

**Syllabus for Information and Communication Technology (ICT):
Ph.D. Entrance Examination**

Basic Electronics: Time and frequency domain analysis of simple RLC circuits; Thevenin's and Norton's theorems; Maximum Power Transfer; Simple Diode Circuits, Clipping, Clamping, Rectifiers.

Basic Transistor Circuits: Amplifiers: Single-and Multi-stage, Differential and Operational; Amplifier Building Blocks; Frequency response of amplifiers.

Field Effect Transistors: JFET and MOSFET Characteristics; Biasing and Bias Stability of Transistor and FET amplifiers.

Feedback and Operational Amplifiers: Simple Op-amp circuits; Simple filters and Active Filters; Sinusoidal oscillators and Criterion for Oscillation; Single-transistor Op-amp configurations.

Digital Electronics: Basic Logic Concepts; TTL and CMOS; Combinational Logic; Sequential Logic and Finite State Machine Design; Monostable, Multivibrators.

Analog Modulation and Digital Communication: AM, FM and PM, Sampling, quantization, PCM, companding and delta modulation, Basics of Digital Modulation Schemes like ASK, FSK, PSK, QAM.

Signals and Systems: Introduction of signals and systems (ranging from their types, properties and different examples). Linear time-invariant (LTI) systems and their representation with the help of convolution sum or integral (which can be used to model many real physical systems). Fourier analysis ranging from Fourier series, Fourier transform, time and frequency characterization of signals and systems (e.g. Fourier transform phase and concept of group delay), Shannon's sampling theory, Laplace and Z-transform, basics of linear algebra (linear independence of vectors, Eigen value decomposition, overdetermined and undetermined nature of linear system of equations).

Electromagnetic Theory: Electrostatic Fields, Electric Fields in Material Space, Electrostatic Boundary Value Problems, Magnetostatic Fields, Magnetic Forces, Time Varying Field & Maxwell's Equations, Propagation of EM Waves, Plane Waves, Wave Impedance, EM Wave Equation, EM Energy and Power Flow, Poynting Theorem,

Waveguides, Coaxial cable, Antennas and Radiating Systems. Single and Multiport Networks, S-Parameters and Scattering Matrix, Transmission Line, Reflection coefficient, Standing Wave Ratio, Impedance matching. Statistics Probability space, basics of random variables, characterization of random variables like PDF, CDF, moments and characteristic functions.

Computer Architecture and Organization: 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).

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 search, minimum spanning trees, shortest paths.

Theory of Computation: Regular expressions and finite automata. Context-free grammars and pushdown 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.

Operating System: Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Database: 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. 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. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Web Technologies: HTML, XML, basic concepts of Web technology