SSC Junior Engineer JE Exam Syllabus 2026

13 **Scheme of Examination:**

13.1 The Computer Based Examination will be conducted in two paper(s) as indicated below:

13.1.1 Paper-I

13.1.2 Paper-II

Papers	Mode of Examination	Subject	Number of Questions /Maximum Marks	Duration
Paper-I	Computer-Based Examination	(i) General Intelligence and Reasoning	50/ 50	2 Hours (2 hours and 40 minutes for the candidates who are eligible for scribe as per **Para-9.1, 9.2 and 9.3**)
		(ii) General Awareness	50/ 50	
		(iii) For the post of JE (Civil): **Part-A** General Engineering (Civil & Structural) OR **For the post of JE (Electrical):** **Part-B** General Engineering (Electrical) OR **For the post of JE (Mechanical):** **Part-C**: General Engineering (Mechanical) OR **For the post of SA in IMD:** **Part-D** General Engineering (Computer Science and Information Technology) / **Part-E** General Engineering (Electronics and Telecommunication Engineering)/ **Part-F** Physics OR **For the post of JE (Telecom):** **Part-G**: Telecommunication	100/ 100	
Paper-II	Computer-Based Examination	**For the post of JE (Civil)**: **Part-A** General Engineering (Civil & Structural) OR **For the post of JE (Electrical):** **Part-B** General Engineering (Electrical) OR **For the post of JE (Mechanical):**	100/ 300	2 Hours (2 hours and 40 minutes for the candidates who are eligible for scribe as per **Para 9.1, 9.2 and 9.3**)

Papers	Mode of Examination	Subject	Number of Questions /Maximum Marks	Duration
		Part-C: General Engineering (Mechanical) OR **For the post of SA in IMD:** **Part-D** General Engineering (Computer Science and Information Technology) / **Part-E** General Engineering (Electronics and Telecommunication Engineering)/ **Part-F** Physics OR **For the post of JE (Telecom):** **Part-G:** Telecommunication		

13.2 **Paper-I**: In Paper-I (Computer Based Examination), i) General Intelligence & Reasoning and ii) General Awareness are compulsory for all the candidates. In addition, candidate is required to attempt the subject(s), i.e., Part-A or Part-B or Part-C or Part-D or Part-E or Part-F or Part-G opted for in the Online Application Form as per their EQ. Six subjects viz. Part-A, Part-B, Part-C, Part-D, Part-E and Part-F will be conducted in one batch, however one subject i.e. **Part-G for the post of JE (Telecom)** will be conducted in a separate batch. Paper-I will be qualifying in nature. Candidates will be shortlisted for Paper-II (CBE) as per their merit subject to obtaining minimum qualifying marks in **Paper-I**.

13.3 Separate merit lists shall be drawn for the post of Junior Engineer (Civil), Junior Engineer (Electrical & Mechanical), Scientific Assistant in IMD and Junior Engineer (Telecom) to appear in Paper-II.

13.4 **Paper-II**: Shortlisted candidates will be required to attempt the subject(s), i.e., Part-A or Part-B or Part-C or Part-D or Part-E or Part-F or Part -G opted for in the Online Application Form as per their EQ. Six subjects viz. Part-A, Part-B, Part-C, Part-D, Part-E and Part-F will be conducted in one batch, however one subject i.e. Part-G for the post of JE (Telecom) will be conducted in a separate batch.

SSC Junior Engineer JE Paper I & Paper II Exam Syllabus 2026

14 **Indicative Syllabus**

14.1 The standard of the questions in the Engineering subjects shall be approximately equivalent to the level of a Diploma in Engineering (Civil, Mechanical, and Electrical). For the subjects of Computer Science & Information Technology, Electronics & Telecommunication Engineering, Physics and Telecommunication, the standard of the questions shall be approximately equivalent to the graduation level. The detailed syllabus is provided below: -

14.2 **PAPER-I:**

14.2.1 **General Intelligence & Reasoning:** The Syllabus for General Intelligence would include questions of both verbal and non-verbal types. The test may include questions on analogies, similarities, differences, space visualization, problem-solving, analysis, judgment, decision-making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series, etc. The test will also include questions designed to test the candidate's ability to deal with abstract ideas and symbols and their relationships, arithmetical computations, and other analytical functions.

