency dependence and applications. Opto-electronic device(Solar cells, photo-detectors, LEDs).Operational amplifiers and their applications. Digital techniques and application (registers, counters, comparators, and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics.

POLITICAL SCIENCE

1. Political Theory and Thought

Ancient Indian Political Thought: Kautilya and Shanti Parva. Greek Political Thought: Plato and Aristotle. European Thought -I: Machiavelli, Hobbes, Locke, Rousseau. European Thought - II: Bentham, J. S. Mill, Hegel, Marx and Green. Contemporary Political Thought -I: Lenin, Mao, Gramsci. Contemporary Political Thought - II: Rawls, Nozic and Communitarians. Modern Indian Thought: Gandhi, M. N. Roy, Aurobindo Ghosh, Jay Prakash Ambedkar, Savarkar. Concepts and Issue -I: Medieval Political Thought: Church State Relationship and Theory of Two Swords. Concepts and Issue - II: Behaviouralism and Post-Behaviouralism, Decline and Resurgence of Political Theory. Democracy, Liberty and Equality.

2. Comparative Politics and Political Analysis, Evolution of Comparative Politics as a discipline; nature and scope. Approaches to the study of Comparative politics: Traditional, Structural- Functional, Systems and Marxist. Constitutionalism: Concepts, Problems and Limitations. Forms of Government: Unitary - Federal, Parliamentary - Presidential. Organs of Government: Executive, Legislature, Judiciary - their interrelationship in comparative perspective. Party Systems and Pressure Groups; Electoral Systems. Bureaucracy -types and roles. Political Development and Political Modernization. Political Culture, Political Socialization and Political Communication. Political Elite; Elitist theory of Democracy. Power, Authority and Legitimacy. -Revolution: Theories and Types. Dependency: Development and Under Development.

3. Indian Government and Politics

National Movement, Constitutional Developments and the Making of Indian Constitution. Ideological Bases of the Indian Constitution, Preamble, Fundamental Rights and Duties and Directive Principles. Constitution as Instrument of Socio-Economic Change, Constitutional Amendments and Review. Structure and Process -I: President, Prime Minister, Council of Ministers, Working of the Parliamentary System. Structure and Process - II : Governor, Chief Minister, Council of Ministers, State Legislature. Panchayati Raj Institutions : Rural and Urban, their working. Federalism : Theory and Practice in India; Demands of Autonomy and Separatist Movements; Emerging trends in Centre-State Relations. Judiciary : Supreme Court, High Courts, Judicial Review, Judicial Activism including Public Interest Litigation cases, Judicial Reforms. Political Parties, Pressure Groups, Public Opinion, Media; Subaltern and Peasant

Movements. Elections, Electoral Behaviour, Election Commission and Electoral Reforms.

4. Public Administration

Development of Public Administration as a discipline; Approaches to the study of Public Administration: Decision-making, Ecological and Systems; Development Administration. Theories of organization. Principles of organization: Line and staff, unity of command, hierarchy, span of control, centralization and decentralization, Types of organization - formal and informal; Forms of organization; department, public corporation and board. Chief Executive: Types, functions and roles. Personnel administration: Recruitment, Training, Promotion, Discipline, Morale; Employee-Employer Relations. Bureaucracy : Theories, Types and Roles; Max Weber and his critics. Civil servant - Minister relationship. Leadership, its role in decision-making; Communication. Financial Administration : Budget, Audit, Control over Finance with special reference to India and UK. Good Governance; Problems of Administrative Corruption; Transparency and Accountability; Right to Information. Grievance Redressal Institutions : Ombudsman, Lokpal and Lokayukta.

5. International Relations

Contending Theories and Approaches to the study of International Relations; Idealist, Realist, Systems, Game, Communication and Decision-making. Power, Interest and Ideology in International Relations; Elements of Power : Acquisition, use and limitations of power, Perception, Formulation and Promotion of National Interest, Meaning, Role and Relevance of Ideology in International Relations. Arms and Wars : Nature, causes and types of wars/conflicts including ethnic disputes; conventional, Nuclear/bio-chemical wars; deterrence, Arms race, Arms control and Disarmament. Peaceful settlement of disputes, conflict resolution, Diplomacy, World-order and Peace studies. Cold war, Alliances, Non-alignment, End of Cold war, Globalisation. Rights and Duties of states in international law, intervention, Treaty law, prevention and abolition of war. Political Economy of International Relations; New International Economic Order, North-South Dialogue, South-South Cooperation, WTO, Neo-colonialism and Dependency. Regional and sub-regional organisations especially SAARC, ASEAN, OPEC, OAS. United Nations : Aims, Objectives, Structure and Evaluation of the working of UN; Peace and Development perspectives; Charter Revision; Power-struggle and Diplomacy within UN, Financing and Peace-keeping operations. India's Role in International affairs : India's relations with its neighbours, wars, security concerns and pacts, Mediatory Role, distinguishing features of Indian Foreign Policy and Diplomacy.

