

Computer-based Exam Syllabus for various Scientific and Technical Positions

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Level 11 (Engineer 'C' - Electronics) and Level 10 (Engineer 'B' - Electronics):

- The base syllabus is the GATE Electronics and Communication Engineering 2026 syllabus
- In addition to the GATE syllabus, the following sub-topics are included:

Section 1: Engineering Mathematics:

- No Additional topics to GATE EC

Section 2: Networks, Signals, and Systems

- In addition to GATE EC, the following topics are added -
- Gaussian noise, Pink Noise, 1/f noise, and other types of noise
- Phase correlation, Intensity correlation

Section 3: Electronic Devices

- In addition to GATE EC, the following topics are added -
- CMOS camera
- Avalanche Photodiode (APD)
- EM CCD Camera
- FPGA time taggers
- FPGA-based time correlation, coincidence detection
- Micro Electro-Mechanical devices (MEMS)
- Photo Multiplier tubes (PMT)
- Spectrum analyzer
- Vector network analyzer (VNA)
- Semiconductor diode laser
- External cavity diode laser (ECDL)
- Optical modulators – Electro and Acousto Optic modulators (EOM and AOM)

Section 4: Analog Circuits

- In addition to GATE EC, the following topics are added -
- Low noise RF and Microwave amplifiers
- Frequency mixers
- Circulators
- Voltage Controlled Oscillators (VCOs)
- Voltage Variable Attenuators (VVA)
- Microwave resonators
- RF and Microwave receivers
- Impedance matching
- Low pass, high pass, and notch filters

Section 5: Digital Circuits

- No Additional topics to GATE EC

Section 6: Control Systems

- In addition to GATE EC, the following topics are added -
- Lock-in Detection
- Phase locked loop (PLL)
- Proportional Integral and Differential (PID) controller
- Temperature controller, Thermistor
- Phase and Intensity stabilization

Section 7: Communications

- Phase and frequency modulation
- Basics of Convolution, De-convolution

Section 8: Electromagnetics

- In addition to GATE EC, the following topics are added -
- Optical circulators
- Beam splitters and polarization-sensitive beam splitters
- Neutral density filters
- Microwave and Optical cavity
- Polarizer, waveplates, bi-refringence
- Polarimetry
- Faraday and Kerr rotations
- Dispersions

Section 9: Antennas and Propagation

Section 10: RF Circuit Design

Section 11: Digital Signal Processing: FFT, FIR and IIR filters

Section 12: Programming in C/C++

Section 13: Electronic Measurements and Instrumentation

Section 14: CPLD, FPGAs, VHDL and Verilog hardware description languages

GATE Electronics and Communication Engineering 2026 Syllabus

Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigenvalues and eigenvectors, rank, solution of linear equations - existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface, and volume integrals, Taylor series.

Differential Equations: First-order equations (linear and nonlinear), higher-order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function, and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence, and curl, Gauss's, Green's, and Stokes' theorems.

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, sequences, series, convergence tests, Taylor and Laurent series, residue theorem.

Probability and Statistics: Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, normal distribution, joint and conditional probability.

Networks, Signals and Systems

Circuit Analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC, and RLC circuits, solution of network equations using the Laplace transform.

Linear 2-port network parameters, wye-delta transformation.

Continuous-time Signals: Fourier series and Fourier transform, sampling theorem and applications.

Discrete-time Signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Electronic Devices

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

Carrier Transport: Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson, and continuity equations.

P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode, and solar cell.

Analog Circuits

Diode Circuits: Clipping, clamping, and rectifiers.

BJT and MOSFET Amplifiers: Biasing, AC coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers.

Op-amp Circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers, and oscillators.

Digital Circuits

Number Representations: Binary, integer, and floating-point numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders.

Sequential Circuits: Latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.

Data Converters: Sample and hold circuits, ADCs, and DACs.

Semiconductor Memories: ROM, SRAM, DRAM.

Computer Organization: Machine instructions and addressing modes, ALU, data-path, and control unit, instruction pipelining.

Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root locus plots; Lag, lead, and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Communications

Random Processes: Auto correlation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

Information Theory: Entropy, mutual information, and channel capacity theorem.

Digital Communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR, and BER. Fundamentals of error correction, Hamming codes, CRC.

Electromagnetics

Maxwell's Equations: Differential and integral forms and their interpretation, boundary conditions, the wave equation, and the Poynting vector.

