



GATE Syllabus

Electronics and Communications



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ELECTRONICS & COMMUNICATIONS

Subject Code: EC

Course Structure

Sections/Units	Topics
Section A	Engineering Mathematics
Unit 1	Linear Algebra
Unit 2	Calculus
Unit 3	Differential Equations
Unit 4	Vector Analysis
Unit 5	Complex Analysis
Unit 6	Numerical Methods
Unit 7	Probability and Statistics
Section B	Networks, Signals and Systems
Unit 1	Network Solution Methods
Unit 2	Continuous-time Signals
Section C	Electronic Devices
Section D	Analog Circuits
Section E	Digital Circuits
Section F	Control Systems
Section G	Communications
Section H	Electromagnetics

Course Syllabus

Section A: Engineering Mathematics

Unit 1: Linear Algebra

- Vector space, basis, linear dependence and independence
- Matrix algebra
- Eigen values and Eigen vectors
- Rank, solution of linear equations:
 - Existence and uniqueness

Unit 2: 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

Unit 3: 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

Unit 4: Vector Analysis

- Vectors in plane and space
- Vector operations
- Gradient, Divergence and Curl
- Gauss's, Green's and Stoke's theorems

Unit 5: Complex Analysis

- Analytic functions
- Cauchy's integral theorem
- Cauchy's integral formula

- Taylor's and Laurent's series
- Residue theorem

Unit 6: Numerical Methods

- Solution of nonlinear equations
- Single and multi-step methods for differential equations
- convergence criteria

Unit 7: Probability and Statistics

- Mean, median, mode and standard deviation
- Combinatorial probability
- probability distribution functions:
 - Binomial
 - Poisson
 - Exponential
 - Normal
- Joint and conditional probability
- Correlation and regression analysis

Section B: Networks, Signals and Systems

Unit 1: 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
 - Transfer functions
- State equations for networks

Unit 2: 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 C: Electronic Devices

- Energy bands in intrinsic and extrinsic silicon
- Carrier transport:
 - Diffusion current
 - Drift current
 - Mobility
 - 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
- Integrated circuit fabrication process:
 - Oxidation
 - Diffusion
 - Ion implantation
 - Photolithography
 - Twin-tub CMOS process

Section D: Analog Circuits

- Small signal equivalent circuits of diodes, BJTs and MOSFETs
- Simple diode circuits:
 - Clipping
 - Clamping
 - Rectifiers
- Single-stage BJT and MOSFET amplifiers:
 - Biasing
 - Bias stability
 - Mid-frequency small signal analysis
 - 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
 - Opamp configurations
- Function generators, wave-shaping circuits and 555 timers
- Voltage reference circuits
- Power supplies: ripple removal and regulation

Section E: Digital Circuits

- Number systems
- 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 and PLAS
- Sequential circuits:
 - Latches and flip-flops
 - Counters
 - Shift-registers
 - Finite state machines

- Data converters:
 - Sample and hold circuits
 - ADCs and DACs
- Semiconductor memories:
 - ROM
 - SRAM
 - DRAM
- 8-bit microprocessor (8085):
 - Architecture
 - Programming
 - Memory and I/O interfacing

Section F: 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 G: 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
 - 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 H: 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