# *Scheme of Written Entrance Test*

## *PRT/ M.Tech*

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## Ph.D Programme

| Faculty | Section | Code | Subject | Marks | Time |
|---|---|---|---|---|---|
| **Ph.D Nano Science & Technology** | Paper – I | GA001 | General Awareness | 50 | 90 Minutes |
| | Paper – II | PH001 | Physics | 50 | 90 Minutes |
| | | CH001 | Chemistry | | |
| | | CE001 | Civil Engineering | | |
| | | EE001 | Electrical Engineering | | |
| | | EC001 | Electronics and Communication Engineering | | |
| | | ME001 | Mechanical Engineering | | |
| **Ph.D Engineering** | Paper – I | GA001 | General Awareness | 50 | 90 Minutes |
| | Paper – II | CE001 | Civil Engineering | 50 | 90 Minutes |
| | | EE001 | Electrical Engineering | | |
| | | EC001 | Electrical and Communication Engineering | | |
| | | ME001 | Mechanical Engineering | | |
| | | CS001 | Computer Science and Information Technology | | |
| **Ph.D Medical Science** | Paper – I | GA002 | Fundamental | 50 | 90 Minutes |
| | Paper – II | MS001 | Anatomy | 50 | 90 Minutes |
| | | MS002 | Physiology | | |
| | | MS003 | Bio-Chemistry | | |
| | | MS004 | Pathology | | |
| | | MS005 | Microbiology | | |
| | | MS006 | Pharmacology | | |
| | | MS007 | Forensic Medicine (FMT) | | |
| | | MS008 | Community Medicine (PSM) | | |
| | | MS009 | Ophthalmology (EYE) | | |
| | | MS010 | General Medicine | | |
| | | MS011 | ENT | | |
| | | MS012 | General Surgery | | |
| | | MS013 | Orthopaedics Surgery | | |
| | | MS014 | Obstetrics & Gynaecology | | |
| | | MS015 | Anaesthesia | | |
| | | MS016 | Paediatrics | | |
| | | MS017 | Radio-Diagnosis | | |
| | | MS018 | Skin & VD | | |
| | | MS019 | Physical Meidicine & Rehabilitatin (PMR) | | |
| | | MS020 | Psychiatry | | |
| | | MS021 | Radiotherapy | | |
| | | MS022 | Plastic Surgery | | |

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| Faculty | Section | Code | Subject | Marks | Time |
|---|---|---|---|---|---|
| **Ph.D Education** | Paper - I | ED001 | Foundation of Education<br>Sociological Foundation of Education<br>Psychological Foundation of Education | 50 | 90 Minutes |
| | Paper - II | ED002 | Research Methodology<br>Hypothesis, Sampling Techniques and Research Design<br>Statistical Methods | 50 | 90 Minutes |

## M.Tech Programme

| Faculty | Section | CODE | Subject | Marks | Time |
|---|---|---|---|---|---|
| **M.Tech Nano Science & Technology** | Paper – I | GA001 | General Awareness | 50 | 90 Minutes |
| | Paper – II | PH001 | Physics | 50 | 90 Minutes |
| | | CH001 | Chemistry | | |
| | | CE001 | Civil Engineering | | |
| | | EE001 | Electrical Engineering | | |
| | | EC001 | Electronics and Communication Engineering | | |
| | | ME001 | Mechanical Engineering | | |

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# *Syllabus of Written Entrance Test*

## *PRT/ M.Tech*

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## GENERAL AWARENESS

**CODE: GA001** **TIME: 90 Minutes**
**SUBJECT: GENERAL AWARENESS** **FULL MARKS: 50**

**Numerical Ability:** Numerical computation, numerical estimation, numerical reasoning and data interpretation. (40%)

**Verbal Ability:** English grammar, sentence completion, verbal analogies, word groups, instructions, critical reasoning and verbal deduction. (40%)

**General Knowledge** (20%)

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# PHYSICS

**CODE: PH001** **TIME: 90 Minutes**
**SUBJECT: PHYSICS** **FULL MARKS: 50**

**Solid State Physics:** Elements of crystallography; diffraction methods for structure determination; bonding in solids; elastic properties of solids; defects in crystals; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids; metals, semiconductors and insulators; transport properties; optical, dielectric and magnetic properties of solids; elements of superconductivity.