14.2.2 **General Awareness:** Questions will be aimed at testing the candidate's general awareness of the environment around him and its application to society. Questions will also be designed to test knowledge of current events and such matters of everyday observations and experience in their scientific aspect, as may be expected of any educated person. The test will also include questions relating to India and its neighboring countries, especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.

14.2.3 **Part-A (Civil Engineering):**

Engineering Mechanics, Solid Mechanics, Structural Analysis, Construction Materials and Management, Estimating, Costing and Valuation, Concrete Structures, Steel Structures, Surveying, Soil Mechanics (Geotechnical Engineering), Fluid Mechanics and Hydraulics, Hydrology and Irrigation Engineering, Environmental Engineering, Transportation (Traffic) Engineering.

14.2.3.1 **Part-B (Electrical Engineering):**

Fundamentals of Electrical Engineering, Magnetic Circuits, A.C. Fundamentals, Measurement and Measuring Instruments, Electrical Machines, Special Electric

Machines and Synchronous Generators, Generation, Transmission and Distribution, Estimation & Costing, Utilization of Electrical Energy, Basic Electronics, Power Electronics.

14.2.3.2 **Part-C (Mechanical Engineering):**

Engineering Mechanics, Strength of Materials, Theory of Machines, Machine Design, Materials Science and Engineering, Thermal Engineering, Fluid Mechanics and Hydraulic Machinery, Industrial Engineering, Manufacturing Engineering, Metrology and Measurement, Advanced Manufacturing Processes.

14.2.3.3 **Part-D (Computer Science and Information Technology)**

Engineering Mathematics, Digital Logic, Computer Organization and Architecture, Programming and Data Structures, Algorithms, Theory of Computation, Compiler Design, Operating System, Databases, Computer Networks.

14.2.3.4 **Part-E (Electronics and Telecommunication Engineering)**

(A) **Electronics**: Electronic Materials & Components, Diodes, Transistors, Amplifiers & Oscillators, Voltage Regulation, Introduction to Network Theorems, AC Circuits, Three-Phase Circuits, Resonance, Digital Electronics, Sequential & Combinational Logic and Data Conversion & Codes.

(B) **Telecommunications**: Antennas, Radio Wave Propagation, Electromagnetic Spectrum, Modulation, Single Sideband, Frequency Modulation, Pulse Modulation, Multiplexing, Introduction to Digital Communication and Radio Frequency Communications & Wireless Telecommunications.

14.2.3.5 **Part-F (Physics)**

Mathematical Methods, Mechanics, General Properties of Matter, Oscillations, Waves, Optics, Electricity, Magnetism, Kinetic Theory, Thermodynamics, Modern Physics, Solid State Physics, Semiconductor Devices, Analog and Digital Electronics.

14.2.3.6 **Part-G (Telecommunications)**

Engineering Mathematics, Network Analysis, Signals and Systems, Electronic Devices, Analog Circuits, Digital Circuits, Control Systems, Analog Communications, Digital Communications, Electromagnetics.

14.3 **PAPER II:**

14.3.1 **Part-A (Civil & Structural Engineering):**

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Centre of mass, Moment of Inertia.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, Uniform torsion, buckling of column, combined and direct bending stresses.

Structural Analysis: Introduction to Statically determinate and indeterminate structures; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Slope deflection and moment distribution method; Influence lines.

Construction Materials and Management:

Construction materials: Bricks, Stones, Timber, Steel, Cement, Aggregates, Plastics, Polymers, Glass, Concrete, concrete mix design, testing of concrete.

Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM.

Estimating, Costing and Valuation: Fundamentals of estimating, Cost Estimates for works, Rate Analysis, Valuation, Detailed Estimates.

Concrete Structures: Working stress and Limit State design concepts; Design of beams, slabs, columns; Foundation and Retaining Walls; Bond and development length.

Steel Structures: Working stress and Limit state design concepts; Bolted connections, Welds, Design of tension members, compression members and beams; Concept of plastic analysis - beams and frames.

Surveying: Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement: Chain and Compass survey, Plane table surveying, Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Tacheometric surveying, Theodolite Surveying, Advanced surveying equipment.

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; Onedimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand.

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, groundwater hydrology - steady-state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, cross drainage structures.

Water and Wastewater Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of Pollutants, their sources and impacts, Air Pollution control, Air Quality Standards, Air Quality Index 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).

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments.

Geometric design of railway Track – Speed and Cant.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

14.3.2 **Part-B (Electrical Engineering):**

Fundamentals of Electrical Engineering: Concepts of Electrical Circuit Elements - Resistors, Capacitors, Inductors, Batteries and the factors affecting their values and performance.

Concept of Voltage, current, power, energy, flux, etc. and their units.

Network Solution Methods: KCL, KVL, Node and Mesh Analysis.

Network Theorems: Thevenin's, Norton's Superposition and Maximum Power Transfer Theorem.

Magnetic Circuits: Concepts of Flux, Reluctance, Self & Mutual Inductance, Magnetomotive Force, Magnetic Circuits.

A.C. Fundamentals: RMS and Average Values of Alternating Waves. Simple series and parallel A.C. Circuits, Resonance, balanced three-phase circuits, Star-Delta transformation, Complex power and Power Factor in AC circuits.

Measurement and Measuring Instruments: Measurement of Voltage, Current, Power and Power Factor. Classification of Instruments, types of errors. Galvanometer, Ammeter, Voltmeter, Wattmeter, Wheatstone Bridge, Kelvin's double bridge, Energy Meter, Megger. Constructional features and Calibration of single-phase electronic energy meter. CT, PT and their uses.

Electrical Machines: Single-Phase and Three-Phase Transformers. DC Machines, their types, characteristics, Losses, efficiency, and applications. AC Machines: Single-Phase and Three-Phase Induction Motors, Starting, Speed Control methods, electrical Braking and Torque-Speed characteristics.

Special Electric Machines and Synchronous Generators: Fractional Motors, Servomotors. Armature Reaction, Parallel Operation of Generators, Synchronization.

Generation, Transmission and Distribution: Types of Power Stations, Load Factor, Demand Factor, and Diversity Factor. Power Factor and its improvement. Types of Transmission and Distribution lines, Transmission line parameters, Corona Effect and Ferranti Effect. Circuit Breakers, Protection of Generators and Transformers. Coaxial Cables, their ratings, and efficiency.

Estimation & Costing: Estimation of lighting schemes. Electric installation of machines and relevant IE Rules. Earthing Practices and IE Rules.

Utilization of Electrical Energy: Illumination, Electric Heating, Electric Welding, Electroplating, Electric Traction and Drives.

Basic Electronics: P-N Junction Diodes, Rectifiers and Wave-Shapers, Clipping, Clamping. BJT and FET Transistors, their characteristics, Amplifiers, Oscillators.

Power Electronics: Static V-I characteristics of Thyristor. Firing & Gating circuits for Thyristor; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single-phase half-controlled, full-controlled and midpoint-controlled rectifier.

14.3.3 **Part- C (Mechanical Engineering)**:

Engineering Mechanics: Free Body Diagrams and Equilibrium/Resultant of Forces/Lami's Theorem/ Laws of Friction/ Sliding and Rolling Friction/ Centroid of geometrical plane figures/ Centre of Gravity of Simple Solids.

