PAPER I (COMPULSARY)

RESEARCH APPTITUDE

(It may be treated as the guide lines of preparation for the Entrance Test)

I. Application of Statistical Concepts/Procedures: Data: Diagrammatical Representation of data: Probability; Dispersion; Skewness and Kurtosis of Normal Distribution; Other natural distributions, Random Sampling.

II. Testing of Hypothesis Tests, X2 (Chi-square), and F-tests, Analysis of Variance, Covariance, Analysis of Variance, Parameters and variables.

III. Functional Units of a Computer; Operating Systems; Files and Folders, Word Editing and Formatting a Document; Excel sheets & Tables; Editing and Formatting Worksheets, Creating and Printing a Presentation; Producing a Slide Show and function keys; Performing Basic Calculations; Using the Internet and the World Wide Web.

IV. Learning Software Packages Specific to the Subject. Creation of Questionnaire Online, Analysis and Interpretation of Data, Construction of Charts, Diagrams, Sharing of Information Online with Respondents, etc. using the following Online Tools:(i) Google Docs (ii) Google Scholar (iii) Research gates (iv) Survey Moneys.

V. Research and funding Organizations and Important research awards (including awardees), Current areas of research

VI. Higher education, policies and commissions, Science and applications

PAPER II (ELECTIVE – AS PER DISCIPLINE)

MANAGEMENT (FINANCE / ACCOUNTING)

1. 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, Capital Budgeting

2. 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. partnership accounts: admission, retirement, death, and dissolution and cash distribution, advanced company accounts: issue, forfeiture, purchases of business, liquidation, valuation of shares, amalgamation, absorption and reconstruction, holding company accounts, cost and management accounts: ratio analysis, fund flow analysis, cash flow analysis, marginal costing and break even analysis, standard costing, budgetary control, costing for decision making, responsibility accounting.
3. Accounting standard in India, inflation accounting, human resource accounting, responsibility accounting, social accounting, money and capital market, working of stock exchange in India, NSE, OTCEI, NASDAQ, derivatives and options, Regularity authorities: SEBI, rating agencies, new instruments, GDRs, ADRs., venture capital funds, mergers and acquisitions, mutual funds, lease financing, factoring, valuation of securities; pricing theories – capital asset pricing model and arbitrage pricing theory, understanding financial statements and analysis thereof, capital budgeting decisions; risk analysis in capital budgeting and long term sources of finance, capital structure – theories and factors, cost of capital, dividend policies – theories and determinants, working capital management- determinants and financing; cash management; inventory management, receivable management, elements of derivatives, corporate risk management, mergers and acquisitions, international financial management.
4. India's foreign trade and policy; export promotion policies; trade agreements with other countries; policy and performance of export zones and export oriented units, export incentives, international marketing logistics, international logistical structures; export documentation framework; organization of shipping services; chartering practices; marine cargo insurance.
5. International financial environment; foreign exchange markets; determination of exchange rates; exchange risk measurement; international investment; international capital markets; international credit rating agencies and implications of their ratings.
6. WTO and multilateral trade agreements pertaining to trade in goods; trade I services and TRIPS ; multilateral environmental agreements (MEAs); international trade blocks – NAFTA, ASEAN, SAARC, EU, WTO and dispute settlement mechanism. Technology monitoring; emerging opportunities for global business.
7. Concepts – types, characteristics; motivation; competencies and its development; innovation and entrepreneurship; small business- concepts Government policy for promotion of small and

tiny enterprises; process of business opportunity identification; detailed business plan preparation; managing small enterprises; planning for growth; sickness in small enterprises; rehabilitation of sick enterprises; intrapreneurship (Organizational entrepreneurship).

8. Role and scope of 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 operation research; linear programming; sensitivity analysis; duality; transportation model; inventory control, queueing theory; decision theory; markov analysis; PERT/CPM.
9. Marketing environment and environment scanning; marketing information system 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. Promotions decisions- promotion mix; advertising; personal selling; channel management; vertical marketing systems; evaluation and control of marketing effort; marketing of services; customer relation management. Uses of internet as a marketing medium – other related issues like branding, market development, advertising and retailing on the net. New issues in marketing.
10. Concepts and perspective in HRM; HRM in changing environment. Human resource planning – objectives, process and techniques. Job analysis – job description, selecting human resources, introduction, 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 grievance management, labour welfare and social security and measures.
11. Concepts of corporate strategy; components of strategy formulation; Ansoffs growth vector; BCG models; porter's generic strategies; competitor analysis; strategic dimensions and group mapping; industry analysis; strategies in industry evolution, fragmentation, maturity and decline; competitive strategy and corporate strategy; transnationalization of world economy; managing cultural diversity; global entry strategies; globalization of financial system and services; managing international business; competitive advantage of nations; RTP and WTO.
12. Income tax law and tax planning: Basic concepts, residential status and tax incidence, exempted incomes, computation of taxable income under various heads, computation of taxable income of individual and firms, deductions of tax, filing of returns, different types of assessment, defaults and penalties, tax planning: concept, significance and problems of tax planning, tax evasion and tax avoidance, method of tax planning, tax consideration in specific business decisions viz make or buy own or lease, retain or replace, export or domestic sales; shout down or closure, expand or contract, invest or disinvest. Computer application in income tax and tax planning.