**Electronics:** Semiconductor devices; Bipolar Junction Transistors, Field Effect Transistors, Amplifier and oscillator circuits; Operational amplifier, Negative feedback circuits, Active filters and oscillators; rectifier circuits, regulated power supplies; basic digital logic circuits, sequential circuits, flip-flops, counters, registers, A/D and D/A conversion.

**Classical Mechanics:** Conservation laws; Central forces, Kepler problem and planetary motion; collisions and scattering in laboratory and centre of mass frames; mechanics of system of particles; Variational principle; Lagrange's and Hamilton's formalisms; equation of motion, Cyclic coordinates, Poisson bracket; periodic motion, Small oscillations, Normal modes; special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence.

**Quantum Mechanics:** Physical basis of quantum mechanics; Uncertainty principle; Schrödinger equation; one, two and three dimensional potential problems; particle in a box, harmonic oscillator, hydrogen atom; linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent perturbation theory; elementary scattering theory.

**Thermodynamics and Statistical Physics:** Laws of thermodynamics; macrostates and microstates; phase space; probability ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, critical point.

**Atomic and Molecular Physics:** Spectra of one- and many-electron atoms; LS and jj coupling; hyperfine structure; Zeeman and Stark effects; electric dipole transitions and selection rules; X-ray spectra; rotational and vibrational spectra of diatomic molecules; electronic transition in diatomic molecules, Franck-Condon principle; Raman effect; NMR and ESR; lasers.

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# CHEMISTRY

**CODE: CH001** **TIME: 90 Minutes**
**SUBJECT: CHEMISTRY** **FULL MARKS: 50**

## PHYSICAL CHEMISTRY

**Structure:** Quantum theory: principles and techniques; applications to a particle in a box, harmonic oscillator, rigid rotor and hydrogen atom; valence bond and molecular orbital theories, Hückel approximation; approximate techniques: variation and perturbation; symmetry, point groups; rotational, vibrational, electronic, NMR, and ESR spectroscopy

**Equilibrium:** Kinetic theory of gases; First law of thermodynamics, heat, energy, and work; second law of thermodynamics and entropy; third law and absolute entropy; free energy; partial molar quantities; ideal and non-ideal solutions; phase transformation: phase rule and phase diagrams – one, two, and three component systems; activity, activity coefficient, fugacity, and fugacity coefficient; chemical equilibrium, response of chemical equilibrium to temperature and pressure; colligative properties; Debye-Hückel theory; thermodynamics of electrochemical cells; standard electrode potentials: applications – corrosion and energy conversion; molecular partition function (translational, rotational, vibrational, and electronic).

**Kinetics:** Rates of chemical reactions, temperature dependence of chemical reactions; elementary, consecutive, and parallel reactions; steady state approximation; theories of reaction rates – collision and transition state theory, relaxation kinetics, kinetics of photochemical reactions and free radical polymerization, homogeneous catalysis, adsorption isotherms and heterogeneous catalysis.

## INORGANIC CHEMISTRY

**Main group elements:** General characteristics, allotropes, structure and reactions of simple and industrially important compounds: boranes, carboranes, silicones, silicates, boron nitride, borazines and phosphazenes. Hydrides, oxides and oxoacids of pnictogens (N, P), chalcogens (S, Se & Te) and halogens, xenon compounds, pseudo halogens and interhalogen compounds.Shapes of molecules and hard- soft acid base concept. Structure and Bonding (VBT) of B, Al, Si, N, P, S, Cl compounds. Allotropes of carbon: graphite, diamond, C60. Synthesis and reactivity of inorganic polymers of Si and P.

**Transition Elements:** General characteristics of d and f block elements; coordination chemistry: structure and isomerism, stability, theories of metal- ligand bonding (CFT and LFT), mechanisms of substitution and electron transfer reactions of coordination complexes. Electronic spectra and magnetic properties of transition metal complexes, lanthanides and actinides. Metal carbonyls, metal-metal bonds and metal atom clusters, metallocenes; transition metal complexes with bonds to hydrogen, alkyls, alkenes and arenes; metal carbenes; use of organometallic compounds as catalysts in organic synthesis. Bioinorganic chemistry of Na, K. Mg, Ca, Fe, Co, Zn, Cu and Mo.