Strength of Materials: Simple Stress and Strain/Types of beams/ Shear Force and Bending Moment/ Simple Bending and Deflection of Beam/ Torsion of Shafts/ Thin Cylindrical Shells.

Theory of Machines: Cams and Follower/ Belt, Chain, Rope, Gear Drives and Gear drives/Gear Trains/Flywheels and Governors/ Balancing and Vibration/ Brakes/ Dynamometers/ Clutches/ Bearings.

Machine Design: Types of Loads and Stresses/ Creep and fatigue/ Theories of Failure/ Design of Cotter Joint, Knuckle Joint, Lever and Crank/ Antifriction Bearing/ Design of Sunk key, Shaft, Couplings, Spur Gear, Power Screw, Springs/ Design of Screw fasteners, Bolted Joints and Welded Joints.

Materials Science and Engineering: Crystal Structure and bonds/ Iron Carbon Phase Diagram/ Heat Treatment of Steel/ Types of Cast Iron and Steels/ Major Non-Ferrous Alloys e.g., Aluminium Alloys, Nickel-Copper Alloys and Bearing Alloys/ Material Properties and testing/ Non-Destructive Testing/ Corrosion.

Thermal Engineering: Sources of Energy/ Laws of Thermodynamics/ Thermal Power Plant/ Heat Pump, Heat Engine and Refrigerator/ Steam Generators/ Steam Turbine-Impulse and Reaction Turbine/ Cooling Tower/ Internal Combustion Engines-Auto, Diesel and Dual Cycles with P-V and T-s Diagrams/ Types of IC Engines/ Air Compressor/Refrigeration and Air Conditioning.

Gas Turbine and Jet Propulsion/Properties of Steam/ Steam Generators/ Steam Nozzle/ Steam Turbine/Heat Transfer - Conduction, Convection and Radiation/ Heat Exchanger.

Fluid Mechanics and Hydraulic Machinery: Properties of Fluid/ Fluid Flow/ Fluid Flow through pipes/ Continuity Equation/ Impact of Jets on plate and curved vanes/ Hydraulic Turbine and Power Plant/ Centrifugal and Reciprocating Pumps.

Industrial Engineering: Site Selection and Plant Layout/ Work study and Work Measurement/ Production Planning and Control/ Statistical Quality Control/ Inventory Control.

Manufacturing Engineering: Pattern making/ Molding/ Casting/ Metal Forming/ Welding-Gas, Arc and Resistance Welding/ Types of lathe and Lathe Operations/ Broaching Machine/ Drilling/ Milling/ Gear Making/ Grinding and Finishing/ Press Working.

Metrology and Measurement: Precision, Accuracy, Sensitivity, Repeatability, Range, Calibration/ Linear and Angular Measurement/ Comparators/ Form and Surface Finish Measurement/ CMM/ Limit, Fits and

Tolerances/Interchangeability.

Advanced Manufacturing Processes: Jigs and Fixture/ CNC Milling Machine and Machining Centre/ PLC/ Special Purpose Machine/Non-Traditional Machining Processes like EDM, ECM, AJM, LBM and EBM/ Fundamentals of CAD/CAM, Industrial Robot Configurations and FMS.

14.3.4 **Part-D (Computer Science and Information Technology):**

Engineering Mathematics:

Discrete Mathematics: Propositional and first-order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, colouring. Combinatorics: counting, recurrence relations, generating functions.

Linear Algebra: Matrices, determinants, systems of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus: Limits, continuity and differentiability, Maxima and minima, Mean value theorem, Integration.

Probability and Statistics: Random variables, Uniform, normal, exponential, Poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes' theorem.

Digital Logic: Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture: Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Programming and Data Structures: Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms: Searching, sorting, hashing. Asymptotic worst-case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths.

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

Compiler Design: Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimization, Data flow analysis: constant propagation, liveness analysis, common subexpression elimination.