Plane Waves and Properties: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Transmission Lines: Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays

Level 10 (Engineer 'B' - Instrumentation): GATE 2026 Instrumentation Engineering Syllabus

Engineering Mathematics

Linear Algebra: Matrix algebra, systems of linear equations, consistency and rank, eigenvalues and Eigenvectors.

Calculus: Mean value theorems, theorems of integral calculus, partial derivatives, maxima and minima, multiple integrals, Fourier series, vector identities, line, surface and volume integrals, Stokes, Gauss, and Green's theorems.

Differential Equations: First-order equation (linear and nonlinear), second-order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, solution of partial differential equations: variable separable method.

Analysis of Complex Variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, residue theorem, solution of integrals.

Probability and Statistics: Sampling theorems, conditional probability, mean, median, mode, standard deviation and variance; random variables: discrete and continuous distributions: normal, Poisson, and binomial distributions.

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Electricity and Magnetism

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, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Electrical Circuits and Machines

Voltage and Current Sources: Independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductance and capacitor; transient analysis of RLC circuits with dc excitation.

Kirchhoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer, and reciprocity theorems.

Peak-, average- and rms values of AC quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L, and C elements; transient analysis of RLC circuits with ac excitation. One-port and two-port networks, driving-point impedance and admittance, open- and short-circuit parameters.

Single Phase Transformer: Equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Types of losses and efficiency calculations of electric machines.

Signals and Systems

Periodic, aperiodic, and impulse signals; Laplace, Fourier, and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

Control Systems

Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feed forward, and ratio controllers, tuning of PID controllers and sizing of control valves.

Analog Electronics

Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of ideal and practical operational amplifiers; applications of Op-Amps: adder, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, precision rectifier, active filters, oscillators, signal generators, voltage-controlled oscillators, and phase locked loop, sources and effects of noise and interference in electronic circuits.

Digital Electronics

Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flipflops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, Embedded Systems: Microprocessor and microcontroller applications, memory and input-output interfacing; basics of data acquisition systems, basics of distributed control systems (DCS) and programmable logic controllers (PLC).

Measurements

SI units, standards (R, L, C, voltage, current, and frequency), systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression. Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C, and frequency, Q-meter. Measurement of voltage, current and power in single and three-phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

Sensors and Industrial Instrumentation

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4- 20 mA two-wire transmitter.

Communication and Optical Instrumentation

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, quadrature amplitude, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photo-diode, light dependent resistor, square law detectors and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing. UV-VIS Spectrophotometers, Mass spectrometer.

Level 10 (Engineer 'B' – Mechanical):

Applied Mechanics and Machine Design

Engineering Mechanics: Free-body diagrams and equilibrium, friction and its applications, including rolling friction, belt-pulley systems, brakes, clutches, screw jacks, wedges, and vehicle mechanics, trusses and frames, principle of virtual work, kinematics and dynamics of rigid bodies in plane motion, linear and angular impulse and momentum, work-energy principles, and Lagrange's equation.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio, Mohr's circle for plane stress and plane strain, thin cylinders, shear force and bending moment diagrams, bending and shear stresses, shear center, deflection of beams, torsion of circular shafts, Euler's column theory, energy methods, thermal stresses, strain gauges and rosettes, testing of materials using universal testing machines, hardness testing and impact testing.

Theory of Machines: Displacement, velocity, and acceleration analysis of plane mechanisms, dynamic analysis of linkages, cams, gears and gear trains, flywheels, governors, balancing of reciprocating and rotating masses, and gyroscopic motion.

Vibrations: Free and forced vibrations of single-degree-of-freedom systems, damping, vibration isolation, resonance, and critical speeds of shafts.

Machine Design: Design under static and dynamic loading, theories of failure, fatigue strength, S-N curve, design principles of bolted, riveted, and welded joints, shafts, gears, rolling and sliding contact bearings, brakes, clutches, and springs.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties, fluid statics, forces on submerged bodies, stability of floating bodies, control volume analysis of mass, momentum and energy, fluid acceleration, continuity and momentum equations, Bernoulli's equation, dimensional analysis, viscous flow of incompressible fluids, boundary layer theory, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings, and fundamentals of compressible fluid flow.