**Solids:** Crystal systems and lattices, miller planes, crystal packing, crystal defects; Bragg's Law, ionic crystals, band theory, metals and semiconductors, Different structures of AX, AX2, ABX3 compounds, spinel's.

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**Instrumental methods of analysis:** Atomic absorption and emission spectroscopy including ICP-AES, UV- visible spectrophotometry, NMR, mass, Mossbauer spectroscopy (Fe and Sn), ESR spectroscopy, chromatography including GC and HPLC and electro-analytical methods (Coulometer, cyclic voltammetry, polarography – aerometry, and ion selective electrodes).

**ORGANIC CHEMISTRY**

**Stereochemistry:** Chirality of organic molecules with or without chiral centres. Specification of configuration in compounds having one or more stereogeniccentres. Enantiotopic and diastereotopic atoms, groups and faces. Stereoselective and stereospecific synthesis. Conformational analysis of acyclic and cyclic compounds. Geometrical isomerism. Configurational and conformational effects on reactivity and selectivity/specificity.

Reaction mechanism: Methods of determining reaction mechanisms. Nucleophilic and electrophilic substitutions and additions to multiple bonds. Elimination reactions. Reactive intermediates- carbocations, carbanions, carbenes, nitrenes, arynes, free radicals. Molecular rearrangements involving electron deficient atoms.

**Organic synthesis:** Synthesis, reactions, mechanisms and selectivity involving the following- alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines. Use of compounds of Mg, Li, Cu, B and Si in organic synthesis. Concepts in multistep synthesis- retrosynthetic analysis, disconnections, synthons, synthetic equivalents, reactivity umpolung, selectivity, protection and deprotection of functional groups.

**Heterocyclic compounds:** Structure, preparation, properties and reactions of furan, pyrrole, thiophene, pyridine, indole and their derivatives.

**Biomolecules:** Structure, properties and reactions of mono- and di-saccharides, physicochemical properties of amino acids, chemical synthesis of peptides, structural features of proteins, nucleic acids, steroids, terpenoids, carotenoids, and alkaloids.

**Spectroscopy:** Principles and applications of UV-visible, IR, NMR and Mass spectrometry in the determination of structures of organic molecules.

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# CIVIL ENGINEERING

**CODE: CE001** **TIME: 90 Minutes**
**SUBJECT: CIVIL ENGINEERING** **FULL MARKS: 50**

## STRUCTURAL ENGINEERING

**Mechanics:** Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

**Structural Analysis:** Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/ energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

**Concrete Structures:** Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam-columns, column bases. Connections- simple and eccentric, beam–column connections, plate girders and trusses. Plastic analysis of beams and frames.

## GEOTECHNICAL ENGINEERING

**Soil Mechanics:** Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability &seepage, effective stress principle, consolidation, compaction, shear strength.

Foundation Engineering: Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes-infinite slopes, finite slopes. Foundation types-foundation design requirements. Shallow foundations-bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysisinsands & clays. Deep foundations–pile types, dynamic &static formulae, load capacity of piles in sands &clays, negative skin friction.

## WATER RESOURCES ENGINEERING

**Fluid Mechanics and Hydraulics:** Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept,

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hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

**Hydrology:** Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

**Irrigation:** Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

**ENVIRONMENTAL ENGINEERING**

**Water requirements:** Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

**Air Pollution:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

**Municipal Solid Wastes:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

**Noise Pollution:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

**TRANSPORTATION ENGINEERING**

**Highway Planning:** Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

**Traffic Engineering:** Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

**SURVEYING**

Importance of surveying, principles and classifications, mapping concepts, coordinate system, map projections, measurements of distance and directions, leveling, theodolite traversing, plane table surveying, errors and adjustments, curves.