CHEMISTRY

INORGANIC CHEMISTRY

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of Molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and Bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, Spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, Analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
10. Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.

PHYSICAL CHEMISTRY

1. Basic principles of quantum mechanics: Postulates; operator algebra; particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
5. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
6. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
7. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
8. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye- Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
9. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

10. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
11. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

ORGANIC CHEMISTRY

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in Acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, Organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
10. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
11. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

MATHEMATICS

Abstract Algebra-

Definition of a group with examples and simple properties (including its alternate definitions). Permutation group, cycle, transpositions, even and odd permutations. Subgroups of a group with its properties,Cyclic groups and their properties, Cosets decomposition. Index of a subgroup, Lagrange's theorem and its applications. Normal subgroups with properties. Simple groups, Quotient groups. Group homomorphism with its kernel and properties. Isomorphism, Fundamental theorem of homomorphism. Rings, Zero divisors, integral domains and fields. Characteristic of a ring, Subrings, subfield, prime field. Ideals and their properties. Principal ideals and principal ideal ring. Prime ideal. Maximal ideal. Fundamental theorem of ring homomorphism.

Numerical Analysis-

Operators: forward difference, backward difference, Shift E, Inverse shift E-1, Differentiation D, Central -Difference, Mean difference, Central sum , Divided difference, Inter relation between various operators, Forward and backward difference table. Factorials notation. Interpolation with equal and unequal intervals, Central difference interpolation, inverse interpolation. Numerical differentiation and Numerical –Integration: Trapezoidal rule, Weddle rule, Simpson's rules, Gauss quadrature formula. Solution of equations: Bisection method, regula-falsi method and Newton-Raphson method. Solution of ordinary differential equations. Picard's mathod, Euler's and modified Euler's methods, Miline's method and Runga Kutta second and fourth order method.

Differential Equation-

Order and Degree of a differential equation. Differential equations of first order and first degree, variables separable, homogeneous equations. Linear equations and equations reducible to linear form. Exact differential equations and equations reducible to exact forms.

Linear differential equations of second order, Linear differential equations with constant coefficients, Total differential equations. Linear differential equations of second order. Transformation by changing the dependent / independent variable. Method of variation of parameters, Exact differential equations and certain particular forms of equations. Partial differential equations of first order, Lagrange's solution. Charpit's general method of solution. Partial differential equations of second and higher orders. Classification of linear partial differential equations of second order.

Linear Algebra-

Definition and examples of a vector space, Subspace of a vector space, Linear combination and Linear span, Linear dependence and independence of vectors, direct sums of subspaces. Basis and dimension of finitely generated spaces. Quotient space, Linear transformation, Rank and nullity of linear transformation. Characteristic values and characteristic vectors of matrices and linear transformations. Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations. Characteristic equation, Eigen values and eigen vectors of a matrix, Cayley-Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear (both homogeneous and non-homogeneous) equations, Consistency and general solution, Diagonalization of square matrices with distinct eigen values.

Statistics and Probability Theory-

Foundations of probability theory, Permutations, Combinations, Sample space, sigma algebra. Axioms of probability theory. Conditional probability, independent events. Baye's theorem. Discrete random variables Definition of a random variable, Probability mass functions and probability distribution functions, Bernoulli trials and related distributions, Poisson distribution, Uniform distribution, Mean and variance. Continuous random variables Definition of a continuous random variable, Probability density function. Summarising a continuous RV, uniform, exponential and gamma distributions, normal distribution. Skewness and tail thickness. Distribution of functions of a continuous random variable.

PHYSICS

Mathematical Methods of Physics
Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

Classical Mechanics
Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence.

Electromagnetic Theory
Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields.

Quantum Mechanics
Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.

Thermodynamic and Statistical Physics
Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases.

Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics.
Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting,

Atomic & Molecular Physics
Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

Condensed Matter Physics
Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

Nuclear and Particle Physics
Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

ENGLISH

1. Chaucer to Shakespeare
2. Jacobean to Restoration Periods
3. Augustan Age : 18th Century Literature
4. Romantic Period
5. Victorian Period
6. Modern Period
7. Contemporary Period
8. American and other non – British Literatures
9. Literary Theory and Criticism
10. Rhetoric and Prosody

SOCIOLOGY

Classical Sociological Theory
The socio-historical and intellectual background of Sociology; August Comte (Sociology — Positivism — social evolution); Karl Marx (historical and dialectical materialism — class conflict — capital — base and super structure); Emile Durkheim (social Fact — methodology — social solidarity — social change — religion and society); Max Weber (social Action— methodology— authority — class, status and power — religion and economy)

Modern Sociological Theory
Conflict Theory and Neo-Marxism (Lewis Coser — Ralf Dahrendorf — Antonio Gramsci — Louis Althusser — Habermas) Functionalism and Neo-Functionalism (Talcott Parsons— Robert Merton —Jefferey Alexander) Interpretative Sociology (G.H. Mead — Harold Garfinkel — Erving Goffman — Alfred Schutz — Peter Berger — Luckmann)

Social Research Method
Meaning and nature (social phenomena — scientific enquiry — objectivity and subjectivity — fact and value); Quantitative methods (survey — research design — hypothesis — sampling , techniques of data collection: observation, questionnaire and interview); Qualitative methods (participant observation — case study — content analysis — oral history — life history); Statistical tools (measures of central tendency— measures of dispersion — correlation — test of significance — reliability and validity).

Sociology of India
Approaches to the Study of Indian Society (Indology — Civilizational — Functional — Marxist — Subaltern); People of India (groups and communities— unity and diversity — pluralism); Caste structure and change (Tribe and Caste— forms of caste — caste and social institutions — changes in caste system); Rural social structure (village community — change in village community); Family, kinship and marriage; Religion in India (ideology — organization — religious movement)

Social Stratification
Theories of social stratification (social class — class, status, and party — cultural stratification); Issues in stratification (difference — hierarchy — equality and inequality); Forms of stratification (caste — class — gender — ethnic); Stratification and social mobility in India.

Economy and Society
Theories on economic social relationship; Features of industrial society (factory system — division of labor— bureaucracy — rationality— production relations — surplus value — alienation); Relationships (labor — management — conciliation — adjudication — arbitration— collective bargaining — trade unions — Joint management councils — quality circles); Agriculture, Industry and service sectors; Industrialization and social change in India; Industrial planning.

Political Sociology

Approaches to the study of politics; Concepts (power and authority — consensus and conflict— elites and masses— state and stateless societies); Local, everyday power and wider political system; State and society under capitalism; Citizenship and the welfare state; sovereignty and institutional autonomy; state and society in India; Civil society and social mobilization.

Sociology of Development

Conceptual perspectives (economic— human — social — sustainable — ecological notions of development); Theories of underdevelopment (Max Weber — Gunnar Myrdal — Frank — Samir Amin — Wallerstein); Paths of development (modernization — globalization —Socialist — Mixed — Gandhian); Social structure and development; Culture and development

Family, Kinship and Marriage

Theories; family (types — characteristics) kinship (incest taboo — honor — descent, residence and inheritance); Marriage patterns (exchange — alliance — bride-wealth — dowry — social reproduction — monogamy — plural marriages); Culture, law and economy; Indian case.

AGRICULTURE

AGRONOMY

Agro meteorology and Crop Weather Forecasting, Cropping Systems and Sustainable Agriculture, Principles and Practices of Water Management, Principles and Practices of Soil Fertility and Nutrient Management, Modern Concepts in Crop Production, Principles and Practices of Weed Management, Agronomy of Major Cereals and Pulses and Agronomy of Oilseeds, Fi re and Commercial Crops.

SOIL SCIENCE

Soil Chemistry, Soil Mineralogy, Genesis, Classification And Survey, Analytical techniques and instrumental methods in soil and plant analysis, Soil Fertility And Fertilizer Use, Soil biology and Biochemistry, Soil, water and air pollution, Fertilizer technology, Soil Physics, Management Of Problem Soils And Waters, Advances in soil fertility, Advances in soil physics, Physical chemistry of soils, Biochemistry of soil organic matter, Land Use Planning and Watershed Management and Soil genesis and micro pedology.

PLANT BREEDING

Principles of Genetics and Cell Biology, Principles of Plant Breeding, Molecular Genetics, Plant genetic resources & seed technology, Principles of Quantitative Genetics, Biotechnology for Crop Improvement, Principles of Cytogenetics, Mutagenesis and Mutation Breeding, Heterosis Breeding, Advanced Genetics, Advanced Biometrical and Quantitative Genetics, Genetic Engineering, Breeding Designer Crops,

FORESTRY

Silviculture - Principles and Practices, Silviculture Systems, Silviculture of Indian trees and shrubs, Forest Seed Technology, Plantation Forestry, Agroforestry Systems, Socioeconomics of Agroforestry System Management, Agroforestry and Reclamation of Degraded and Problem Areas, Modern Nursery Technology, Forest Ecology, Energy Plantations and Biofuels, Climate Change Mitigation through Land Use Management, Watershed Management, Forest Management, Forests and People, Forest Resource Management and Economics, Forest Protection, Forests and Environmental Policies, Laws and International Conventions, Non-Timber Forest Produce, Forest Mensuration and Tree Breeding & Improvement.