Heat Transfer: Modes of heat transfer including conduction, convection and radiation, one-dimensional heat conduction, thermal resistance concept, electrical analogy, heat transfer through fins, transient heat conduction, lumped parameter analysis, Heisler charts, thermal boundary layer, dimensionless parameters in free and forced convection, heat transfer correlations for flow over flat plates and through pipes, heat exchanger analysis using LMTD and NTU methods, Stefan-Boltzmann law, Wien's displacement law, black and grey body radiation, view factors and radiation network analysis.

Thermodynamics: Thermodynamic systems and processes, properties of pure substances, behaviour of ideal and real gases, zeroth, first and second laws of thermodynamics, work and heat interactions, thermodynamic property charts and tables, availability, irreversibility and thermodynamic relations.

Applications: Air and gas compressors, vapour and gas power cycles, regeneration and reheat cycles, Otto, Diesel and Dual cycles, vapour compression refrigeration, gas refrigeration, heat pump cycles, psychrometric properties and processes, psychrometric chart, impulse and reaction turbines, Pelton wheel, Francis turbine, Kaplan turbine, steam turbines and gas turbines.

Materials, Manufacturing, and Industrial Engineering

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

Casting, Forming and Joining Processes: Casting processes, pattern, mould and core design, solidification and cooling, gating and riser design, plastic deformation and yield criteria, hot and cold working processes, forging, rolling, extrusion, drawing, sheet metal operations including shearing, bending and deep drawing, powder metallurgy, welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining, conventional machine tools, single and multi-point cutting tools, tool geometry and materials, tool wear and tool life, machining economics, abrasive machining, non-traditional machining processes, work holding devices, jigs and fixtures, NC and CNC machines, and CNC programming fundamentals.

Metrology and Inspection: Limits, fits and tolerances, linear and angular measurements, comparators, interferometry, surface finish measurement, alignment and testing methods, tolerance analysis in manufacturing and assembly, and coordinate measuring machines (CMM).

Computer Integrated Manufacturing: Fundamentals of CAD, CAM, CAD/CAM integration, computer-integrated manufacturing systems, and additive manufacturing.

Production Planning and Control: Forecasting techniques, aggregate production planning, scheduling, material requirement planning (MRP), and lean manufacturing.

Inventory Control: Deterministic inventory models, economic order quantity (EOQ), safety stock and inventory control systems.

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

Optics

Optics: Geometrical optics, reflection, refraction, total internal reflection, total external reflection, Fermat's principle, ray transfer (ABCD) matrices, Paraxial rays, lenses and mirrors, optical aberrations - Spherical aberration, coma, astigmatism, distortion, chromatic aberration, Bragg's law, Snell's law, interference of light, Young's double slit experiment, Michelson and Fabry-Perot interferometers, diffraction, Fresnel zones, diffraction gratings, zone plates, resolving power, polarization, Brewster's law, wave plates, optical resonators, and basic laser systems.

Level 5 (Engineering Assistant 'C' – Mechanical):

Manufacturing Technology

Manufacturing Technology: Centre lathe and its construction, lathe operations, taper turning methods, lathe attachments and accessories, capstan and turret lathes, automatic lathes, theory of metal cutting, chip formation, orthogonal and oblique cutting, cutting tool geometry, cutting tool materials, tool wear, tool life, cutting fluids, drilling machines and operations, twist drill geometry, milling machines and milling operations, milling cutters, indexing methods, shaping, planing, grinding, honing, lapping, polishing, buffing, unconventional machining processes (EDM, ECM, LBM, USM, AJM), casting processes, moulding sands, patterns, special casting methods, welding processes (Arc, Gas, TIG, MIG and Resistance welding), rolling, sheet metal operations, powder metallurgy, CNC machines, CNC part programming, robotics, jigs and fixtures, and engineering drawing fundamentals including dimensioning and surface finish symbols.

Strength of Materials and Theory of Machines

Strength of Materials and Theory of Machines: Simple stresses and strains, Hooke's law, factor of safety, elastic constants, Young's modulus, Poisson's ratio, bulk modulus, shear modulus, center of gravity, moment of inertia, shear force and bending moment, torsion, bending theory, transmission of power through belt, rope, chain and gear drives, velocity ratio, gear trains, basic kinematics of machines, four-bar mechanism and inversions, friction, coefficient of friction, angle of friction and angle of repose.