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# ELECTRICAL ENGINEERING

**CODE: EE001** **TIME: 90 Minutes**

**SUBJECT: ELECTRICAL ENGINEERING** **FULL MARKS: 50**

**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, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

**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.

**Electrical Machines:** Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

**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; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

**Control Systems:** Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

**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; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

**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; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; 8-bit microprocessor basics, architecture, programming and interfacing.

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**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; bridge converters – fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

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## ELECTRONICS AND COMMUNICATION ENGINEERING

**CODE: EC001** **TIME: 90 Minutes**
**SUBJECT: ELECTRONICS AND COMMUNICATION ENGINEERING** **FULL MARKS: 50**

**Networks:** Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations usingLaplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

**Electronic Devices:** Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers.p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERs. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

**Analog Circuits:** Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier.Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers.Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations.Function generators and wave-shaping circuits, 555 Timers. Power supplies.

**Digital circuits:** Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor(8085): architecture, programming, memory and I/O interfacing.

**Signals and Systems:** Definitions and properties ofLaplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

**Control Systems:** Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system **compensators:** elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

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**Communications:** Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

**Electromagnetics:** Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain

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# MECHANICAL ENGINEERING

**CODE: ME001** **TIME: 90 Minutes**
**SUBJECT: MECHANICAL ENGINEERING** **FULL MARKS: 50**

## APPLIED MECHANICS AND DESIGN

**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; Euler's theory of columns; strain energy methods; thermal stresses.

**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; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

## FLUID MECHANICS AND THERMAL SCIENCES

**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; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

**Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

**Thermodynamics:** Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

**Applications:** Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. I.C. Engines: air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric

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chart, basic psychrometric processes. Turbomachinery:Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

**MANUFACTURING AND INDUSTRIAL ENGINEERING**

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

**Metal Casting:** Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

**Forming:** Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

**Joining:** Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

**Machining and Machine Tool Operations:** Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures

**Metrology and Inspection:** Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

**Computer Integrated Manufacturing:** Basic concepts of CAD/CAM and their integration tools.

**Production Planning and Control:** Forecasting models, aggregate production planning, scheduling, materials requirement planning.

**Inventory Control:** Deterministic and probabilistic models; safety stock inventory control systems.

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

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# COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

**CODE: CS001** **TIME: 90 Minutes**

**SUBJECT: COMPUTER SCIENCE AND INFORMATION TECHNOLOGY** **FULL MARKS: 50**

**Digital Logic:** Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

**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.

**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.

**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.

**Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

**Compiler Design:** Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

**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.

**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.

**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.

**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.

**Web technologies:** HTML, XML, basic concepts of client-server computing.

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## Fundamental

**CODE: GA002** **TIME: 90 Minutes**

**SUBJECT: Fundamental (Paper – I)** **FULL MARKS: 50**

**Fundamentals:** Fundamentals of Anatomy, Physiology & Biochemistry, Pathology, Microbiology, Pharmacology, FMT, PSM, Eye, General Medicine, ENT, General Surgery, Orthopedics Surgery, Obst & Gynae, Anesthesia, Paediatrics, Radio- Diagnosis, Skin/ VD, PMR, Psychiatry, Radiotherapy, Plastic Surgery.

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## ANATOMY

**CODE: MS001** **TIME: 90 Minutes**

**SUBJECT: ANATOMY (Paper – II)** **FULL MARKS: 50**

- Morphology and gross general Anatomy above diaphragm with applied and concerning embryology and histology.
- Morphology and gross anatomy below the diaphragm with applied and concerning embryology and histology
- Neuro-anatomy with applied

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## PHYSIOLOGY

**CODE: MS002** **TIME: 90 Minutes**

**SUBJECT: PHYSIOLOGY (Paper – II)** **FULL MARKS: 50**

- General physiology, including History of Physiology
- Systemic physiology (system providing transport, nutrition and energy) including comparative physiology)
- System physiology including cellular physiology, regulation and neural control

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## BIO-CHEMISTRY

**CODE: MS003** **TIME: 90 Minutes**

**SUBJECT: BIO-CHEMISTRY (Paper – II)** **FULL MARKS: 50**

- General Bio-chemistry, bio-statics, bio-chemical technique
- Cell physiology, molecular Biology, and Human genetics
- Intermediary metabolism, macro and micro nutrients, inborn errors of metabolism