PSYCHOLOGY

1. **Perceptual Processes**

Approaches to the Study of Perception : Gestalt and physiological approaches Perceptual Organization : Gestalt, Figure and Ground, Laws of Organization Perceptual Constancy : Size, Shape and Brightness, Illusion; Perception of Depth and Movements. Role of motivation and learning in perception

2. **Learning Process**

Classical conditioning : Procedure, Phenomena and related issues Instrumental learning : Phenomena, Paradigms and theoretical issues Reinforcement: Basic variables and schedules Verbal learning : Methods and materials, organizational processes

3. **Memory and forgetting**

Memory processes : Encoding, Storage, Retrieval Stages of memory : Sensory memory, Short-term Memory (STM) and Long-term Memory (LTM), Episodic and Semantic memory. Theories of Forgetting: Interference, decay, retrieval

4. **Thinking and Problem Solving**

Theories of thought processes: Associationism, Gestalt, Information processing Concept formation : Rules and strategies; Reasoning: Deductive and inductive Problem-solving: Type and strategies", Role of concepts in thinking

5. **Motivation and Emotion**

Basic motivational concepts : Instincts, needs, drives, incentives, motivational cycle Approaches to the study of motivation : Psychoanalytical, ethological, S-R Cognitive, humanistic. Biological Motives : Hunger, thirst, sleep and sex . Social Motives : Achievement, affiliation, approval Exploratory behaviour and curiosity Physiological correlates of emotions. Theories of emotions : James-Lange, Cannon-Bard, Schachter and Singer Conflicts : Sources and types

6. **Human Abilities**

Intelligence : Biological, Social, Eco-cultural determinants Theories of intelligence : Spearman, Thurston, Guilford Individual and group differences : Extent and causes Measurement of human abilities

7. **Personality**

Determinants of personality : Biological and socio-cultural. Approaches to the study of personality : Psychoanalytic, neo-freudian, social learning, trait and type, cognitive Personality assessment: Psychometric and projective tests Self-concept: Origin and development

8. Research Methodology

Research problems, hypothesis, variables and their Operationalization
Types of psychological research. Methods of psychological research : Experimental, Quasi - experimental, case studies, field studies and cross-cultural studies.-
Methods of data collection : Observation, interview, questionnaire, tests and scales. Non-parametric tests

9. Measurement and testing

Test construction: Item writing, item analysis test standardization .Reliability, validity and norms. Types of tests : Intelligence, aptitude, personality - characteristics and important examples. Attitude scales and interest inventories _
Educational measurement and evaluation.

10. Biological Basis of Behaviour

Receptors, effectors and adjuster mechanisms Neural impulse : Origin, conduction and measurement Sensory system: Vision and Audition Human nervous system: Structure and functions.

SOCIOLOGY

1. SOCIOLOGICAL CONCEPTS-

Nature of Sociology, Definition, Sociological Perspective Basic Concepts Community Institution Association Culture Norms and Values Social Structure Status and role, their interrelationship Multiple roles, Role set. Status set, Status sequence Role conflict Social Group Meaning " Types : Primary-Secondary, Formal- Informal, Ingroup-Outgroup, Reference group Social Institutions Marriage Family Education Economy Polity Religion Socialization Socialization, Resocialization, Anticipatory socialization. Adult socialization Agencies of socialization Theories of socialization Social Stratification Social differentiation. Hierarchy and Inequality Forms of stratification : Caste, Class, Gender, Ethnic Theories of social stratification Social mobility Social Change Concepts and Types : Evolution, Diffusion, Progress, Revolution, Transformation, Change in structure and Change of structure Theories : Dialectical and Cyclical

2. SOCIOLOGICAL THEORY-

Structural Nadel, Radcliffe Brown, Levi-Strauss Functional, Malinowski Durkheim Parsons, Merton Interactionist, Social action: Max Weber, Pareto Symbolic interactionism : G. H. Mead, Blumer Conflict Karl Marx Dahrendorf Coser Collins

3. METHODOLOGY-

Meaning and Nature of Social Research, Nature of social phenomena the scientific method The problems in the study of social phenomena: Objectivity and subjectivity, fact and value Quantitative Methods Survey, Research Design and its types Hypothesis Sampling Techniques of data collection: Observation, Questionnaire, Schedule, Interview, Qualitative Methods, Participant observation Case study Content analysis Oral history Life history Statistics in Social Research, Measures of Central Tendency: Mean, Median, Mode, Measures of dispersion, Correlational analysis Test of significance Reliability and Validity.

