ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

RAJAMPET, YSR Kadapa District, AP – 516126, INDIA

COMMON ENTRANCE TEST FOR ADMISSION TO Ph.D PROGRAMMES
SYLLABI FOR RESEARCH ADMISSION TEST-2026 (AURAT)

RESEARCH METHODOLOGY

Research and Types of research: Meaning of Research- Characteristics-Objectives of Research- Motivation in Research. Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Process. Criteria of good Research.

Research Formulation –Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Modeling, Mathematical Models for research.

Interpretation and report writing - Techniques of interpretation - Structure and components of scientific reports -title of the research-Abstract-introduction-literature review-methodology-Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of reports - Technical reports and Conclusions.

Research article, workshop, seminar, conference and symposium. Analysis and Interpretation of research data using statistical tools.

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Note:- Research Methodology is common to all the disciplines in addition to their respective discipline syllabus.

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CIVIL ENGINEERING

Engineering Mechanics: System of forces, Internal forces in structures, Friction and its applications, Centre of mass, free Vibrations of undamped SDOF system.

Solid Mechanics: Bending moment and shear force in statically determinate beams, Simple bending theory, buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/energy methods, Method of superposition, Analysis of trusses, arches, beams, cables and frames, Displacement methods, Slope deflection and moment distribution methods.

Concrete Structures: Working stress and Limit state design concepts, Design of beams, slabs.

Steel Structures: Design of tension and compression members, plate girders.

Soil Mechanics: Three-phase system, index properties, Permeability, flow nets, Principle of effective stress and quicksand condition, Compaction of soils, One dimensional Consolidation, Shear Strength, Mohr's circle.

Foundation Engineering: Sub-surface investigations, plate load test, standard penetration and cone penetration tests, Rankine Earth pressure theory, Stability of slopes, Boussinesq's theory, Deep foundations, Axial load capacity of piles, pile load test, pile group efficiency.

Fluid Mechanics and Hydraulic Engineering: Properties of fluids, fluid statics, Continuity, energy and momentum equations, Flow in pipes, Uniform flow in channels, specific energy, critical flow, hydraulic jump, Turbines, Pumps.

Water Resources Engineering: Hydrologic cycle, unit hydrograph, ground water, duty, delta, Gravity Dams and Spillways, Lined and unlined canals, Design of weirs on permeable foundation, cross drainage structures.

Transportation Infrastructure: Geometric design of Highways, sight distances, horizontal and vertical alignments and Geometric design of Railway Track.

Highway Pavements: Highway materials, Design of flexible and rigid pavements.

Water and Waste Water Quality and Treatment: Water quality, Physical, chemical and biological parameters, Drinking water treatment, Water distribution system, Sewerage system design, primary and secondary treatment.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, solid waste management.

Geomatics Engineering: Principles of surveying, Levelling and trigonometric levelling, Traversing and triangulation survey; Total station, Photogrammetry and Remote Sensing.

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ELECTRICAL & ELECTRONICS ENGINEERING

Electric Circuits

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, three phase circuits.

Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium.

Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; three phase transformers.

Three phase induction motors: principle of operation, types, torque-speed characteristics, equivalent circuit, speed control methods.

Synchronous machines: cylindrical and salient pole machines, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses

Power Systems

Models and performance of transmission lines and cables, Series and shunt compensation, Per-unit quantities, Bus admittance matrix, Newton-Raphson method of load flows, Load Frequency control, economic load dispatch, Symmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, Equal area criterion.

Control Systems

Mathematical modelling and representation of systems, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz criteria, Root loci, Lead-Lag compensators; P, PI and PID controllers; State space model.

Electrical Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers.

Digital Electronics

Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters

Power Electronics

Characteristics of semiconductor power devices: Diode, Thyristor, MOSFET, IGBT; Buck, Boost and Buck-Boost converters; Single and three phase configurations of line commutated thyristor-based converters, Bidirectional ac to dc voltage source converters.

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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; impulse and momentum (linear and angular) and energy formulations.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams, thermal stresses

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; flywheels and governors; balancing of reciprocating and rotating masses. **Vibrations:** Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Machine Design: Basics of Engineering Drawing, Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears.