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## PATHOLGY

**CODE: MS004** **TIME: 90 Minutes**

**SUBJECT: PATHOLGY (Paper – II)** **FULL MARKS: 50**

- General including special Pathology
- Systemic including chemical pathology and Histo-Pathology
- Clinical Pathology including Haematology and Blood transfusion

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# MICROBIOLOGY

**CODE: MS005** **TIME: 90 Minutes**

**SUBJECT: MICROBIOLOGY (Paper – II)** **FULL MARKS: 50**

- General Microbiology and Immunology
- Systemic Bacteriology and Mycology
- Virology and Parasitology

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## PHARMACOLOGY

**CODE: MS006** **TIME: 90 Minutes**

**SUBJECT: PHARMACOLOGY (Paper – II)** **FULL MARKS: 50**

- General Pharmacology and applied Pharmacology
- Bioassay and experimental Pharmacology
- Systemic Pharmacology, Chemotherapy & Pharmacological therapeutics.

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## FORENSIC MEDICINE (FMT)

**CODE: MS007** **TIME: 90 Minutes**

**SUBJECT: FORENSIC MEDICINE (FMT) (Paper – II)** **FULL MARKS: 50**

- Basic science in Anatomy and Physiology and other allied subjects as applied aspect of Clinical Forensic Medicine. Basic of diseases in clinical medicines.
- Forensic Medicine including Medical jurisprudence including Clinical Forensic medicine
- Forensic Medicine including Forensic Pathology and Forensic Toxicology

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## COMMUNITY MEDICINE (PSM)

**CODE: MS008** **TIME: 90 Minutes**

**SUBJECT: COMMUNITY MEDICINE (PSM) (Paper – II)** **FULL MARKS: 50**

- Basic & public Health Scheme, nutrition and medical & health statistics. Concept in Community Medicine & principle & practice of epidemiology.
- Epidemiology of communicable and non-communicable diseases, tropical medicine, and health services management including organization and management of rural health scheme principle & practice of health administration.
- Environmental Health, occupational health, demography, family planning and maternity and child health, industrial hygiene

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## OPHTHALMOLOGY (EYE)

**CODE: MS009** **TIME: 90 Minutes**

**SUBJECT: OPHTHALMOLOGY (EYE) (Paper – II)** **FULL MARKS: 50**

- Applied basic science (Anatomy, physiology, pharmacology, pathology) related to ophthalmology
- Diseases of eye and ocular manifestation with systemic diseases
- Operative techniques in ophthalmological surgery

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## GENERAL MEDICINE

**CODE: MS010** **TIME: 90 Minutes**

**SUBJECT: GENERAL MEDICINE (Paper – II)** **FULL MARKS: 50**

- Applied basic Medical Science (Anatomy, Physiology, Pathology, Microbiology and Pharmacology) Immunology National Program and preventive strategies. Impact of medical diseases on pregnancy, Dermatology & Psychiatric, Nutrition, Immune system & disease Molecular Cell biology & genetic disease.
- General Medicine

  a. Intensive Care Medicine

  b. Rheumatology & Bone Disease

  c. Infectious diseases, Tropical Medicines and STD

  d. Environmental Medicine

  e. Drug Therapy and Poisoning

- Systemic Disease

  a. GIT

  b. Liver, Biliary and Pancreatic Diseases

  c. Malignant disease

  d. Renal diseases

  e. Cardio-vascular & Respiratory diseases

  f. Endocrine & Diabetic and other metabolic diseases

  g. Neurological diseases

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## ENT

**CODE: MS011** **TIME: 90 Minutes**

**SUBJECT: ENT (Paper – II)** **FULL MARKS: 50**

- Anatomy, Physiology, Pathology, Microbiology, Biochemistry & acoustic as related to ENT
- Diseases of Ear, Nose and Throat
- Recent operative technique applied to ear, nose and throat treatment