AGRICULTURE ENTOMOLOGY

- Insect Morphology
- Insect Ecology
- Principles of Integrated Pest Management
- Classification of Insects
- Insect Physiology and Nutrition
- Toxicology of Insecticides
- Pests of Field Crops
- Pests Of Horticultural and Plantation Crops
- Biological Control of Crop Pests and Weeds
- Beneficial Insects

COMPUTER APPLICATIONS

DISCRETE STRUCTURES

Sets, Relations, Functions. Pigeonhole Principle, Inclusion-Exclusion Principle, Equivalence and Partial Orderings, Elementary Counting Techniques, Probability. Measure(s) for information and Mutual information.

Computability : Models of computation—Finite Automata, Pushdown Automata, Non-determinism and NFA, DPDA and PDAs and Languages accepted by these structures. Grammars, Languages, Non-computability and Examples of non-computable problems.

Graph : Definition, walks, paths, trails, connected graphs, regular and bipartite graphs, cycles and circuits. Tree and rooted tree. Spanning trees. Eccentricity of a vertex radius and diameter of a graph. Central Graphs. Centre(s) of a tree. Hamiltonian and Eulerian graphs, Planar graphs.

Groups : Finite fields and Error correcting/detecting codes.

COMPUTER ARITHMATIC

Propositional (Boolean) Logic, Predicate Logic, Well-formed-formulae (WFF), Satisfiability and Tautology.

Logic Families : TTL, ECL and C-MOS gates. Boolean algebra and Minimization of Boolean functions, Flip-flops—types, race condition and comparison. Design of combinational and sequential circuits.

Representation of Integers : Octal, Hex, Decimal, and Binary. 2's complement and 1's complement arithmetic. Floating point representation.

PROGRAMMING IN C AND C++

Programming in C : Elements of C—Tokens, identifiers, data types in C. Control structures in C. Sequence, selection and iteration(s). Structured data types in C—arrays, struct, union, string, and pointers.

O-O Programming Concepts : Class, object, instantiation. Inheritance, polymorphism and overloading.

C++ Programming : Elements of C++ —Tokens, identifiers. Variables and constants, Data types, Operators, Control statements. Functions parameter passing. Class and objects. Constructors and destructors. Overloading, Inheritance, Templates, Exception handling.

RELATION DATABASE DESIGN AND SQL

E-R diagrams and their transformation to relational design, normalization—1NF, 2NF, 3NF, BCNF and 4NF. Limitations of 4NF and BCNF.

SQL : Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL) commands. Database objects like—Views, indexes, sequences, synonyms, data dictionary.

DATA AND FILE STRUCTURES

Data, Information, Definition of data structure. Arrays, stacks, queues, linked lists, trees, graphs, priority queues and heaps.

File Structures : Fields, records and files. Sequential, direct, index-sequential and relative files. Hashing, inverted lists and multi-lists. B trees and B^+ trees.

COMPUTER NETWORKS

Network fundamentals : Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless Networks, Inter Networks.

Reference Models : The OSI model, TCP/IP model.

Data Communication : Channel capacity. Transmission media—twisted pair, coaxial cables, fibre-optic cables, wireless transmission—radio, microwave, infrared and millimeter waves. Lightwave transmission. Thelephones—local loop, trunks, multiplexing, switching, narrowband ISDN, broadband ISDN, ATM, High speed LANS. Cellular Radio. Communication satellites—geosynchronous and low-orbit.

Internetworking : Switch/Hub, Bridge, Router, Gateways, Concatenated virtual circuits, Tunnelling, Fragmentation, Firewalls.

Routing : Virtual circuits and datagrams. Routing algorithms. Conjestion control.

Network Security : Cryptography—public key, secret key. Domain Name System (DNS)—Electronic Mail and Worldwide Web (WWW). The DNS, Resource Records, Name servers. E-mail-architecture and Serves.

SYSTEM SOFTWARE AND COMPILERS

Assembly language fundamentals (8085 based assembly language programming). Assemblers—2-pass and single-pass. Macros and macroprocessors.

Loading, linking, relocation, program relocatability. Linkage editing.

Text editors. Programming Environments. Debuggers and program generators.

Compilation and Interpretation. Bootstrap compilers. Phases of compilation process. Lexical analysis. Lex package on Unix system.