Thermal Engineering

Thermal Engineering: Thermodynamic systems, properties of matter, internal energy, enthalpy, entropy, specific heats, gas laws, zeroth, first and second laws of thermodynamics, thermodynamic processes, internal combustion engines, two-stroke and four-stroke petrol and diesel engines, brake power, indicated power, mechanical efficiency, gas turbines, steam generation, air compressors, refrigeration and air conditioning, vapour compression and vapour absorption refrigeration systems, coefficient of performance (COP) and refrigerants.

Fluid Mechanics and Pneumatics

Fluid Mechanics and Pneumatics: Properties of fluids, pressure measurement, manometers, pressure gauges, fluid flow, Bernoulli's equation, Venturimeter, orifice meter, hydraulic coefficients, pipe losses, hydraulic gradients, water hammer, centrifugal and reciprocating pumps, hydraulic systems and components, hydraulic pumps, valves, cylinders, motors, accumulators, pneumatic systems, FRL unit, pneumatic valves, actuators, air motors and pneumatic symbols.

Industrial Management

Industrial Management: Principles of management, organization, production and productivity, product design, production planning and control, purchasing procedures, tendering, storekeeping, inventory control, material requirement planning (MRP), Just-In-Time (JIT), FIFO, leadership and motivation, logistics, quality management, total quality management (TQM), PDCA cycle, quality circles, quality tools, ISO 9000 standards, maintenance practices, industrial safety, accident prevention, environmental protection, waste management, water conservation and climate change.

Materials Science and Measurements

Materials Science and Measurements: Mechanical properties of engineering materials, ferrous and non-ferrous metals, cast iron, steel, copper, aluminium, lead, zinc, tin and nickel, heat treatment of steels, plastics, ceramics and composite materials, engineering measurements, measuring instruments, gauges, sine bar, transducers, strain gauges, proving rings, load cells, tachometers, LVDT, optical pyrometers, thermocouples, hydrometers, hygrometers, liquid level sensors, limits, fits, tolerances, interchangeability and systems of fits.

Level 5 (Engineering Assistant 'C' – IT):

- Information Technology Skills
- Basics of Computer Organization
- Python programming
- Database concepts and technologies
- Computer Networks
- System and Network Administration
- Operating Systems and Administration
- Web development

Level 5 (Engineering Assistant 'C' – Electronics):

Applied Electronics

- Energy Levels, Energy Bands in Solids
- Soldering Techniques
- BJT, FET, Diode
- R-C coupled Amplifiers
- Oscillators

Digital Electronics

- Number Systems
- Boolean Algebra and Logic Gates
- Digital Integrated Circuit and Logic Families
- Boolean Expression Forms and Simplification
- Combinational Circuit: Adders, Multipliers, Encoders, etc.
- Flip Flops, Shift Registers
- Counters, Memories, ADC, DAC

Communication Systems

- Block Diagram of a Communication Receiver
- Analog Modulation Techniques
- Noise, Sources of Noise
- Need for Filters, Types of Filters
- Network Theorem – Superposition, Thevenin, Max. Power Transfer
- Digital Modulation Techniques
- Transceivers,
- Multiplexing – TDM, FDM

Basics of C programming

- Need for Programming Languages
- Flowcharts, Algorithms
- Basics of Assembler, Linker, and Compiler
- Arithmetic and Logical Operators
- Decision making Statements, Loop, Functions,
- Arrays, Strings, and Pointers
- Structures

Power Electronics

- Function and Characteristics of Power Transistors, Power Diodes
- Power MOSFETs
- SCRs, Thyristors and Applications
- AC-DC and DC-AC converters

Electronic Measurement and Analysis

- Electrical Transducer and Classification
- Ammeters, Voltmeters, Digital Multimeter
- Basics of Oscilloscopes

Microcontroller and Applications

- Introduction/Concepts of Microcontrollers
- 8051 microcontroller Architecture
- Polling, Interrupts, Serial Communication
- Arduino Uno microcontroller

Basics of Hardware Description Languages

- Introduction and Need for Hardware Description Languages
- Basics of Verilog HDL
- Basics of CPLD, FPGA

Engineering Assistant 'C' – Civil (Level 5):

Surveying

Principles of surveying, classification of surveys; Measurement of distances and directions, direct and indirect methods; chain and compass survey; leveling and trigonometric leveling, Contours; Theodolite and tachometric survey.

