

Module I (a): Technical Mathematics

- I. Matrices – Identification of Matrices, matrix operations, adjoint and inverse.
- II. Determinants – Evaluation of second and third order, minors and cofactors, solutions of simultaneous linear equation in three unknown using Cramer's rule.
- III. Binomial Series – Expansions using Binomial theorem.
- IV. Trigonometric functions – Signs of functions in each quadrant. Trigonometric values of angles, properties of trigonometric functions, applications of the identities $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$.
- V. Coordinate geometry – Equations to a straight line – slope-intercept form, intercept form, Angle between two lines, condition for two lines to be perpendicular, parallel.
- VI. Differentiation – Limits and continuity, derivatives of functions, equation to tangents and normals. Maxima and minima of functions of one variable.
- VII. Integration of functions – Integration of different types of functions.

- VIII. Applications of integration – Area bounded by a curve and X or Y axis, solutions of differential equations using the method of variable separable, solutions of linear differential equations of first order.

Module I (b): Basic Civil Engineering

Materials: Brick – varieties and strength, characteristics of good brick. Cement – varieties and grade of cement and its uses. Steel – types of steel for reinforcement bars, steel structural sections. Aggregates – types & requirements of good aggregates.

Concrete – grades of concrete as per IS code, water cement ratio. Workability, mixing, batching, compaction and curing.

Construction: Parts of building – foundation – types of foundations – spread footing, isolated footing, combined footing, Raft, pile and well foundations. Masonry – types rubble masonry, brick masonry, English bond and Flemish bond. (One brick wall).

Surveying: Chain surveying – principles, instruments, ranging, and chaining survey lines, field work and field book, selection of survey stations, units of land area.

Levelling: Levelling instruments, different types, bench mark, reduced level of points, booking of field notes, reduction of levels by height of collimation method (simple problem). Modern survey – instruments – Total station, Electronics theodolite, Distomat.

Module I (c): Basic Mechanical Engineering

The importance of IC Engines: Definition, classification – two stroke engines, four stroke engines, working of two stroke engines and four stroke engines with the help of line sketches, comparison between two stroke and four stroke engines, comparison between petrol and diesel engines, function of fly wheel, clutch, gearbox, propeller shaft and differential in power transmission, explain with sketch the working of differential, briefly explain power transmission of 4 wheel vehicle with line diagram.

The importance of Power Plants: Introduction, classification of power plants – working of hydroelectric power plant with schematic sketches – working of thermal (Steam and Diesel) power plant with schematic sketches – working of nuclear power plant with schematic sketches.

Module I (d): Basic Electrical Engineering

Review with discussion of electric current, potential difference, power, EMF, resistance and its laws, Ohms law and series parallel circuit, electromagnetism, generation of AC and DC supply.

Idea of Basic electrical circuit: Electrical supply and load and its functioning, division of voltage and current in a parallel and series circuit – simple problems, units of power and energy, solution of DC circuit with calculation of energy consumption in an installation.

Circuit parameters: Resistance, Capacitance and inductance. AC circuit with R, L, C. Simple solution of typical AC circuit with resistance, impedance, power and power factor.

Electrical circuit of an installation: Earthing, lightning protection.

Module I (e): Essentials of Electronics Engineering

Active and passive devices – review only. LED – working, applications, comparison of LED lighting and CFL lighting. Full wave rectifier – diagram and explanation, 5 V power supply – with bridge rectifier and 7805. SMPS – block diagram and advantages. Integrated circuits. SMDs – advantages. Static electricity – precautions in handling electronic circuits.

Switches: ON / OFF, push to ON, push to OFF, push to ON / OFF, SPST, SPDT, DPDT. Working and application of limit switches, proximity switches, relays.

Microcontrollers: Simple block diagram of 8 bit microcontrollers – application.

Mobile technology: CDMA and GSM. Compare – 2G and 3G technologies.

Inverter & UPS: Block diagram. Compare – inverter and UPS. Online and off line UPS – differentiate. Battery selection for UPS and inverter.

E-waste: Health hazards of e-waste.

Module II : Electronic Circuits

Solid state devices – Characteristics of PN junction and Zener diode, Tunnel diode, NPN and PNP transistor – N channel and P channel, JFET and MOSFET – Rectifier –

half wave and full wave, filters – capacitor, inductor, LC filter, pie section – analysis and characteristics. Transistor – CB, CE, CC configuration, calculation – voltage gain,

current gain – harmonic distortion, power amplifier – class A, class B, class C, class AB, class D, class S – Push Pull, Complementary Symmetry – Analysis.

Biasing methods of Transistor – AC and DC load lines, frequency response – gain calculation, gain in db – Analysis. Transistor as a switch – applications – Darlington pair. Different coupling methods of transistor amplifiers – RC, DC, Transistor Coupled, tuned amplifier – multi stage amplifier – staggered tuning – cascade and cascade – gain bandwidth product – analysis. FET amplifiers – CS, CD.

Comparison of FET and BJT – Feed back in amplifiers – negative and positive feed backs, effect of feed backs. Oscillators – Barkhausen criterion. RC phase shift, Wein bridge, LC, Hartley and Colpitts oscillators, crystal oscillator – Analysis, Multivibrators – Astable, Bistable, Monostable – calculation of Time period, triggering methods, Schmitt trigger, LTP, UTP – Hysteresis – Applications and analysis.