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

Databases: ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Computer Networks: Concept of layering: OSI and TCP/IP Protocol Stacks: Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium access Control, Ethernet bridging; Routing protocols:

shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP supports protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control, congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

14.3.5 **Part-E (Electronics and Telecommunication Engineering):**

(A) Electronics:

Electronic Materials & Components: Conductors, Semi-conductors, Insulators, Magnetic, Passive components, characteristics of Resistors, Capacitors and inductors.

Diodes: PN Junction diode, forward and reverse bias characteristics and equivalent circuits of diode, Zener diode and applications, clipping, clamping and rectifier circuits using diodes.

Transistors: Bipolar Junction Transistors (BJT), Field Effect Transistor (FET) and MOSFET; Biasing and stability, Emitter follower and its applications – Negatives Feedback-Transistor as a switch.

Amplifiers & Oscillators: Multistage Amplifiers, Feedback, Oscillators, Multi vibrators, Power amplifiers.

Voltage Regulation: Voltage regulation.

Introduction to Network Theorems: Kirchoff's laws, superposition, Thevenin's, Norton's and Maximum power theorems.

AC Circuits: Voltage and Current relationship in the resistance, inductance and capacitance. Concept of reactance, susceptance, conductance, impedance and admittance in series and parallel RL, RC and RLC circuits.

Three-Phase Circuits: Three phase supply-star and delta connection diagrams – Relation between line and phase & voltages and currents.

Resonance: Series and parallel resonance circuits – condition of resonance, resonant frequency, Q factor and bandwidth.

Digital Electronics: Logic gates, De Morgan's theorem, Boolean algebra and digital logic circuits, systems & codes.

Sequential & Combinational Logic: Flip-flops, shift registers, frequency counters and combinational logic design.

Data Conversion & Codes: Basic concepts of Digital to Analog and Analog to Digital Converters and Timing circuits.

(B) **Telecommunication**:

Antennas: Basic antenna principle directive gain, directivity, radiation pattern, broad-side and end-fire array, Yagi antenna and Parabolic antenna.

Radio Wave Propagation: Ground wave propagation, space waves and ionosphere propagation

Electromagnetic Spectrum: Frequency spectrum.

Modulation: Modulation, types of modulation, Amplitude Modulation (AM), Modulation index, Power relation in AM, Generation and Demodulation of AM.

Single Sideband: Power requirement in comparison with AM, Advantages of SSB over AM. Concept of Balanced Modulator, Generation of SSB, Pilot Carrier System. Independent Side System, Vestigial Sideband Transmission.

Frequency Modulation: Definition of FM, Bandwidth, Noise triangle, Pre-emphasis and De-emphasis.

Pulse Modulation: Definition of PM. Difference between AM and FM. Radio receivers. Sampling Theorem, PAM, PTM, PWM, PPM, pulse code modulation, Quantization noise, companding, PCM system, differential PCM, Delta modulation.

Multiplexing: FDM/TDM.

Introduction of digital Communication: PSK, ASK, FSK, introduction to fiber optics system, Propagation of light in optical fiber and ray model.

Radio Frequency (RF) Communications and Wireless Telecommunications: Propagation of signals at HF, VHF, UHF and microwave frequency and satellite communications.

14.3.6 **Part-F (Physics)**

Mathematical Methods: Calculus, Integral Calculus, Differential Equations, Fourier Series, Taylor expansion, Vector Algebra, Vector Calculus, Integral Theorems, Linear Algebra and Complex Numbers, Statistics and Error Analysis.

Mechanics: Newton's laws of motion and applications, coordinate systems and kinematics, inertial and non-inertial frames, Centrifugal and Coriolis forces, Motion under a central force, Kepler's Law, Gravitational Law, conservative and non-conservative forces, System of particles, conservation laws, Elastic and inelastic collisions, Moment of inertia, Rigid body dynamics.

