



**SOMAIYA**  
VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering



**Somaiya Post Graduate Entrance Examinations  
in Engineering**

**SPG-E 2020**

**Syllabus**



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## SCS: Computer Science and Information Technology

### **Section 1:** Engineering Mathematics Discrete Mathematics:

Propositional and first order logic, Sets, relations, functions, partial orders and lattice, Groups,

Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.

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

Calculus: Limits, continuity and differentiability, Maxima and minima, Mean value theorem, Integration. Probability: Random variables, Uniform, normal, exponential, Poisson and binomial distributions, Mean, median, mode and standard deviation, Conditional probability and Bayes theorem.

### **Section 2:** Digital Logic

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

### **Section 3:** Computer Organization and Architecture

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

### **Section 4:** Programming and Data Structures

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

### **Section 5:** Algorithms

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



## **Section 6:** 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

## **Section 7:** Operating System

Processes, Threads, Inter-process communication, Concurrency and synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems

## **Section 8:** 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.

## **Section 9:** Computer Networks

Concept of layering, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, Routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, Congestion control, Application layer protocols (DNS, SMTP, POP, FTP, HTTP, Basics of Wi-Fi,

## **Section 10 :** Cryptography and Security

Cryptography: Classical Cryptography, Symmetric and Asymmetric Key Cryptography,

Program Security : Unintentional Program errors, Safe programming, Malicious Programs, Code injection, Database Security,

Network security: authentication, digital signatures and certificates, firewalls, email Security

## SEC - Electronics and Communication Engineering

### Section 1: Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values 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.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

### Section 2: Networks, Signals and Systems

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

### Section 3: Electronic Devices and Analog Circuits

Energy bands in intrinsic and extrinsic silicon; 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.

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

#### **Section 4: Digital Circuits**

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; microprocessor basics : architecture, programming, memory and I/O interfacing.

#### **Section 5: 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.

#### **Section 6: Communications**

Random processes: autocorrelation 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, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

#### **Section 7: Electromagnetics**

Electrostatics; 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, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion



relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

### **Section 8:** Computer Communication Networks

Concept of layering, OSI model, TCP/IP model, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, Routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, Congestion control, Application layer protocols (DNS, SMTP, POP, FTP, HTTP, Basics of Wi-Fi, basics of authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls, various attacks.

## SME -Mechanical Engineering

### Section 1: Engineering Mathematics

**Linear Algebra:** Matrix algebra, rank of a matrix, systems of linear equations: homogeneous and non-homogeneous equations, eigenvalues and eigenvectors.

**Calculus:** Mean value theorems, indeterminate forms; evaluation of double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

**Differential Equations:** First order and first degree equations; higher order linear differential equations with constant coefficients, initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

**Complex variables:** Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series. Zeros, Poles and Singularities, residue theorem.

**Probability and Statistics:** Correlation, Regression, Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations: Gaussian elimination, Gauss-Jordan method, Gauss-Seidel method; integration by trapezoidal and Simpson's rules; numerical solutions of first order ordinary differential equations: Taylor's series method, Euler's method and Euler's modified method, Runge-Kutta fourth order method.

### Section 2: Applied Mechanics and Design

**Engineering Mechanics:** Resultant of force system, Equilibrium of forces, Trusses, Friction, Kinematics of particles and rigid bodies in plane motion, Kinetics of particle – Newton's second law, Work Energy Principle, Impulse and momentum (linear), Collisions.

**Strength of Materials:** Stress and strain, elastic constants, Poisson's ratio, thermal stresses; Mohr's circle for principal stresses; thin cylindrical and spherical shells; shear force and bending moment diagrams; stresses in beams; short columns subjected to eccentric loading, core of section, deflection of beams for simple cases; torsion of circular shafts; Euler's theory of columns; testing of materials with universal testing machine; testing of hardness and impact strength,

**Theory of Machines:** Displacement, velocity and acceleration analysis of plane mechanisms; cams and followers; Flexible connectors (Belt and rope drive), gear trains; clutches, brakes, flywheel and governors; gyroscope, balancing of rotating and reciprocating masses.

**Mechanical Vibrations:** Linear Free and forced single degree of freedom vibration; longitudinal and torsional systems, viscous damping; under damped, critical damped and over damped system, logarithmic decrement, vibration isolation and transmissibility; critical speeds of shafts.

**Machine Design:** Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, spur and helical gears, rolling contact bearings, hydrodynamic journal bearings, flange coupling, helical spring.

### Section 3: Fluid Mechanics and Thermal Sciences

**Fluid Mechanics and Machinery:** Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings. Turbine; impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.

**Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction; lumped parameter system, Heisler's charts (for time and space variable); thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; Analysis of heat exchanger performance, LMTD and Effectiveness - NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis; radiation heat transfer between two bodies, radiation shielding.

**Thermodynamics:** Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; Zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; application of first and second law to flow and non flow processes. thermodynamic property charts and tables, availability and irreversibility; Vapour power cycles, concepts of regeneration and reheat. Gas power cycle: Air-standard Otto, Diesel and dual cycles. Testing and Performance of Internal Combustion Engines, Air refrigeration cycle and Vapour compression refrigeration cycle; properties of moist air, psychrometric chart, basic psychrometric processes and analysis of air conditioning system.

## Section 4: Production and Industrial Engineering

**Materials** – Properties and Processes: Structure and properties of engineering materials, basics of phase diagrams, heat treatment of steels, stress-strain diagrams of engineering materials. Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy; principles of welding, brazing, soldering and adhesive bonding.

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

**Metrology:** Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods.

**Computer Aided Engineering:** Basic concepts of CAD/CAM, CIM and FEA; introduction to Additive Manufacturing.

**Manufacturing Planning and Control:** Demand forecasting, production planning, scheduling, materials requirement planning, deterministic models of inventory control.

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

## Section 5: Basic Electrical Engineering

DC Circuits, Single Phase AC Circuits, Three Phase AC Circuits, Electrical Machines: Single phase transformer construction and principle of working, emf equation of a transformer, different types of transformer, losses in transformer, voltage regulation and efficiency of transformer (no numerical expected), Construction and working principle of DC motors such as series, shunt and compound, torque-speed characteristics, selection criteria and applications (no derivations and numerical expected ), Review and comparison of Torque–speed characteristics of DC motors and AC induction motors. Basic principles of speed control of AC/DC motors. Basics of BLDC motor, Linear Actuator motor, Servo Motor Suitability of each motor for various industrial applications, Selection and sizing



## General Aptitude

### Logical Reasoning

### Quantitative Aptitude

**Numerical Ability:** Numerical computation, numerical estimation, numerical reasoning and data interpretation

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