Engineering Mechanics and Strength of Materials

Forces - types of Forces, Parallelogram, Triangle and Polygon Law of Forces, Lami's theorem; Centre of Gravity and Moment of Inertia; Simple stresses and strains, Hooke's law – stress strain diagram, working strength, elastic constants, Poisson's ratio, Relationship between elastic constants, compound rods, supports conditions and their types, temperature stresses, strain energy, proof resilience, impact loading; Shear force and bending moment diagrams for simply supported, over hanging and cantilever beams, relation between intensity of loading, shear force and bending moment; Theory of simple bending, modulus of section, moment of resistance, distribution of shear stress in rectangular, circular and I-Sections; Deflection in cantilever and simply supported beams subjected to simple loading; Columns and struts - Euler's and Rankine's formulae, Slenderness ratio, simple built-up columns; Analysis of dams and retaining walls; Simple plane and pin-jointed trusses, Stresses by method of joints and method of sections.

Construction Materials & Practice

Properties and uses of construction materials - Stones, Bricks, Tiles, Sand, Cement, Timber, Plastics, Glass, Asbestos, Paints, Distempers, Enamels and Varnishes; Preparation of Cement mortar for various works. Classification of Buildings as per NBC, Site investigation for foundation as per NBC - Trial Pit and auger boring, classification of foundations, construction of spread footing and well foundation; Stone and Brick masonry - types and principles of construction; Doors and Windows - types, fittings and fastenings, types and functions of Lintels, Sunshades and Roofs, Flooring - Construction and types of material; Types of Stairs; Scaffolding; Types of Plastering, Pointing, Painting and White/Colour Wash.

Concrete Technology

Ingredients of Concrete; Types of Aggregate; Types and grades of cement; Types and grades of concrete; Mixing & transportation of concrete; Testing of concrete; water cement ratio; Factors affecting the strength of concrete; Shrinkage of Concrete; Definitions & characteristics of PCC, PPC, OPC, RCC, PSC, RMC, SCC, etc; Construction chemicals and admixtures;

Theory of structures and Design of RCC Structures AND Steel structures.

Analysis of statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Analysis of thin and thick cylinders; Slope deflection, moment distribution, and Stiffness and flexibility methods of structural analysis; Influence lines. I) Reinforced Concrete Structures: Concepts of working stress, limit state and ultimate load design methods; IS code specifications for design of beams, slabs, columns, footings, and walls; design of beams, slabs, columns; Analysis of beam sections at transfer and service loads; Design of wall footings, foundations, retaining walls, and water tanks Principles of pre-stressed concrete, methods of pre-stressing;

design of simple members; Design of brick masonry ii) Steel Structures: Concepts of Working stress and Limit state design methods; Design of tension and compression members, beams, columns and column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses.

Quantity Surveying

Abstract estimate, detailed estimate - centerline and long & short wall method, various items of Civil Engineering works as per Indian Standards; General Specifications - earth work, brick / stone masonry in cement mortar, RCC, plastering in cement mortar, Floor finishes with ceramic tiles and marbles, white washing, color washing; Standard schedule of rates, lead and lift, preparation of lead statement; Computation of earth work - Mid-ordinate, Mean Sectional area, Trapezoidal method, Prismoidal Rule; Approximate estimate : Plinth area and cubic rate estimate.

Environmental Studies

Sources of water: surface and sub-surface water, aquifers, yield from wells, Infiltration galleries, types of intakes and design of intakes, collection and conveyance of water; water demand and its variations, estimation of water demand; quality of water, characteristics, water-borne diseases, water sampling and analysis, water quality standards; Water Treatment: unit operations and processes for water treatment, sedimentation, coagulation and flocculation, filtration, disinfection, water softening, removal of colour, iron and manganese; aeration, Defluoridation of water, demineralization of water, R.O. process, principles and design of various water treatment units; Distribution of treated water, systems of water distribution, layouts of distribution systems, components of distribution systems, valves, analysis and design of the water distribution systems, Storage and distribution reservoirs; leakages and control in water distribution system; Rural water supply.