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli’s equation; viscous flow of incompressible fluids, elementary turbulent flow, flow through pipes, turbines.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth law, first laws of thermodynamics, second law of thermodynamics; thermodynamic relations. Air standard cycles.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, heat transfer through fins; unsteady heat conduction; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer; radiation heat transfer.

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

Production Engineering: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Fundamentals of hot and cold working processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear principles of non-traditional machining processes.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design. Alignment and testing methods

Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

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ELECTRONICS & COMMUNICATION ENGINEERING

NETWORKS, SIGNALS & SYSTEMS

Circuit analysis: Node and mesh analysis, Network Theorems. Time and frequency domain, analysis of linear circuits: RL, RC and RLC circuits, Linear 2-port network parameters, Star-delta transformation. **Continuous & Discrete Time signals:** Fourier series and Fourier transform, sampling theorem and applications, DFT, z-transform, LTI systems: definition and properties, causality, stability, impulse response, convolution.

ANALOG ELECTRONICS

Diffusion & drift current, generation and recombination of carriers, Poisson and continuity equations, P-N junction, Zener diode, Rectifiers, BJT, MOSFET, LED, photo diode and solar cell, clippers, clampers. **BJT and MOSFET amplifiers:** biasing, small signal analysis, frequency response. **Op-amp circuits:** Amplifiers, summers, differentiators, integrators, active filters, oscillators.

DIGITAL ELECTRONICS

Combinational & Sequential circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, multiplexers, decoders, Latches and flip-flops, counters, shift-registers, finite state machines. **Semiconductor memories:** ROM, SRAM, DRAM.

Introduction of Microprocessor 8086 & Microcontroller 8051: Architecture, Addressing modes, instruction set, interrupts, Programming, Memory and I/O interfacing of 8086.

COMMUNICATIONS

Amplitude modulation and demodulation, angle modulation and demodulation super heterodyne receivers, PCM, DPCM, digital modulation schemes (ASK, PSK, FSK), Optical sources: LED, Semiconductor Lasers, Optical fibers: attenuation and dispersion characteristics.

ELECTROMAGNETICS

Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector. **Wave guides & Antennas:** Rectangular and circular wave guides, Antenna Parameters, principles, Dipole and monopole antennas, linear antenna arrays.

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COMPUTER SCIENCE AND ENGINEERING

Discrete Mathematics: Propositional and first order logic, partial orders and lattices, monoids, groups, combinatoric, counting, recurrence relations. Linear Algebra: system of linear equations, eigenvalues and eigenvectors. Calculus**:** Maxima and minima and integration. Probability and Statistics: Random variables, Uniform, normal, exponential, poisson and binomial distributions.

Digital Logic: Boolean algebra, Combinational and sequential circuits, Minimization and computer arithmetic.

Computer Organization: Machine instructions and addressing modes. ALU, control unit. Instruction pipelining, Memory hierarchy and I/O interface.

Programming and Data Structures: Programming in C, Arrays, stacks, queues, linked lists, trees, graphs, searching, sorting and hashing.

Design and Analysis of Algorithms: Asymptotic Notations, Design techniques: greedy, divide-and-conquer, dynamic programming, backtracking and Branch-Bound.

Theory of Computation: Chomsky Hierarchy, Regular expressions and finite automata, Context-free grammars and push-down automata, pumping lemma and Turing machines.

Compiler Design: Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation, Code Optimization and Code Generation.

Operating System: System calls, processes, threads, inter-process communication, concurrency, synchronization, Deadlock, Memory management, virtual memory and File systems.

Databases: ER-model, Relational model, SQL, Integrity constraints, normal forms, indexing. Transactions and concurrency control.

Computer Networks: OSI and TCP/IP Protocols, Data link layer: framing, error detection, Medium Access Control, Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols, Transport layer and Application layer protocols.