Context free grammars. Parsing and parse trees. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom up parsers—shift-reduce, operator precedence, and LR. YACC package on Unix system.

Topdown parsers—left recursion and its removal. Recursive descent parser. Predictive parser, Intermediate codes—Quadruples, Triples, Intermediate code generation, Code generation, Code optimization.

OPERATING SYSTEMS (WITH CASE STUDY OF UNIX)

Main functions of operating systems. Multiprogramming, multiprocessing, and multitasking.

Memory Management : Virtual memory, paging, fragmentation.

Concurrent Processing : Mutual exclusion. Critical regions, lock and unlock.

Scheduling : CPU scheduling, I/O scheduling, Resource scheduling, Deadlock and scheduling algorithms. Banker's algorithm for deadlock handling.

UNIX

The Unix System : File system, process management, bourne shell, shell variables, command line programming.

Filters and Commands : Pr, head, tail, cut, paste, sort, uniq, tr, join, etc., grep, egrep, fgrep, etc., sed, awk, etc.

System Calls (like) : Creat, open, close, read, write, iseek, link, unlink, stat, fstat, umask, chmod, exec, fork, wait, system.

SOFTWARE ENGINEERING

- *System Development Life Cycle (SDLC)* : 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* : Testing level metrics. Software quality and reliability. Clean room approach, software reengineering.

PHARMACY

1. bsorptiometric assay of Organic Compounds, Structural Analysis. Theory and instrumentation, of the following: IR, NMR and Mass Spectrometry, Optical Rotatory Dispersion, H.P.L.C, HPTLC, GC and hyphenated techniques (LC-MS), TGA, DTA, DSC and XRD.
2. Structure Activity relationships, mechanism of action and synthesis for following class of drugs: Antimicrobial and Antiviral agents, Antimalarial, Anticancer, Analgesics and Antiinflammatory agents, Antidiabetics, Cardiovascular and Antifertility agents. Basic concepts of drug design with reference to physicochemical parameters related to ligand and receptor design, QSAR basics like Hansch approach.
3. Basics of stereochemistry including enantiomers, diastereomers, resolution, meso compounds, configuration and its specifications including sequence rule. Reaction Mechanism and principles of Oxidation, Reduction, Aliphatic and Aromatic nucleophillic and Electrophilic substitutions, Addition, Elimination and Rearrangement reactions.
4. Organization of screening for the pharmacological activity of new substances with emphasis on evaluation using in-vivo, in-vitro, ex-vivo, in-situ, in silico toxicity evaluation and other possible animal alternative models.
5. Neurohumoral transmission in CNS and ANS. Autacoid Pharmacology.
6. Fundamentals involved in Physical, Chemical and Biological evaluation of crude drugs. Monograph preparation of herbal drugs and standard tests involved thereof.
7. Approaches for enhancement of production of secondary metabolites using techniques like tissue culture, r-DNA technology and biotransformation. Biological sources, method of preparation, active constituents, adulterants of antidiabetic, Anti-inflammatory, antiasthmatic, antibacterial and anticancer drugs.
8. Preformulation (Physical, Chemical and Biopharmaceutical Characteristics of Medicinal Agent). Stability Testing and Dating. Diffusion and Dissolution.
9. Product Development Approaches for the Conventional Dosage Form (Tablet, Capsule, Sustained Release Formulation, Injectables, Ointment).
10. Fundamentals, Basic Concepts and Approaches involved in Newer Drug Delivery Systems.
11. Biopharmaceutics: Biopharmaceutical Consideration in drug product Design (Factors influencing Dosage Form Design, Drug Dissolution & Bioavailability. Rate-limiting steps in Bioavailability). Bioavailability Assessment and Bioequivalence Studies.
12. Pharmacokinetics: Principle, Basic concept and Characteristics of Compartment Models. Nonlinear (Dose dependent) Pharmacokinetics.

Hindi

हिन्दी भाषा और उसका विकास

अपभ्रंश (अवहट्ट सहित) और पुरानी हिन्दी का सम्बन्ध, काव्यभाषा के रूप में अवधी का उदय और विकास, काव्यभाषा के रूप में ब्रजभाषा का उदय और विकास, साहित्यिक हिन्दी के रूप में खड़ी बोली का उदय और विकास, मानक हिन्दी का भाषा वैज्ञानिक विवरण (रूपगत), हिन्दी की बोलियाँ — वर्गीकरण तथा क्षेत्र, नागरी लिपि का विकास और उसका मानकीकरण ।

हिन्दी प्रसार के आन्दोलन, प्रमुख व्यक्तियों तथा संस्थाओं का योगदान, राजभाषा के रूप में हिन्दी ।

हिन्दी भाषा-प्रयोग के विविध रूप — बोली, मानकभाषा, सम्पर्कभाषा, राजभाषा और राष्ट्रभाषा, संचार माध्यम और हिन्दी ।

