Department of Electronics,
Cochin University of Science & Technology, Kochi

Department Admission Test for PhD Admissions 2025

WRITTEN EXAM FORMAT

1. The exam syllabus consists of 10 sections as given below.
2. There will be 15 questions from each section.
3. Candidates have to attempt **four out of the ten** sections. **Candidates should choose the sections aligned to their intended area of research.**
4. Section 1 - Engineering mathematics is mandatory for all candidates. Candidates have to choose any **three out of the remaining nine** sections and this choice has to be indicated in the space provided in the answer sheet. Any questions attempted in other sections than the ones indicated will not be valued.
5. Questions will be of multiple choice type.
6. Each correct answer carries **1 mark** and incorrect answer carries **-0.25 marks**.
7. Candidates who have secured at least 50% marks in the written exam are eligible to be called for the interview. 5% relaxation will be given to students from SC/ST/OBC (Non-creamy Layer)/ Differently Abled category/ EWS/ as mentioned in the regulations.
8. Candidates falling under the DAT exempted category, or those with a valid GATE or NET (under category 2 & 3) score do not need to appear for this written exam.
9. For details about eligibility and other criteria for admission to a PhD program, read the regulations at
   https://cusat.ac.in/uploads/Ph_D_Regulations_2023.pdf
   https://cusat.ac.in/uploads/Ph_D_Regulations_2023-modified1.pdf
   https://cusat.ac.in/uploads/Ph_D_Regulations_2023-modified.pdf

WRITTEN EXAM SYLLABUS

1. Engineering Mathematics

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

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: Mean, median, mode, standard deviation, combinatoria probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, normal distribution, joint and conditional probability.

2. Networks Analysis

Circuit Analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. 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, wye-delta transformation.

3. Signals and Systems

Continuous-time Signals: Fourier series and Fourier transform, sampling theorem and applications.

Discrete-time Signals: DTFT, DFT, z-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.

4. 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, LED, photo diode and solar cell.

5. 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.

6. Digital Circuits

Number Representations: binary, integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, arithmetic circuits, code converters, multiplexers, decoders.

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

Verilog HDL: Structural and Behaviour Modeling of Combinational and Sequential Circuits

Data Converters: sample and hold circuits, ADCs and DACs.

MOSFET Circuits: NMOS, PMOS, CMOS, Inverters, Static CMOS Circuits, Pass-Transistor Logic, Transmission gates, Dynamic CMOS Circuits

7. Computer Organization and Architecture

Computer Organization: ISA, Addressing modes. Arithmetic Circuits - Adder, subtractors, multipliers and dividers, data-path and control unit. Instruction pipelining, pipeline hazards, stalls

Memories: ROM, SRAM, DRAM, Memory hierarchy: cache, main memory, secondary storage; I/O interface (interrupt and DMA mode)

Microarchitecture: Amdahl's Law, Performance Metric: CPI, IPC, Instruction Level parallelism, Static and Dynamic Scheduling, Branch prediction, RISC and CISC designs.

8. Electromagnetics

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.

Rectangular and circular waveguides, light propagation in optical fibers, dipole, monopole, loop, horn, patch, parabolic antennas, linear antenna arrays.

9. Communications

Random processes: Mean, variance, autocorrelation, cross correlation 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, super heterodyne receivers.

Information theory: entropy, mutual information and channel capacity theorem.

Digital communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Wireless communications: Large scale propagation models: Free space Propagation Model, Simplified Path-Loss Model. Impulse response Model of the channel, Types of Small scale fading: due to multipath time delay spread and Doppler spread. Performance metrics: Capacity of AWGN and wireless channels, Outage probability.

10. Programming

C Programming.