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AGRICULTURE

AGRONOMY

Fundamentals of Agronomy, Introductory Agrometeorology and Climate Change Introduction to Forestry, Crop Production Technology of different crops, Farming Systems and Sustainable Agriculture, Irrigation Water Management, Geoinformatics and Nanotechnology for Precision Farming, Practical Crop Production, Rainfed Agriculture & Watershed Management and Principles of Organic Farming., Agricultural Waste Management, Weed Management

GENETICS AND PLANT BREEDING

Fundamentals of Genetics and Plant Breeding, Crop Improvement of different crops, Intellectual Property Rights, Principles of Seed Technology, Fundamentals of Biotechnology, Quantitative Genetics, Molecular Genetics and Breeding.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Fundamentals of Soil Science, Manures, Fertilizers and Soil Fertility Management, Problematic Soils and their Management, Soil, Plant, Water and Seed Testing.

ENTOMOLOGY

Insect Morphology and Taxonomy, Insect Ecology and Concepts of IPM, Pests of Field crops, Horticultural Crops & Stored Grain and their Management, Beneficial insects.

PLANT PATHOLOGY

Introduction to Plant Pathology, Principles of Plant Pathology, Diseases of Field and Horticultural Crops and their Management, Principles of Integrated Disease Management.

CROP PHYSIOLOGY

Fundamentals of Crop Physiology, Eco-physiology, Environmental Studies and Disaster Management, Crop modelling and Stress Physiology.

AGRICULTURAL ECONOMICS

Fundamentals of Economics, Agricultural Finance and Co-operation, Agricultural Marketing, Trade and Prices, Farm Management, Production and Resource Economics, Agribusiness Management.

AGRICULTURAL EXTENSION

Human Values & Ethics, Rural Sociology & Educational Psychology, Fundamentals of Agricultural Extension Entrepreneurship Development and Business Communication, Communication Skills and Personality Development.

STATISTICS AND COMPUTER APPLICATIONS

Elementary Mathematics, Statistical Methods, Agriculture Informatics.

HORTICULTURE

Fundamentals of Horticulture, Production Technology of Fruits and Plantation Crops, Vegetables, Spices, Ornamental Crops, Medicinal & Aromatic Plants. Landscaping, Post-harvest Management and Value Addition of Fruits and Vegetables.

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EDUCATION

Foundations of Education: Contribution of Indian Schools of philosophy (Sankhya Yoga, Vedanta, Buddhism, Jainism) and Western schools of Philosophy (Idealism, Realism, Naturalism, Pragmatism, Marxism, Existentialism) to Education. Approaches to Sociology of Education. Concept and types of social Institutions and their functions (family, school and society). Socialization and education-education and culture, social change, Democracy, Equality., Contribution of Indian thinkers and Committees and Commissions regarding Education.

Educational Psychology: Growth and Development, Concept and Principles, Cognitive Processes and stages of Cognitive Development, Personality: Definitions and theories. Mental health and Mental hygiene, Approaches to Intelligence from Unitary to Multiple, Assessment of Intelligence, Concepts of Problem Solving, Critical thinking, Metacognition and Creativity. Principles and Theories of learning: Behavioristic, Cognitive and Social theories of learning. Theories of Counselling (Behavioristic, Rational, Emotive and Reality). Guidance and Counselling Nature, Principles and Need, Types of Guidance

Research in Education: Meaning and Scope of Educational Research, Meaning and steps of Scientific Method, Characteristics of Scientific Method, Types of research, Variables: Meaning of Concepts, Constructs and Variables, Types of Variables Hypotheses , Types & Tools of Research, Types of Measurement Scale, Quantitative Data Analysis -Descriptive data analysis, Testing of Hypothesis, Use and Interpretation of statistical techniques , Correlation, t-test, z-test, ANOVA, chi-square..etc.

Teacher Education: Meaning, Nature , Scope and types of Teacher Education, NCERT and NCTE at Elementary, Secondary and Higher Secondary Levels, Organization of Components of Pre-service Teacher Education Transactional Approaches., Concept, Need, Purpose and Scope of In-service Teacher Education, Organization and Modes of In-service Teacher Education, Agencies and Institutions of In-service Teacher Education at District, State and National Levels (SSA, RMSA, SCERT, NCERT, NCTE and UGC).