हिन्दी साहित्य का इतिहास

हिन्दी साहित्य का इतिहास-दर्शन, हिन्दी साहित्य के इतिहास-लेखन की पद्धतियाँ ।

हिन्दी साहित्य के प्रमुख इतिहास ग्रन्थ, हिन्दी के प्रमुख साहित्यिक केन्द्र, संस्थाएँ एवं पत्र-पत्रिकाएँ, हिन्दी साहित्य के इतिहास का काल-विभाजन और नामकरण ।

आदिकाल : हिन्दी साहित्य का आरम्भ कब और कैसे ? रासो-साहित्य, आदिकालीन हिन्दी का जैन साहित्य, सिद्ध और नाथ साहित्य, अमीर खुसरो की हिन्दी कविता, विद्यापति और उनकी पदावली, आरम्भिक गद्य तथा लौकिक साहित्य ।

मध्यकाल : भक्ति-आन्दोलन के उदय के सामाजिक-सांस्कृतिक कारण, प्रमुख निर्गुण एवं सगुण सम्प्रदाय, वैष्णव भक्ति की सामाजिक-सांस्कृतिक पृष्ठभूमि, आलवार सन्त, प्रमुख सम्प्रदाय और आचार्य, भक्ति आन्दोलन का अखिल भारतीय स्वरूप और उसका अन्तःप्रादेशिक वैशिष्ट्य ।

हिन्दी सन्त काव्य : सन्त काव्य का वैचारिक आधार, प्रमुख निर्गुण सन्त कवि कबीर, नानक, दादू, रैदास, सन्त काव्य की प्रमुख विशेषताएँ, भारतीय धर्म साधना में सन्त कवियों का स्थान ।

हिन्दी सूफी काव्य : सूफी काव्य का वैचारिक आधार, हिन्दी के प्रमुख सूफी कवि और काव्य — मुल्ला दाऊद (चन्दायन), कुतुबन (मिरगावती), मंझन (मधुमालती), मलिक मुहम्मद जायसी (पद्मावत), सूफी प्रेमाख्यानकों का स्वरूप, हिन्दी सूफी काव्य की प्रमुख विशेषताएँ ।

हिन्दी कृष्ण काव्य : विविध सम्प्रदाय, वल्लभ सम्प्रदाय, अष्टछाप, प्रमुख कृष्ण-भक्त कवि और काव्य, सूरदास (सूरसागर), नन्ददास (रास पंचाध्यायी), भ्रमरगीत परम्परा, गीति परम्परा और हिन्दी कृष्ण काव्य — मीरा और रसखान ।

हिन्दी राम काव्य : विविध सम्प्रदाय, राम भक्ति शाखा के कवि और काव्य, तुलसीदास की प्रमुख कृतियाँ, काव्य रूप और उनका महत्व ।

रीति काल : सामाजिक-सांस्कृतिक परिप्रेक्ष्य, रीतिकाव्य के मूल स्रोत, रीतिकाल की प्रमुख प्रवृत्तियाँ, रीतिकालीन कवियों का आचार्यत्व, रीतिमुक्त काव्यधारा, रीतिकाल के प्रमुख कवि : केशवदास, मतिराम, भूषण, बिहारीलाल, देव घनानन्द और पद्माकार, रीतिकाव्य में लोकजीवन ।

आधुनिक काल : हिन्दी गद्य का उद्भव और विकास ।

भारतेन्दु पूर्व हिन्दी गद्य, 1857 की राज्य क्रान्ति और सांस्कृतिक पुनर्जागरण, भारतेन्दु और उनका मण्डल, 19 वीं शताब्दी के उत्तरार्द्ध की हिन्दी पत्रकारिता ।

द्विवेदी युग : महावीर प्रसाद द्विवेदी और उनका युग, हिन्दी नवजागरण और सरस्वती, मैथिलीशरण गुप्त और राष्ट्रीय काव्यधारा, राष्ट्रीय काव्यधारा के प्रमुख कवि, स्वच्छन्दतावाद और उसके प्रमुख कवि ।

छायावाद और उसके बाद : छायावादी काव्य की प्रमुख विशेषताएँ, छायावाद के प्रमुख कवि : प्रसाद, निराला, पन्त और महादेवी, उत्तर छायावादी काव्य और उसके प्रमुख कवि, प्रगतिशील काव्य और उसके प्रमुख कवि, प्रयोगवाद और नई कविता, नई कविता के कवि, समकालीन कविता, समकालीन साहित्यिक पत्रकारिता ।