Systems of sewage collection, conveyance, and disposal; estimation of quantity of sewage and storm water, sewerage systems, sewer appurtenances, material for sewers, laying of sewers, Design of sewers, operation and maintenance of sewerage systems; pumping of sewage; Characteristics of sewage, sampling and analysis of sewage, unit operations and process for wastewater treatment, aerobic, anaerobic, facultative and anoxic processes, principles and design of various wastewater treatment units, principles and design of septic tanks, disposal of septic tank effluent; Common Effluent Treatment Plants, Zero liquid discharge; Disposal of products of sewage treatment; Sludge handling, treatment and disposal; self-purification of streams; Building drainage, Plumbing Systems; Rural and semi-urban sanitation; Urban storm water management, Impact of storm water, Management of storm water runoff, design of storm water drainage systems;

Hydraulics

Properties of fluids, fluid pressure and its measurement; Types of flows, energies in fluid motion, Bernoulli's theorem and its applications – venturi meter, pitot tube; Orifice and mouthpiece; Notches and weirs; Flow through pipes, hydraulic gradient line and total energy line, laminar and turbulent flow in pipes - Reynolds number, measurement of velocity; open channels; Water turbines – classification, centrifugal and reciprocating pumps; Layout of hydroelectric power plant.

Irrigation Engineering

Definitions, duty, delta, base period, rainfall – Precipitation, Run-off, percolation and its measurement, factors affecting runoff, methods of computing maximum flood discharge; Classification of head works, water requirements for plants including wilting of crops, component parts of a weir and barrage, factors influencing selection of site - reservoirs and dams; Classification of canals, canal lining, cross drainage works; Soil erosion, water logging, soil water plant relationship; Necessity of irrigation - advantages and disadvantages, irrigation methods.

Roads & Transportation

Alignment of roads - plain and hilly terrain, surveys; Cross section of road structure, width of pavement, Camber, Gradient, Super elevation, Transition curves, horizontal and vertical alignment; Pavement marking, traffic signs, traffic islands.

Soil Mechanics

Physical and index properties of soil, classification and interrelationship; Permeability and seepage, Darcy's law; flow nets, uplift pressure, piping; Compressibility and consolidation; Compaction behaviour, methods of compaction and their choice; Shear strength of soils, stresses and failure, Mohr's circle; Earth pressure theories, stability analysis of slopes, retaining structures, stress distribution in soil; site investigations and sub-surface exploration; Types of foundations, selection criteria, bearing capacity, effect of water table, settlement, laboratory and field tests; principles and design considerations of shallow and deep foundations; Types of piles, their design and layout, pile load tests, Caissons, Foundations on expansive soils, swelling and its prevention;

Types of soil, classification of soil - Textural, IS Classification, physical properties - plasticity, cohesion, consolidation, compaction, permeability, compressibility, soil moisture content, specific gravity, density; Bearing capacity of soil.

Construction management

Types of construction projects; Concreting Equipment, Earthwork Equipment, Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Types and method of estimation; Project planning and network analysis: PERT and CPM, Resource allocation.

Engineering Assistant 'C' – Electrical (Level 5):

Electrical Engineering materials: Conducting materials – Semi-conducting materials – Insulating materials – Dielectric materials – Magnetic materials – Special purpose materials

Basic Electrical Engineering: Basic Principles of electricity – DC Circuits & Network theorems – Work, Power & Energy – Electrical Units – Heating effects of electric current – Single phase AC circuits – Poly phase AC circuits – Magnetic effect of electric current – Electromagnetic induction – Electrostatics & capacitance

Circuit Theory: Electrostatics - Basic Concepts of Electricity - Ohm's Law, Kirchhoff's Laws, Series, Parallel and Series- Parallel Circuits - Network Theorems (Mesh Analysis, Nodal Analysis, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems) - Star-Delta transformation

DC Machines: Fundamentals of DC Generators – Construction, Principle of operation, losses, power stages, Efficiency – Armature Reaction & Commutation – Types & Characteristics of DC Generators, Applications – Fundamentals of DC Motors – Principle of operation, Back EMF, Types & characteristics, losses, power stages, Efficiency, Speed Control & Braking, Starters for DC Motors – Testing of DC Machines – Applications

Single-phase Transformers: Principle of operation & constructional details – Phasor diagram & Equivalent circuit – Transformer tests, losses, Voltage regulation, efficiency, All day efficiency, Auto transformers, Parallel operation, Applications

Three-phase transformers: Construction and type of connections – Parallel operation & Load sharing – Methods of cooling – Transformer accessories – Transformer oil testing – Earthing – Applications – Maintenance

Alternators: Working principle and constructional details – Types – EMF equation

Methods of obtaining sine wave - Load characteristics, performance & testing – Cooling of alternators – excitation and exciters - Parallel operation & synchronisation – Armature reaction – Voltage regulation – Application – Maintenance