Curriculum and Technology in/ for Education: Concept and Principles of Curriculum, Strategies of Curriculum Development, Stages in the Process of Curriculum development, Foundations of Curriculum Planning - Philosophical Bases (National, democratic), Sociological basis (socio cultural reconstruction), Psychological Bases (learner's needs and interests), Bench marking and Role of National level Statutory Bodies - UGC, NCTE and University in Curriculum Development, Use of ICT in Evaluation, Administration and Research: E portfolios, ICT for Research - Online Repositories and Online Libraries, Online and Offline assessment tools.

Inclusive Education: Concept and Principles, Scope and Target Groups (Slow Learners, with disabilities, Policies and Legislations, NEP 1986, Programme of Action (1992), Persons with disability act (1995), National Policy and disabilities (2006), Inclusive education under Sarva Shiksha Abhiyan (SSA), Identification of diverse learners, Types, characteristics and educational needs of diverse learners intellectual, physical and multiple disabilities. Planning and management of Inclusive classrooms, infrastructure, Human resources, curriculum and instructional practices.

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COMPUTER SCIENCE / COMPUTER APPLICATIONS

Discrete Structures: Sets, Relations, Functions. Pigeonhole Principle, Inclusion-Exclusion Principle, Equivalence and Partial Orderings, Elementary Counting Techniques.

Computability: Models of computation-Finite Automata, Pushdown Automata, Non–determinism and NFA, DPDA and PDAs, Non – computability and Examples of non – computable problems.

Graph Theory: Definition, walks, paths, trails, connected graphs, regular and bipartite graphs, cycles and circuits. Tree & rooted tree. Spanning trees, Hamiltonian & Eulerian graphs, Planar graphs.

Groups: Finite fields and Error correcting / detecting codes.

Number System: Octal, Hex, Decimal, Binary, Complements, Arithmetic, Floating representation.

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, pointers.

OOPS Concepts: Class, object, instantiation. Inheritance, polymorphism and overloading.

C++ Programming: Elements of C++ – Tokens, identifiers. Variables and constants, Datatypes, Operators, Control statements. Functions parameter passing, Constructors, destructors, Exceptions.

Relational Database Design and SQL: E-R diagrams and their transformation to relational design, Normal Forms, Limitations of 4NF and BCNF. SQL: DDL, DML, DCL commands, Database objects.

Data & File structures: Arrays, stacks, queues, linked lists, trees, graphs, priority queues and heaps, Fields, records, files. Sequential, direct, index-sequential, relative files. Hashing, B trees & B+ trees.

Networks: LAN, MAN, WAN, Hub, Bridge, Router, Gateways, Wireless Networks, Inter Networks, OSI & TCP / IP model, Tunnelling, Fragmentation, Firewalls.

Data Communication: Channel capacity. Transmission media-twisted pair, coaxial cables, fibre – optic cables, wireless transmission-radio, microwave, infrared and millimeter waves. Lightwave transmission. multiplexing, switching, narrowband ISDN, broadband ISDN, ATM, High speed LANS.

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

Network Security: Cryptography-public key, secret key. Domain Name System (DNS) – Electronic Mail and WWW. Name servers. E-mail-architecture and Servers.

Operating Systems: Functions of OS, Multiprogramming, multiprocessing, and multitasking, Memory Management, Mutual exclusion. Critical regions, CPU, I/O, Resource scheduling. algorithms**.**

UNIX: File system, process management, bourne shell, shell variables, command line programming.

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

System Calls: Create open, close, read, write, iseek, link, unlink, stat, umask, chmod, exec, fork, wait.

Software Engineering: Software Development Life Cycle (SDLC), Software Metrics, Software Design, Coding and Testing, Software re-engineering.

Data Warehousing & Mining: Environment, architecture, analysis, design, construction and administration, Extracting models and patterns, classification, regression, clustering, summarization, dependency modelling, link analysis, sequencing analysis.