हिन्दी साहित्य की गद्य विधाएँ

हिन्दी उपन्यास : प्रेमचन्द पूर्व उपन्यास, प्रेमचन्द और उनका युग, प्रेमचन्द के परवर्ती प्रमुख उपन्यासकार : जैनेन्द्र, अज्ञेय, हजारी प्रसाद द्विवेदी, यशपाल, अमृतलाल नागर, फणीश्वरनाथ रेणु, भीष्म साहनी, कृष्णा सोबती, निर्मल वर्मा, नरेश मेहता, श्रीलाल शुक्ल, राही मासूम रजा, रांगेय राघव, मन्नू भण्डारी ।

हिन्दी कहानी : बीसवीं सदी की हिन्दी कहानी और प्रमुख कहानी आन्दोलन ।

हिन्दी नाटक : हिन्दी नाटक और रंगमंच, विकास के चरण और प्रमुख नाट्यकृतियाँ : अंधेर नगरी, चन्द्रगुप्त, अंधायुग, आधे-अधूरे, आठवां सर्ग, हिन्दी एकांकी ।

हिन्दी निबन्ध : हिन्दी निबन्ध के प्रकार और प्रमुख निबन्धकार — रामचन्द्र शुक्ल, हजारीप्रसाद द्विवेदी, कुबेरनाथ राय, विद्यानिवास मिश्र, हरिशंकर परसाई ।

हिन्दी आलोचना : हिन्दी आलोचना का विकास और प्रमुख आलोचक : रामचन्द्र शुक्ल, नन्ददुलारे वाजपेयी, हजारी प्रसाद द्विवेदी, रामविलास शर्मा, डॉ० नगेन्द्र, डॉ० नामवर सिंह, विजयदेव नारायण साही।

हिन्दी की अन्य गद्य विधाएँ : रेखाचित्र, संस्मरण, यात्रा-साहित्य, आत्मकथा, जीवनी और रिपोर्ताज़ ।

काव्यशास्त्र और आलोचना

भरत मुनि का रस सूत्र और उसके प्रमुख व्याख्याकार ।

रस के अवयव ।

साधारणीकरण ।

शब्द शक्तियाँ और ध्वनि का स्वरूप ।

अलंकार — यमक, श्लेष, वक्रोक्ति, उपमा, रूपक, उत्प्रेक्षा, संदेह, भ्रान्तिमान, अतिशयोक्ति, अन्योक्ति, समासोक्ति, अत्युक्ति, विशेषोक्ति, दृष्टान्त, उदाहरण, प्रतिवस्तूपमा, निदर्शना, अर्थान्तरन्यास, विभावना, असंगति तथा विरोधाभास ।

रीति, गुण, दोष ।

मिथक, फन्तासी, कल्पना, प्रतीक और बिम्ब ।

स्वच्छन्दतावाद और यथार्थवाद, संरचनावाद, उत्तर संरचनावाद, आधुनिकता, उत्तर आधुनिकता ।

समकालीन आलोचना की कतिपय अवधारणाएँ : विडम्बना (आयरनी), अजनबीपन (एलियनेशन), विसंगति (एब्सर्ड), अन्तर्विरोध (पैराडॉक्स), विखण्डन (डीकन्स्ट्रक्शन) ।

वैचारिक पृष्ठभूमि, मार्क्सवाद, मनोविश्लेषणवाद, आस्तित्ववाद ।

प्रगतिवाद : सामाजिक दृष्टि, नागार्जुन — यथार्थ चेतना और लोक-दृष्टि, केदारनाथ अग्रवाल — प्रकृति चित्रण और सौन्दर्य बोध ।

प्रयोगवाद : व्यष्टि-चेतना, अज्ञेय — प्रयोगधर्मिता और काव्य-भाषा ।

नयी कविता : व्यष्टि-समष्टि-बोध, मुक्तिबोध — समाज-बोध, फैंटसी ।

समकालीन कविता : काल संसक्ति और लोक संसक्ति, रघुवीर सहाय — राजनीतिक चेतना, काव्य-भाषा, कुंवर नारायण — मिथकीय चेतना, काव्य-दृष्टि ।

हिन्दी नाटक और भारतेन्दु : भारत-दुर्दशा, अंधेर नगरी, यथार्थ बोध ।

प्रसाद के नाटक : चन्द्रगुप्त, ध्रुवस्वामिनी, राष्ट्रीय और सांस्कृतिक चेतना, नाट्य-शिल्प ।

प्रसादोत्तर नाटक : अंधायुग, आधे-अधूरे — आधुनिकता बोध, प्रयोगधर्मिता और नाट्य-भाषा ।

निबन्ध और प्रमुख निबन्धकार : बालकृष्ण भट्ट, रामचन्द्र शुक्ल, चिन्तामणि, अन्तर्वस्तु और शिल्प ।