General Properties of Matter: Elasticity, surface tension, viscosity, fluid dynamics, kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem.

Oscillations: Simple harmonic oscillator, superposition of two or more simple harmonic oscillators, Lissajous figures, damped and forced oscillations, resonance, quality factor and bandwidth.

Waves: wave equation, travelling and standing waves in one dimension, energy density and energy transmission of waves, group velocity and phase velocity, sound waves, Doppler effect.

Optics: Geometrical optics-Fermat's principle, Reflection and refraction, mirrors and lenses and image formation, Interference of light and diffraction, Rayleigh Criterion and resolving power, diffraction gratings, polarization: linear, circular and elliptic polarization, double refraction and optical rotation.

Electricity: Coulomb's law, electric field, electric potential, Gauss's law, conductors and dielectrics, polarization and bound charges, capacitors and capacitances, electrostatic energy, boundary conditions, Laplace equation and boundary value problems, electric current and current density, Ohm's law, DC circuits, AC circuits (RC, LC, LCR), resonance in AC circuits.

Magnetism: Magnetic field, Bio-Savart law, Ampere's circuital law, magnetic vector potential, Lorentz force, Motion of charged particles in electric and magnetic fields, electromagnetic induction, Faraday's law, self and mutual induction, Maxwell's equations, displacement current, EM waves, Poynting vector and energy flow, Reflection and transmission of EM waves.

Kinetic Theory: Kinetic theory postulates, ideal gas equation, pressure and temperature, degree of freedom, equipartition theorem, specific heat of mono-, di-, and tri -atomic gases, Maxwell's velocity distribution, most probable velocity, mean and RMS velocity, mean free path, van der Waals gas and equation of state.

Thermodynamics: Laws of thermodynamics, thermodynamic processes (isothermal, adiabatic, isobaric, isochoric), entropy, reversible, irreversible and quasi - static processes, Carnot cycle, heat engines and efficiency, Maxwell's thermodynamic relations and applications, thermodynamic potentials and their applications, phase transitions, Clausius-Clapeyron equation, microstate and microstate, ideas of ensembles, Maxwell- Boltzmann, Fermi-Dirac and Bose -Einstein distributions.

Modern Physics: Inertial frames and Galilean invariance, Special theory of relativity, black body radiation, photo electric effect, Compton effect, De

Broglie waves, uncertainty principle, X-rays Schrodinger equation and its solution for one, two and three dimensional boxes, particle in a box, harmonic oscillator, potential steps and barrier, tunneling, Bohr atom, atomic spectra, Pauli exclusion principle, structure of atomic nucleus, mass and binding energy, radioactivity and its applications, laws of radioactive decay.

Solid State Physics: Crystal structure, unit cell and lattice parameters, Bravais lattices, basis and crystal systems, Miller indices, crystal planes and directions, X-ray diffraction and Bragg's law, band theory of solids, conductors, semiconductors and insulators, energy bands, Fermi energy and Fermi level, intrinsic and extrinsic semiconductors, carrier concentration and conductivity, variation of resistivity with temperature.

Semiconductor Devices: PN junction diode, diode characteristics, Zener diode and its applications, rectifiers, bipolar junction transistors (BJT), CB, CE and CC configurations, transistor characteristics.

Analog and Digital Electronics: Single-stage amplifiers, two-stage RC-coupled amplifiers, simple and sinusoidal oscillators, Barkhausen condition, Operational amplifiers (OPAMP) and applications, Inverting and non-inverting amplifiers, Integrator and Differentiator, Boolean algebra: binary number system, conversion from one number system to another number system; binary addition and subtraction. Logic Gated: AND, OR, NOT, NAND, NOR, XOR; Combination of gates, Truth tables, De Morgan's theorem.

14.3.7 **Part-G (Telecommunication Engineering):**

Engineering Mathematics:

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, null space, solution of linear equations - existence and uniqueness, least squares solution.

