Written Test Pattern and Syllabus

1. Applicants who have a valid score card in national level exams like GATE/UGC-NET/CSIR-NET/NBHM, etc. are exempted from the written test. Such applicants are expected to produce the valid score card while reporting at the institute.
2. The Question Paper consists of two-parts. Part A consists of 50 Multiple Choice Type Questions, each carrying 1 mark. For every incorrect 1-mark question, 1/3 marks are deducted.
3. Part B consists of 10 Multiple Choice Type Questions, each carrying 5 marks. No negative marking for Part B questions.
4. The duration of the examination is 180 mins.

இந்திய தகவல் தொழில்நுட்பம், வடிவமைத்தல் மற்றும் உற்பத்தி நிறுவனம், காஞ்சிபுரம்

भारतीय सूचना प्रौद्योगिकी अभिकल्पना एवं विनिर्माण संस्थान, कांचीपुरम

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING KANCHEEPURAM

(An Institute of National Importance established by the Government of India)

Melakottaiyur, Off Vandalur-Kelambakkam Road, Chennai-600127, Tamilnadu, INDIA

Department of Electronics and Communication Engineering

PhD Admissions (Dec 2025)

Syllabus for Written Test

Instructions:

- Duration of the Test: 3 hours
- Total Marks: 100
- The question paper will consist of two parts: Part-A and Part-B.
- Part-A is Compulsory for all the candidates. Part-A will contain 50 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.
- Part-B will have four sections for different specializations. Each section will contain 10 MCQs including a field for choice justification. For each correct answer, 5 marks will be awarded. No marks for unattended questions. Maximum marks will be 50 for Part-B. Under Part-B, Candidate can take the test on any one Section only.

PART – A

Engineering Mathematics:

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and Eigen vectors.

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.

Electrical Circuits:

Voltage and current sources - independent, dependent, ideal and practical; v-i relationships of resistor, inductor and capacitor; transient analysis of RLC circuits with dc excitation; Kirchoff's laws, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems; Peak, average and rms values of ac quantities; apparent, active and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, realization of basic filters with R, L and C elements.

Signals and Systems:

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:

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

Section-1: 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.

Section-2: 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.

Section-3: Electrical Power & Control

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.

Section-4: Communications (Communications, RF, and Fiber-Optics/Photonics Group)

- **Communication Engineering**

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.

- **RF and Photonics**

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.