शुक्लोत्तर निबन्ध और निबन्धकार : हजारी प्रसाद द्विवेदी, कुबेरनाथ राय, विद्यानिवास मिश्र, संस्कृति-बोध, लोक-संस्कृति।

भक्ति-काव्य : स्वरूप और भेद, निर्गुण और सगुण का सम्बन्ध : साम्य और वैषम्य ।

कबीर : निर्गुण का स्वरूप, कबीर के राम और तुलसी के राम में अन्तर, रहस्य साधना, कबीर का समाज दर्शन और उनकी प्रासंगिकता, कबीर : कवि के रूप में ।

जायसी : सांस्कृतिक दृष्टि, प्रेम-भावना, पद्मावत में लोक-तत्त्व, संस्कृति, प्रकृति-चित्रण, सौन्दर्य दृष्टि, रूपक तत्त्व ।

सूरदास : भक्ति-भावना, माधुर्य और शृंगार वर्णन, लोक-तत्त्व, सौन्दर्य-बोध, प्रकृति-चित्रण, भ्रमरगीत, अंतर्वस्तु और विदग्धता, गीति-तत्त्व, लीला-भाव, बाल-लीला वर्णन का वैशिष्ट्य ।

तुलसीदास : तुलसी की रचनाएँ, भक्ति, दर्शन, मानस की प्रबन्ध कल्पना, मर्यादा भाव, चित्रकूट सभा का महत्व, सामाजिक-पारिवारिक आदर्श, युग-बोध, रामराज्य की परिकल्पना, तुलसी की काव्य-दृष्टि ।

Paper

Aptitude Test of Education & ICT

1. Philosophical Foundation of Education

Relationship of Education and Philosophy

Western Schools of Philosophy :

Idealism, Realism, Naturalism, Pragmatism, Existentialism, Marxism with special reference to the concepts of knowledge, reality and values their educational implications for aims, contents and methods of education.

Indian Schools of Philosophy (Sankhya, Vedanta, Buddhism, Jainism, Islamic traditions) with special reference to the concept of knowledge, reality and values and their educational implications

Contributions of Vivekananda, Tagore, Gandhi and Aurobindo to educational thinking

National values as enshrined in the Indian Constitution, and their educational implications

Modern concept of Philosophy : Analysis—Logical analysis, Logical empiricism and Positive relativism—(Morris L. Prigge)

2. Sociological Foundations of Education

Relationship of Sociology and Education

Meaning and nature of Educational sociology and Sociology of education

Education—as a social sub-system—specific characteristics

Education and the home

Education and the community with special reference to Indian society

Education and modernization

Education and politics

Education and religion

Education and culture

Education and democracy

Socialization of the child

Meaning and nature of social change

Education as related to social stratification and social mobility

Education as related to social equity and equality of educational opportunities

Constraints on social change in India (caste, ethnicity, class, language, religion, regionalism)

Education of the socially and economically disadvantaged sections of the society with special reference to scheduled castes and scheduled tribes, women and rural population

3. Psychological Foundations of Education

Relationship of Education and Psychology

Process of Growth and Development

— physical, social, emotional and intellectual

— development of concept formation, logical reasoning, problem solving and creative thinking; language development

— individual differences—determinants; role of heredity and environment; implications of individual differences for organising educational programmes

Intelligence—its theories and measurement

Learning and Motivation

Theories of learning—Thorndike is connectionism; Pavlov's classical and Skinner's operant conditioning; Learning by insight; Hull's reinforcement theory and Tolman's theory of learning; Lewin's Field theory

— Gagne's hierarchy of learning

— Factors influencing learning

— Learning and motivation

— Transfer of learning and its theories

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 defence mechanism, mental hygiene and mental health. Sex Education

Guidance

4. Methodology of Educational Research

Nature and Scope of Educational Research

Meaning and Nature

Need and Purpose

Scientific Inquiry and Theory Development—some emerging trends in research

Fundamental—Applied and Action Research

Formulation of Research Problem

Criteria and sources for identifying the problem

Delineating and Operationalizing variables

Developing assumptions and hypothesis in various types of research

Collection of Data

Concept of population and sample

Various methods of sampling

Characteristics of a good sample

Tools and Techniques

Characteristics of a good research tool

Types of research tools and techniques and their uses

Questionnaire-Interviews-Observations

Tests and scales, projective and sociometric techniques

Major Approaches to Research

Descriptive Research

Ex-post facto Research

Laboratory Experiment

Field Experiment

Field Studies

Historical Research

Analysis of Data

Descriptive and Inferential Statistics. The null hypothesis. test of significance, types of error, one-tailed and two-tailed tests

The *t*-test

The *F*-test (one-way and ANOVA)

Non-parametric tests (Chi-square test)

Biserial, point-biserial, tetrachoric and phi-coefficient of correlation

Partial and multiple correlations