INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN AND MANUFACTURING, KANCHEEPURAM

Department of Electronics and Communication Engineering

PhD Admissions (Jan 2027) – Written Test Syllabus

Instructions to Candidates

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

  Note: A candidate can select only one of the above four areas that best aligns with his/her area of interest.
- **Paper Structure:** 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.
- **Part A (Common):** 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 unattempted questions. Maximum marks: 50.
- **Part B (Area Specific):** Specific to your chosen area of interest and consists of 10 MCQs. Each question has five major steps and the question requires to fill each step in the answer book. Each correct answer is awarded 5 marks; if the answer is incorrect then the steps are evaluated. There is no penalty for incorrect or unattempted questions. Maximum marks: 50.

Summary of Test Pattern:

Part	Description	Questions	Marking Scheme	Total Marks
Part A	Common to all areas	50 MCQs	+1 for correct, -1/3 for incorrect	50 Marks
Part B	Area-specific	10 MCQs with steps	+5 for correct, no negative marking	50 Marks

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Syllabus for Written Test: PART A (Common – 50 Marks)

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'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.

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]

Analog Electronics: 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.

Digital Electronics: 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.

Syllabus for Written Test: PART B (Area Specific – 50 Marks)

ECE1: Communications

Discrete-time signals and Systems: 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 (FFT), Z-transform, Sampling theorem.

Transmission Lines: Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart.

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 (Image/Video/Audio and Bio-medical Systems)

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 (FFT), 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.