Module III : Linear Integrated Circuits & Wave Shaping Circuits

Differential amplifiers – analysis – CMRR, Op-amps – ideal characteristics, block schematic slew rate, input and output offset, virtual ground. Concept of 741 Op-Amp, gain bandwidth product, open loop and closed loop gain. Linear Op-amp circuits, Inverter and non-inverter amplifiers, summing amplifiers, subtractor, instrumentation amplifiers, Precision rectifiers – analysis.

Non-linear Op-Amp circuits

Log, Anti Log amplifiers, Schmitt trigger, comparator, astable and monostable multivibrators – analysis. Active filters – LPF, HPF, BPF, BSF, Universal filters – Butterworth and Chebyshev filter first and second order, transfer function – realization – analysis. Triangular wave generator, sawtooth generator, Oscillator – Wein bridge, phase shift – analysis of circuits, 555 internal block diagram – applications – design of astable and monostable using 555 – VCO, PLL, phase detector – principle of operation – capture and lock range – applications – analysis. Integrator and differentiator using passive devices, op-amps – design and analysis – application. Miller and Bootstrap sweep, V to I and I to V converters – analysis.

Module IV : Digital Electronics, Microprocessor and Micro controllers

Number system – binary, octal, hexadecimal, decimal converters, Binary codes – numeric and alpha numeric codes – gray, BCD, excess-3, self-complementing codes – weighted and unweighted codes. Error detection and correction codes – parity, hamming codes. Boolean algebra theorem, De Morgan's theorem, logic gates, logic function, truth tables, SOP and POS forms, combinational and sequential circuits, simplification and implementation of logic expressions using K-maps, half adder, full adder, half subtractor, full subtractor, multiplexer, demultiplexer, encoder, decoder, priority encoder, serial adder, parallel adder, ripple and look ahead carry adders, Flip flops – RS, JK, T, D, edge and level trigger flip flops, excitation tables, counter – synchronous and asynchronous, up down – design, Analysis of sequential networks, derivation of state graphs and tables.

Shift register – SISO, SIPO, PIPO, PISO, universal shift register, timing diagram, Johnson and Ring counter. Memory – RAM, ROM, FLASH, NVRAM, EPROM, EEPROM, EDORAM, Memory organization.

Logic families – fundamentals of RTL, ECL, DTL, IIL and TTL transfer characteristics Fan in and Fan out, propagation delay, Schottkey and other TTL gates, CMOS inverter – stepped power product. Tri state logic, open collector and wired logic.

ADC and DAC – R – 2R ladder binary weighted, accuracy, resolution, conversion speed, offset error, ADC sample and hold, error of ADC, flash converter, successive approximation and dual slope.

Microprocessors – 8086 architecture – addressing modes – instruction set – programs – Interrupts – maximum and minimum modes, interfacing chips – 8255, 8359, 8251, 8279, 8254, 8257.

Basics of 80286 and 80386 - 8051 Micro controller – architecture – interrupt – instruction set, programs.

Module V : Communication Engineering

Classification of signals, elementary signal, LTI system, Noises, Different types of Noises, Signal to noise ratio, Shannon theorem, entropy, baud rate, maximum channel capacity.

Electromagnetic radiation and wave propagation – ground, sky, space waves, polarization, atmospheric layers and its characteristics.

Amplitude modulation – Analysis, generation and detection of AM signals, DSB, SSB, VSB.

AM transmitter – TRF and Super hetrodyne receiver, noise analysis of AM receiver.

Frequency modulation – narrow band and wide band FM, generation of FM signals, direct and indirect methods, FM demodulation techniques, Noise in FM receiver, preemphasis and de-emphasis.

Phase modulation – basics of phase modulation.

DSP – Discrete Fourier transforms – properties of DFS, decimation in time, frequency algorithm, FFT algorithm for a composite number, Signal Flow graph, digital filter design, antennas, half wave, folded dipole, microwave antenna, rhombic, parabolic, Yagi-Uda, horn, helical antenna.

Television transmission – interlaced scanning, composite video signals, audio modulation, working principles of picture tubes.

Television Camera – different types – working principle – CCD camera. NTSC and PAL colour system, Basic idea TV transmitter and receiver, PAL and NTSC decoder, basic ideas on digital TV, HD TV and satellite TV receiver. Basic of optical and satellite communication.

Digital Modulation techniques – sampling theorem, PCM, PAM, PPM, PWM generation and demodulation. ASK, FSK, PSK, MSK, QPSK, BPSK generation and demodulation.

Multiplexing Techniques – Basic of CDMA, TDMA, FDMA, Spread spectrum, frequency hopping, fading, GSM, GPRS, Blue tooth basics.

Microwave devices – Klystron, Magnetron, TWT, SWR, Impatt, Trapatt diodes.

Radar – different types, basic operation, range equation.

Basic of GPS.

Module VI : Power Electronic, Opto Electronic, PLC and Measuring Equipment's

Thyristors – different types – SCR, UJT, TRIAC, DIAC, SCS, IGBT – working principle and characteristics. Triggering and commutation schemes – different types.

Converters – series and parallel, Inverters – single phase and three phase, choppers,

cycloconverter. Different types of industrial heating, electronic welding, industrial applications of ultrasonic, SMPS, servo controlled voltage stabilizer, 3 pin IC regulators.

Basics of PLCs, characteristics of LDRs, photo diode, photo transistor, photo voltaic cell, photo detector, LED, opto coupler, and laser diodes and optical amplifiers.

Multimeter – working principle, characteristics, accuracy, sensitivity, selectivity, resolution, Construction of CRTs working principle of DSO and spectrum analyser.

Working principle of LED, LCD plasma displays, logic probes, and logic analysers.