Three-phase Induction motor: Principle of operation, construction and characteristics – Types of motors – Slip and slip frequency – torque – characteristics – phasor diagram – equivalent circuit – no load test and blocked rotor test – circle diagram – losses – efficiency – speed control – starters – types of starters – circuits – applications

Single-phase Induction motor: Principle of operation and characteristics – Starting methods – Types of Induction motors and their construction, operation, characteristics & applications

Synchronous motors: Principle of operation – methods of starting – construction – characteristics – effects of excitation – hunting – damper winding – applications

Special AC/DC machines: Construction & working, Permanent magnet motors – AC and DC Servo motors – Stepper motors – types, construction & principle of working – Characteristics – comparisons – applications – AC series motor, universal motor, repulsion motor, reluctance motor, hysteresis motor

Measurement and Instrumentation: Methods of measurements, Classification of instruments, characteristics of Instruments Operating torques, Working and construction, damping systems, Range extension, Instruments for measurement of current, voltage, R, L, C, Power, Energy, Power factor, Frequency, Phase difference, waveform – Instruments types – operation – principles – construction – working – Rectifier type instruments – Instruments transformers – Testing, Errors and characteristics of CT and PT – Megger – Earth tester – Multimeters – Synchroscope – CRO – CRT – Digital storage oscilloscope – Transducers and sensors

Electric power Generation: Conventional methods of power generation – Hydel, Thermal, Nuclear power plants – Principles and types of cogeneration – Diesel, Gas, Pumped storage schemes – Renewable Energy Sources – Solar PV system – Wind power Generation – Hybrid Solar PV system – Grid or Interconnected system – Load curves – Connected load – Average load – Maximum demand – Diversity factor – Tariff – Load sharing

Transmission: Elements of transmission Line – Overhead line – Types of Insulators – properties – string efficiency – Types of conductors – Spacing – Span – Sag – Calculation of Sag – Constants of a Transmission line – Transposition of Transmission lines – Skin Effect – Ferranti effect – Corona – capacitance – grading – Voltage regulation and efficiency – HV DC Transmission – Underground cables – classification, construction details, laying, cable faults

Distribution: Substation – classification of substations – substation equipments – Bus bar – Types of bus bar arrangement – Distribution system – classification of Distribution Systems – types connection – schemes of Distribution System – AC Distribution calculations

Switch Gears: Basic principle of circuit breaker – Arc phenomenon – Methods of Arc extinction – Circuit breaker ratings – Classification, Construction and Working principle of various Circuit Breakers, MCBs, ELCB, RCCB, SF₆, Vacuum Circuit Breaker – Fuses – Fuse Element materials – HRC, cartridge fuse, Voltage surge – causes of over voltage – Lightning – Lightning arrester

Protective relays: Importance – classification of relays – Principle, Operation, Construction, Characteristics, application of various protective relaying

Grounding: Equipment grounding – System grounding – ungrounded neutral system – Methods of grounding

System of wiring: List of symbols – Rules – Elements – Circuits – Types of internal wiring – Protection of electrical installation – electric shock – Soil resistivity – Safety signs – Domestic and Industrial wiring – Estimate and costing

Earthing: Requirement of earthing – Methods of earthing

Electric drives & braking: Types of Electric drives – Concept of electric drives – Factors governing the selection of motors – Standard ratings of motor – Classes of load duty cycles – Braking – Type of Braking – Electric braking – Plugging, Dynamic and Regenerative braking

Electric Traction: Traction systems – Methods of supplying power – Over Head equipments – Different systems of Track Electrification – Booster transformer – Neutral sectioning Traction Mechanics – Traction motors and control – Regenerative Braking

Illumination: Definition and units of different terms used in illumination – Sources of light – Arc lamp, Incandescent lamp, Halogen Lamp, Sodium vapour lamp, High pressure mercury vapour lamp, Fluorescent tube – Induction lamp – LED lamps, Requirements of Good Lighting System – Laws of Illumination – Types of Lighting Scheme – Design of lighting scheme – Energy efficient lamps & lighting controls

Electric heating: Modes of heat transfer – Types of electric heating – Electric furnaces – Electric welding

Storage Batteries: Classification of cells – construction – chemical action – electrical specifications – efficiencies – defects and their remedies – capacity – methods of charging – series and parallel connections of batteries – maintenance – applications