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## GENERAL SURGERY

**CODE: MS012** **TIME: 90 Minutes**

**SUBJECT: GENERAL SURGERY (Paper – II)** **FULL MARKS: 50**

- Applied basic sciences in relation of General Surgery, Urology, Gastroenterology Breast, Endocrines
- General Surgery and Surgical diseases of organs above the diaphragm including pre-operative and post operative treatment
- General Surgery and Surgical diseases of organs below the diaphragm including pre-operative and post operative treatment

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## ORTHOPAEDICS SURGERY

**CODE: MS013** **TIME: 90 Minutes**

**SUBJECT: ORTHOPAEDICS SURGERY (Paper – II)** **FULL MARKS: 50**

- Applied basic science (Anatomy, Physiology, Pathology, Pharmacology & Therapeutics) related to orthopaedic diseases and surgery
- General orthopaedic surgery & (pre & post operative management)
- General Surgery applied to orthopaedic surgery with pre & post operative management

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## OBSTETRICS & GYNAECOLOGY

**CODE: MS014** **TIME: 90 Minutes**

**SUBJECT: OBSTETRICS & GYNAECOLOGY (Paper – II)** **FULL MARKS: 50**

- Basic Medical Science- Anatomy, Physiology, Pathology, Pharmacology etc related to Obst. & Gynae
- Gynecology
- Obstetrics

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## ANAESTHESIA

**CODE: MS015** **TIME: 90 Minutes**

**SUBJECT: ANAESTHESIA (Paper – II)** **FULL MARKS: 50**

- Applied basic science, Anatomy, Physiology, Parmakinetics, Premedication, difficult air way-related to anaesthesia
- a)Method & technique of anaesthesia and complication with their management
  b) Pharmacology of drugs used in Anaesthesia.
  c) Pre-operative and post operative assessment and proper care of the Pt
- Clinical Anaesthesia with relation to special regime & disease complication & management.

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## PAEDIATRICS

**CODE: MS016** **TIME: 90 Minutes**

**SUBJECT: PAEDIATRICS (Paper – II)** **FULL MARKS: 50**

- Applied Basic Science, Anatomy, Physiology & Pharmacology as related to Pediatrics.
- Social and Preventive Pediatrics neonatal disorders and child psychology.
- a) General Medicine as applied to Pediatrics & community pediatrics.
  b) Therapeutics in relation to diseases of children.

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## RADIO-DIAGNOSIS

**CODE: MS017** **TIME: 90 Minutes**

**SUBJECT: RADIO-DIAGNOSIS (Paper – II)** **FULL MARKS: 50**

- Applied basic science including isotopes and Radio-Physics related to Radiology.
- Radio-diagnosis related to General Medicines and Surgery contents above the diaphragm, Bones and joints.
- General Paper in Radiology, - Radio-diagnosis of the content below the diaphragm.

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## Skin & VD

**CODE: MS018** **TIME: 90 Minutes**

**SUBJECT: Skin & VD (Paper – II)** **FULL MARKS: 50**

- Basis Science of Skin, S.T.D., Leprosy (Anatomy, Physiology Biochemistry and Pharmacology.)
- Disease of Skin STD & Leprosy, Therapeutic in relation of diseases, of Skin.
- Histopathology of Skin, STD, Leprosy Diseases. -Darmatosurgery Cosmetology.

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## Physical medicine & rehabilitation (PMR)

**CODE: MS019** **TIME: 90 Minutes**

**SUBJECT: Physical medicine & rehabilitation (PMR) (Paper – II)** **FULL MARKS: 50**

- Basis Science - Anatomy, Physiology, Pathology, Pharmacology and Biochemistry as applied to Physical Medicine and Rehabilitation.
- Medical Science applied to physical medicines & rehabilitation including surgical aspect.
- Physical Medicine, Rheumatology and Rehabilitation including recent advances.

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## Psychiatry

**CODE: MS020** **TIME: 90 Minutes**

**SUBJECT: Psychiatry (Paper – II)** **FULL MARKS: 50**

- Psychological Medicines, Chemical Psychiatrics including management and therapeutics.
- Disease of Nervous System, Organic Psychiatry.
- Pathology and Pharmacology in relation to psychological medicine, psycho-pathology psychometry.

