Department of Electronics and Communication Engineering

PhD Admissions (Jul 2026)

Instructions to Candidates:

1. Duration of the Test: 180 minutes
2. Total Marks: 100
3. There are four areas of interest to ECE, IIITDM:
    1. ECE1: Communications (a. Communications, b. Photonics and RF)
    2. ECE2: Controls, Energy and Power
    3. ECE3: Signal Processing (Image/Video/Audio and Bio-medical systems)
    4. ECE4: VLSI Design and Circuits

    A candidate can select only one of the four areas that best aligns with his/her area of interest.
4. The question paper consists of two parts: Part A and Part B. Part A is common to all areas of interest, and Part B is area specific.
5. Part A contains 50 Multiple Choice Questions (MCQs). For each correct answer, 1 mark will be awarded. For an incorrect answer, -1/3 mark will be awarded. No marks for unattended questions. Maximum marks will be 50 for Part A.
6. Part B is specific to your chosen area of interest and consists of 10 MCQs. Space is provided alongside each question to show the steps required to solve it. The steps are as much important as the final answer. Each correct answer, or sequence of steps is awarded 5 marks, for a maximum total of 50 marks. There is no penalty for incorrect or unattempted questions.

Syllabus for Written Test

PART A

Engineering Mathematics: [10 marks]
Matrix algebra: Eigen values and eigen vectors, 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, Taylor series
Probability: Probability axioms, distributions, joint and conditional probability.

Electrical Circuits: [10 marks]
Node and mesh analysis, superposition, Thevenin's theorem, Norton'stheorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximumpower transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLCcircuits, solution of network equations using Laplace transform.

Continuous Time Signals and Systems: [15 marks]
Representation of continuous time signals, shifting and scaling properties, linear time-invariant and causal systems, properties of LTI systems, Fourier series representation of continuous periodic signals, sampling theorem, Fourier Transform for continuous time signals, Laplace Transform.

Analog and Digital Electronics: [15 marks]
Basic characteristics and applications of diode, BJT and MOSFET; Characteristics and applications of operational amplifiers - difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, waveform generators. Number systems, Boolean algebra; combinational logic circuits - arithmetic circuits, comparators, encoder/decoder, MUX/DEMUX. Sequential circuits – latches and flip flops, state diagrams, shift registers and counters.

PART B

ECE1: Communications

The candidates can choose ECE1a Communications or ECE1b Photonics and RF.

ECE1a Communications:

Probability Theory: Basic Probability axioms, Joint and Conditional Probabilities, Random Variables, and Random Processes, autocorrelation and power spectral density, properties of white noise.

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, and superheterodyne receivers.

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

ELE1b Photonics and RF:

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 and monopole antennas, linear antenna arrays.

ECE2 Controls, Energy and Power:

Electric Circuits: 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; Two-port networks, Three phase circuits, Power and power factor in ac circuits.

Electrical Machines: Energy conversion principles, DC machines, types, generator and motor characteristics, starting, braking and speed control, Single phase transformer, equivalent circuit, phasor diagram, regulation and efficiency, Three phase transformer, connections, parallel operation, autotransformer, Three phase Induction motor, equivalent circuit, performance characteristics, starting, speed control, Single phase induction motors, Synchronous machines, performance, regulation, parallel operation, starting, characteristics, and applications.

Power Electronics: Characteristics of semiconductor power devices: Diode, Thyristor, Triac, MOSFET, IGBT; DC to DC conversion: Buck, Boost, Cuk, Fly-back and Forward converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, unity power factor converters, Single phase and three phase inverters, Sinusoidal pulse width modulation techniques, Snubber circuits.

Control Systems: Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time-invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, P, PI and PID controllers.

ECE3 Signal Processing (including Biomedical):

Discrete-time signals: sequences, discrete-time systems and their properties Linear constant-coefficient difference equations, linear and circular convolution, correlation, Discrete-time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Properties of DFT, convolution using the DFT, Fast Fourier Transform, Z-transform, Sampling theorem.

ECE4 VLSI Design and Circuits:

MOS Device Modeling: Flat-band Voltage, Surface Condition, Strong and Weak Inversion, Threshold Voltage; Level 2 and level 3 models; Short channel effects. Analog Integrated Circuit Design: Differential Amplifier, Common and Differential mode analyses, Single and Two-stage Opamp, Simple and Cascode Current Mirror.

Digital Integrated Circuit Design: CMOS Inverter: Transfer Characteristics, Noise margin, Capacitances, Propagation Delay, Power; Combinational Logic Circuits: Static CMOS, Pass Transistors, Dynamic CMOS; SRAM, DRAM and Flash Memory.

VLSI Technology: Crystal Structure of Si, Defects in Crystal, Crystal growth, Epitaxy, Oxidation, Diffusion, Ion Implantation, Lithography, Etching, CMOS Technology, Latch-up in CMOS, Fabrication steps of CMOS IC.