Power electronics devices and circuits: Semiconductor and Diodes – Classification, working, characteristics and applications – intrinsic and extrinsic, N type and P type – PN junction diode – Zener diodes – Rectifiers – filters – Transistor – transistor biasing – classification of amplifiers – negative feedback – oscillators and multivibrators – FET, UJT, SCR, DIAC, TRIAC, MOSFET, Classifications of optoelectronic devices – symbols, characteristics and working of LDR, LED, 7-segment LED and LCD – opto coupler – photo transistor – Clipper, clamper circuits – Solar cell – Applications of power electronics – SMPS, Inverters, UPS, Converters

Digital electronics: Number System – Conversion from one to another – binary codes – Boolean Algebra

Logic gates: Basic logic gates – Universal gates – Special gates – Boolean techniques – Boolean expression – TTL, CMOS Logics – Tristate logic – Combinational Circuits – Arithmetic circuits – Binary Addition & subtraction – Parallel and serial adders – Encoder and decoder – Multiplexer – Demultiplexer – Parity checker and generator

Sequential circuits: Flip flops – SR, JK, T, D Flip flops, JK Master slave Flip flop – Triggering of Flip flop – edge and level triggering – Counters – Registers – Memory devices

Basic computer: Computer hardware – CPU – RAM – ROM – I/O devices – Software – Internet and Web Technologies – Elementary concepts in Operating System – Windows – Introduction to MS Office – Auto CAD

Level 2 (Tradesman 'A' – Electrical):

- 1) Fundamentals of electricity, Ohm's Law, Kirchhoff's Laws.
- 2) Chemical effect of electric current.
- 3) Inverter, Battery Charger, UPS fundamentals.
- 4) Electromagnetism.
- 5) D.C Machines.
- 6) Different types of wiring systems (domestic and industrial), different types of earthing techniques, and insulating materials.
- 7) Alternating current fundamentals. Generation, transmission, and distribution of electricity.
- 8) Transformers.
- 9) Synchronous motors, Induction motors, AC and DC machine winding.
- 10) Electrical measurements and Measuring instruments.
- 11) Illumination and lighting fundamentals.
- 12) Protective devices – Fuses, Relays, MCBs, MCCBs, ELMCBs.
- 13) Basic electronics, semiconductors, and digital electronics.
- 14) Solving simple electrical problems, basic electrical formulae.
- 15) Reading of circuit diagrams / single line diagrams / Block diagrams / Recording basic electrical parameters / Identification of basic electrical symbols.
- 16) Electrical Safety – Causes for Electric shock and protection.
- 17) Fire Safety – types of fire prevention and fire extinguishing techniques.

Level 2 (Tradesman 'A' – AC Mechanic):

1. Introduction to Air Conditioning

Principles of air conditioning; types of AC systems; applications; HVAC industry; occupational safety, PPE, electrical safety, and safe refrigerant handling.

2. Refrigeration & Thermodynamics

Heat transfer, pressure, temperature, psychrometry, humidity, vapour compression refrigeration cycle, and comfort cooling.

3. Refrigerants

Properties, identification, charging, recovery, leak detection, eco-friendly refrigerants, and environmental regulations.

4. Electrical Systems

Single/three-phase supply, motors, compressors, capacitors, relays, contactors, thermostats, control panels, wiring diagrams, and protection.

5. Air Conditioning Systems

Window, split, packaged, ducted, VRF/VRV, chilled water systems, components, and inverter technology.

6. Controls & Automation

Thermostats, sensors, timers, smart controls, relay logic, IoT, pressure switches, and overload protection.

7. Installation Practices

Site survey, mounting, copper piping, brazing, flaring, insulation, drainage, vacuuming, charging, and commissioning.

8. Maintenance & Troubleshooting

Preventive maintenance, servicing, fault diagnosis, testing instruments, compressor faults, and corrective maintenance.

9. Energy Efficiency & Standards

EER, SEER, star ratings, ASHRAE, BIS, ventilation, BMS, solar AC, and documentation.

10. HVAC systems

Duct designing, AHU systems, dampers

Level 2 (Tradesman 'A' – Mechanical, Fitter, Turner, and Machinist):

The test will assess the candidate's knowledge of basic mechanical engineering principles, workshop practices, engineering drawing, engineering materials, precision measurement, machine tools, machining processes, fitting operations, limits, fits and tolerances, cutting tools, cutting parameters, heat treatment, workshop calculations, quality control, occupational safety, maintenance practices, and basic CNC concepts.