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MANAGEMENT STUDIES

Management and Organizational Behaviour: Concepts, Process, theories and Approaches, functions, Management Roles and Skills, Skills and roles in an organization, Contemporary organization structures, Understanding and managing individual behavior, Personality, Perception, Values and Attitudes, Learning, Motivation, Understanding and Managing Group Behavior, Interpersonal and Group Dynamics, Managing Conflicts.

Managerial Economics: Demand Analysis, Production function, Cost Output Relations, Market Structures, Pricing Theories and Methods.

Business Environment: Economic and Legal Environment as applicable to Business in India, WTO, TRIPs and TRIMs, Fiscal and Monetary Policy of Government of India.

Entrepreneurship: Concept, Types, Theories and Process, Developing, Intrapreneurship – Concept and Process, Innovations in Business – Types of Innovations, Creating and Identifying Opportunities, Screening of Business Ideas

Human Resource Management: Human Resource Planning, Recruitment, Selection, Induction, Training and Development, Performance Management, Compensation Management. Basics of Industrial Relations Management.

Financial Management: Valuation Concepts, Capital Budgeting Decisions, Capital Structure and Cost of Capital, Dividend Policy, Long Term and Short Term Financing Instruments, Mergers and Acquisitions.

Marketing Management: Demand Measurement and Forecasting, Market Segmentation, Product Mix, Product Life Cycle, New Product Development, Branding and Packaging, Pricing Strategies, Promotion Mix, Advertising and Personal Selling, Channel Management, CRM, Marketing of Services.

Production Management: Facility Location, Layout Planning, PPC, Determinants of Product Mix, Production Scheduling, Work Measurement, Time and Motion Study, SQC, Linear Programming, Transportation Models, Queuing Theory, Decision Theory, PERT/CPM.

Strategic Management: Elements of Strategy, SWOT Analysis, Strategy Formulation and Execution, Core Competence and Competitive Advantage, Contemporary Strategies for Stability, Growth, Turnaround and Expansion.

Statistics for Management: Concept, Measures Of Central Tendency and Dispersion, Probability Distribution – Binominal, Poison, Normal and Exponential, Hypothesis Testing – Procedure; T, Z, F, Chi-square tests.

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MATHEMATICS

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear Transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms. Groups. Sylow theorems. Rings, Fields.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Numerical Analysis: Numerical solutions of algebraic equations, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge - Kutta methods.

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems, ordinary differential equations, singular solutions, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange Charit methods and Cauchy problem (first order). Classification (second order), General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

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PHYSICS

Classical and Quantum Mechanics

Newton's laws, Central force motions. Two body Collisions - and Centre of mass frames. Rigid body dynamics moment of inertia tensor. Non-inertial frames and pseudo forces. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Special Theory of relativity Lorentz transformations, relativistic kinematics and mass–energy equivalence. Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator). Tunneling through a barrier. Wave-function in coordinate andmomentum representations. Heisenberg uncertainty principle. Stern-Gerlach experiment. Pauli exclusion Principle.

Electromagnetic Theory and Electronics

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, Magneto statics: Biot-Savart law, Ampere's theorem. Faraday's law, Lenz law Maxwell's EM wave equations in free space and linear isotropic media. Scalar and vector potentials, Dynamics of charged particles in static and uniform electromagnetic fields. Semiconductor devices (diodes, transistors, FET), Opto- electronicdevices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques (logic gates, flip flops, registers, counters,). A/D and D/A converters.Microprocessor.

Statistical and Atomic Physics

Micro-canonical, canonical and grand-canonical ensembles and partition functions. Blackbody radiation and Planck's distribution law. LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. ESR. NMR. 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,

Nuclear and particle physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semiempiricalmass formula, liquid drop model and shell model. Nature of the nuclear force, Elementary ideas of alpha, betaand gamma decays and their selection rules. Nuclear Fission and fusion. Elementary particles and their quantum numbers. Quark model, baryons and mesons.

Condensed Matter Physics

Bravais lattices. Reciprocal lattice. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall Effect. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors.Superconductivity: type-I and type-II superconductors. Josephson junctions. Defects and dislocations. Ordered phases of matter: translational and orientational order, Quasi crystals.