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## Radiotherapy

**CODE: MS021** **TIME: 90 Minutes**

**SUBJECT: Radiotherapy (Paper – II)** **FULL MARKS: 50**

- Principal of Racliation Therapy – Tele therapy – Brachy-therapy Principals of Radiation Physics and their clinical application. -Radiation protection.
- Pathology and pathogenesis of Malignancies, Pathological Classification, staging & their importance in treatment.
- Clinical aspects of Malignancies.

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## Plastic Surgery

**CODE: MS022** **TIME: 90 Minutes**

**SUBJECT: Plastic Surgery (Paper – II)** **FULL MARKS: 50**

- Surgical Anatomy, Physiology, Biochemistry, Pharmacology as applied to Plastic Surgery.
- General Surgery as applied to plastic surgery.
- Orthopaedics Surgery & ENT as applied to plastic surgery.

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## PAPER –I (Ph.D Education)

**CODE: ED001** **TIME: 90 Minutes**
**SUBJECT: Paper -I** **FULL MARKS: 50**

**Part I: Philosophical Foundation of Education**

a) Fundamentals of Philosophy
Philosophy and Education - Different branches of philosophy: Metaphysics, Epistemology and Axiology and their implications to Education. Jainism, Buddhism, Bhagawatgita, Islam, Vedanta, Christianity, Idealism, Naturalism, Realism, Pragmatism and Existentialism.

b) Contributions to Educational Thought by great Thinkers

**Indian Thinkers:** Mahatma Gandhi, Sri Aurobindo, Tagore,

**Western Thinkers:** Rousseau, Karl Marx.

**Part II: Sociological Foundation of Education**

a) Sociology of Education: Concept, Nature and Scope . Social functions of education. Social organizations, social groups, social stratification, institutions, attitudes and values.
b) Culture - meaning and nature of culture, Role of education in cultural context, education and cultural change.
c) Education and society - Education as a social system, as **a** socialization process and a process of social progress and change.
d) Equality of educational opportunity and excellence in education, equality vs equity in education, Education and democracy: constitutional provision of education, nationalism and education, Education for National integration and international understanding.

**Part III: Psychological Foundation of Education**

a) Nature and scope of Educational Psychology
b) Individual differences: Meaning, characteristics, determinants, causes, individual differences and classroom management.
c) Physical and mental development: concept and principles, theories of Piaget and Bruner and implications for education.
d) Learning: nature, theories of learning, laws of learning and transfer of learning.
e) Intelligence: nature, theories and measurements and structure of human abilities; creativity.
f) Personality: structure of personality, personality traits, personality adjustment, and measurement.
g) Adjustment and mental health: causes, prevention and treatment of maladjustment.

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## PAPER –II (Ph.D Education)

**CODE: ED002** **TIME: 90 Minutes**
**SUBJECT: Paper -II** **FULL MARKS: 50**

**Part I : Research Methodology**

a) Historical, philosophical, Developmental, Descriptive, Causal, Comparative, Co- relational, Case-study, Experimental and Action research.
b) Formulation of the problems for research: Sources, specification of forming research questions, analysis procedures and evaluation.
c) Review of Literature, emerging trends for the review, rationale for the selection of problem.
d) Specifying objectives and hypotheses of the study.

**Part II: Hypothesis, Sampling Techniques and Research Design**

a) Choosing appropriate design and stating the procedure: appropriate methods, instruments, tools and techniques.
b) Sampling - types and techniques of sampling.
c) Tools - tests, attitude scales, questionnaires, opinionnaires, interview, and observation;, inventory, differential scale.
d) Techniques: observation, interview, focused group discussion, ethnography, document study, case study.
e) Hypothesis and testing of Hypothesis: Sources of Hypothesis, Types of Hypotheses, characteristics of a good hypothesis, Hypothesis testing and theory, errors in testing of hypothesis.

**Part III: Statistical Methods**

a) Nature of educational data: quantitative and qualitative, scales of measurement, organization and representation of data.
b) Descriptive statistics: Measures of central tendency, variability, normal probability curve, measures of relationships, percentile ranks, standard scores, t-score, z-score.
c) Inferential statistics: Concepts underlying applications, Tests of significance: t-test, Chi-square test, ANOVA, linear and Multiple Regression

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