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: Random variable (continuous and discrete), Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, uniform distribution, exponential distribution, normal distribution; probability density function, cumulative density function, probability mass function, probability distribution function and their properties, joint and conditional probability.

Network Analysis:

Circuit Analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, Tellegen's theorem. Sinusoidal steady state analysis:

phasors, complex power, maximum power transfer theorem. Transient Time and frequency-domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform.

Linear 2-port network parameters: Z, Y, h and ABCD parameters, reciprocity and symmetry conditions, interconnections of two-port parameters (cascade, series, parallel), wye-delta transformation.

Signals and Systems:

Continuous-time Signals: Fourier series, Fourier transform, Laplace transform and their properties, sampling theorem, convolution and applications. Inverse transforms. Transformation of signals.

Discrete-time Signals: DTFT, DFT, z-transform and their properties and inverse 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, LTI systems in terms of differential and difference equations. LTI system properties in terms of transforms

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 and their circuit configurations; 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, demultiplexers, decoders, encoders, half adder, full adder, look-ahead carry adder, multiplier, comparator

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

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 and feedforward principle;

Transfer function and Laplace transform; Block diagram representation and reduction principle; Signal flow graph and Mason gain formula;

Transient and steady-state analysis of LTI systems, Static error coefficients, and generalized error coefficients; Frequency response; Routh-Hurwitz criterion, and Nyquist stability criteria; Bode plots, gain margin and phase margin, and root locus plots; Lag, lead and lag-lead compensation, minimum phase system; State variable model and solution of state equation of LTI systems, controllability and observability.

Analog Communications:

Random Processes: Autocorrelation and power spectral density and their properties, wide and strict sense stationary, ergodicity, filtering of random signals through LTI systems, low-pass equivalent of band-pass signals.

Noise: Properties of white noise, thermal noise, shot noise, noise figure, noise equivalent bandwidth,

Analog Communications: Amplitude modulation and demodulation, envelope detector, angle modulation and demodulation, efficiency of AM, spectra of AM, DSB-SC modulation and demodulation, Costas receiver, SSB-SC modulation and demodulation, FM modulation and demodulation, NBFM and WBFM, Carson's rule of bandwidth, Frequency discriminator, Phase locked loop, Noise analysis for DSB-SC and SSB-SC modulation; super heterodyne receivers

Digital Communications:

Information Theory: Entropy, conditional entropy, entropy rate, mutual information, capacity of binary symmetric channel and binary erasure channel, Huffman coding, Shannon-Fano coding, Kraft inequality, Shannon source coding theorem, Shannon channel coding theorem.

Digital Communications: PCM, DPCM, Delta modulation, Linear prediction filter, Line coding (NRZ-unipolar, RZ-unipolar, NRZ-polar, RZ-polar, Manchester) and their PSD with bandwidth.

Digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth efficiency, average energy per bit, orthogonal basis representations, minimum distance.

Inter-symbol interference, eye patterns, Nyquist pulse criteria, Raised cosine pulse, RRC pulse, MAP, ML detection, matched filter receiver, SNR, Cauchy-Schwarz inequality, Gram-Schmidt Orthogonalization, Correlation receiver, and BER of digital modulation schemes.

Fundamentals of error correction codes, block codes, Hamming codes, CRC, and convolution codes.

Electromagnetics:

Cartesian, Cylindrical, and Spherical coordinates and their transformation;

Electrostatics: Electric field and potential due to point charge, line charge, surface charge, Electric flux density and capacitance.

Magnetostatics: Magnetic induction, Faraday's law, Magnetic flux density and strength, Ampere's law, Gauss' law, Permeability, Energy stored in magnetic field, Magnetic vector potential.

Maxwell's Equations: Differential and integral forms and their interpretation, boundary conditions, wave equation, 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, reflection coefficient, VSWR, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibres, dipole and monopole antennas, linear antenna arrays