ZOOLOGY

1. **Biology and system physiology of non chordates** : Organization of Coelom, Locomotion, Evolution and adaptive radiation, Economic Importance of fishes, birds and reptiles. Blood and circulation, Cardiovascular system, Respiratory system, Nervous system, Sense Organs, Excretory system, Thermoregulation Digestive system, Endocrinology and reproduction.
2. **Developmental biology**: Basic concept of development, Gometogenesis Fertilization an early development, Morphogenesis and orgononesis in animals.
3. **Inheritance Biology**: Mendel ion Principles and their Extensions, Concept of gene, Extra chromosomal inheritance, Microbial genetics, Human genetics, Quantitative genetics, Mutation, Structural and numerical alteration of chromosomes, Recombination.
4. **Method in Biology**: Molecular biology, Recombinant DNA methods, Wisto chemical and immuno techniques, Biophysical methods, Statistical methods, Radio labeling techniques, Microserpic techniques, Electrophysiological method.
5. **Evolution & Behavior** : Origin of cell and unicellular evolution; Emergence of evolutionary thoughts, Paleontology and evolutionary history, Molecular evolution, Brain behavior and evolution,
6. **Ecological principles & biodiversity and taxonomy**: The Environment, Types of Eco system, Population ecology, Community ecology, Biogeography, Consecration biology, Sustainable development.

CHEMICAL ENGINEERING

Basic Chemical Engineering Calculations Process variables estimation, basic Chemical Engineering Calculations, Material balance on reactive and non-reactive systems, Energy balance on reactive and non-reactive systems.

Fluid flow operations Fluid statics, Pressure drop measurement by manometers, Newtonian and Non-Newtonian fluids, Mass and momentum balance equation, Bernoulli equation, friction factor, pressure drop for flow through pipe, flow meters, pumps and compressors, agitation and mixing.

Mechanical Operations Sieve analysis, Sphericity and Specific surface area of solids, Size reduction, Ball mill. Estimation of drag, Motion of particles in fluid. Free and Hindered settling, Estimation of terminal velocity, Sedimentation, Fluid flow through a packed bed, Determination of Pressure drop through packed bed, Determination of minimum fluidization velocity and pressure drop. Cake filtration, Gas-fluid separation.

Mass Transfer Diffusion in fluids, steady state diffusion, diffusivity of liquids and gases, Mass transfer coefficient, theories for mass transfer coefficient, Absorption, Distillation, liquid-liquid extraction, Adsorption, Humidification and drying, Leaching, crystallization. Heat Transfer Steady-State Conduction in Plane Wall, The Cylinder and Sphere, Convection in Laminar Flow in Circular Tubes, Convection in Turbulent Flow in Circular Tubes, Heat Transfer by radiation, Boiling and Condensation, Heat Exchangers, Heat Exchanger Design.

Chemical Reaction Engineering Elementary and non-elementary reactions, Rate of reaction, Rate constant and order of reaction, Arrhenius' law, Activation energy, Constant volume batch reactor, Variable volume batch reactor, Types of reactors, PFR, CSTR etc, Size comparison of single reactors, Performance equations for CSTR and PFR; RTD of fluid in reactors, Homogenous and heterogeneous reactions.

Chemical Engineering Thermodynamics The law of conservation of Energy, First Law of Thermodynamics: Closed and Open Systems, enthalpy, heat capacity, specific heat, Equation of state, Estimation of thermodynamic properties. Heat effects, Second law and entropy, Maxwell's relations and fluid property estimation, Residual properties, Single Phase Mixtures and Solutions; Partial molar properties, Gibbs-Duhem equation, fugacity and fugacity coefficient for pure components and for mixture of gases and liquids. Excess properties of mixtures, activity co-efficient, Chemical reaction equilibrium.