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CHEMISTRY

Inorganic Chemistry: Chemical periodicity-Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory). Concepts of acids and bases, Main group elements and their compounds Transition elements and coordination compounds: structure, bonding theories, Cages and metal clusters, Organometallic compounds: synthesis, bonding and structure, and reactivity. Nuclear chemistry, Inorganic spectroscopy and Bioinorganic chemistry.

Analytical chemistry: Separation, spectroscopic, electro- and thermo-analytical methods. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance. Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Physical Chemistry: Atomic structure and spectroscopy, Basic principles of quantum mechanics, Chemical thermodynamics: Laws, state and path functions and their applications. Statistical thermodynamics. Chemical bonding in diatomic molecules. Group theory and Molecular Spectroscopy. Statistical thermodynamics, Electrochemistry, Kohlrausch's law and its applications; ionic equilibria; Chemical kinetics; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions. Colloids and surfaces and solid state and Polymer chemistry.

Organic Chemistry: IUPAC nomenclature of organic molecules including regio- and stereoisomers. Principles of stereochemistry. Aromaticity, Organic reaction mechanisms, Organic reactive intermediates, Synthesis and reactivity of common heterocyclic compounds, Chemistry of natural products. Structure determination of organic compounds. Asymmetric synthesis and Pericyclic reactions.

Applied Chemistry: Chemistry in Nanoscience and technology, catalysis and green chemistry, medicinal chemistry, supra molecular and environment chemistry.

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ENGLISH

Language Studies and Phonetics

- Sounds of English
- Accent and Intonation

English Language Teaching

- Theory
- Methods
- Practice

Technical Communication & Professional Ethics

- Elements of Communication
- Styles of Communication
- Barriers to Communication
- Written and Oral Communications
- Non-verbal Communication

Soft Skills & Behavior

- Personality
- Handling Cultural Conflict
- Valuing other's time, space
- Estimating Intentions

Twentieth Century Literature

Women's Writings in English

American and African Literatures

Works of William Shakespeare: Hamlet, Twelfth Night, Julius Caesar, Henry IV

Famous poets of English

Indian Literature in English

Green Cultural Studies

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Pharmaceutical Sciences

Pharmaceutics and Drug Delivery: Preformulation studies, physicochemical properties of drugs, drug-excipient interactions, stability, and dosage form design. Tablets, capsules, parenterals, ophthalmics, semisolids, aerosols, and novel dosage forms. Biopharmaceutics, pharmacokinetics, bioavailability, bioequivalence, *in vitro-in vivo* correlation, and dosage regimen concepts. Controlled release, targeted delivery, process validation, in-process quality control, scale-up, GMP, SOPs.

Pharmaceutical Analysis and Instrumentation: Principles and applications of UV-Visible, IR, fluorescence, NMR, mass spectrometry, and thermal methods. Chromatographic methods including TLC, HPTLC, HPLC, GC, and hyphenated techniques. Method development, validation, uncertainty, impurity profiling, reference standards, and stability-indicating methods.

Medicinal Chemistry and Pharmaceutical Chemistry: Physicochemical properties related to drug action, drug-receptor interactions, stereochemistry, and SAR principles. Organic reaction mechanisms, synthetic methods, stereoselective synthesis, and heterocyclic chemistry. Peptide chemistry, carbohydrates, natural products, antibiotics, alkaloids, steroids, biologically active compounds and principles of CADD.

Pharmacology: Pharmacodynamics, receptors, Drugs acting on ANS, CNS, CVS and endocrine systems, chemotherapy, pharmacological screening,

Pharmacognosy: Herbal drugs, phytochemistry, extraction, standardization, tissue culture, metabolites, nutraceuticals, herbal formulations.

Biotechnology and Microbiology: Industrial fermentation, recombinant DNA technology, monoclonal antibodies, basic immunology, staining and sterilization techniques.

Pharmacy Practice and Clinical Research: Pharmacovigilance, pharmacoepidemiology, pharmacoeconomics, health technology assessment, and evidence-based practice. Basics of clinical trial design, GCP, informed consent, and protocol evaluation.

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