**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY**
**DESIGN AND MANUFACTURING KURNOOL**
(An Institute of National Importance funded by MoE, Govt. of India)
Jagannathagattu, Dinnedevarapadu, Kurnool-518007, Andhra Pradesh
Ph: 08518-289-114    Fax: 08518-289-127

**03.12.2021**

## SCHEDULE FOR THE INTERVIEW FOR Ph.D PROGRAM (Full/Part time)

| Department | | Reporting Time for verification of original documents | Date/Time of Written Test | Date/Time of Interview |
|---|---|---|---|---|
| SCIENCES | MATHEMATICS | 15-12-2021 at 8.30 am Venue: Seminar Hall | - | 15-12-2021 at 9.30 am onwards |
| | PHYSICS | | | |
| | ENGLISH | | | |
| COMPUTER SCIENCE AND ENGINEERING | | | 15-12-2021 at 9.30 am onwards | 15-12-2021 at 1.30 pm onwards |
| MECHANICAL ENGINEERING | | | | |
| ELECTRONICS AND COMMUNICATION ENGINEERING | | | | |

**Instructions to Shortlisted candidates:**

1. The written test/interviews will be conducted through offline mode as per the above indicated scheduled date and time.
2. The candidates who have not uploaded any of the following documents must send their documents before interview to phdadmissions@iiitk.ac.in, failing which he/she will not be considered for the selection process
   a) Copies of all Mark sheets/grade cards, degree certificates beginning from SSLC towards proof of qualification.
   b) Copy of Community Certificate in the case of SC/ST/OBC/Economically Weaker Section (EWS) candidates issued by the competent authority of respective State Government.
   c) Authorized Doctor's Certificate with disability descriptions in the case of Person with Disabled (PwD) candidates.
   d) Copy of GATE score or UGC - JRF/NET/CSIR/ DAE-JEST/Inspire fellowship or other fellowship award.
   e) Copy of proof of Experience certificate, if any.
   f) Copy of No Objection and Sponsorship certificate.
3. Candidate should produce all original certificates at the time of verification.
4. Candidate may note that No change of date will be entertained.

03.12.2021

# Syllabus for written test

## Computer Science and Information Technology

**Section1: Engineering Mathematics**
Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring.
Combinatorics: counting, recurrence relations, generating functions.
Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.
Probability and Statistics: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

**Section 2: Digital Logic**
Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

**Section 3: Computer Organization and Architecture**
Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

**Section 4: Programming and Data Structures**
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

**Section 5: Algorithms**
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths

**Section 6: Theory of Computation**
Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contexfree languages, pumping lemma. Turing machines and undecidability.

**Section 7: Compiler Design**
Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimisation, Data flow analyses: constant propagation, liveness analysis, common subexpression elimination.

**Section 8: Operating System**
System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

**Section 9: Databases**
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.

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### Section 10: Computer Networks

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

# Mechanical Engineering

### Section 1: Engineering Mathematics

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations. Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series. Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions. Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

### Section 2: Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and

rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

**Section 3: Fluid Mechanics and Thermal Sciences**

Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; basics of compressible fluid flow.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Applications: Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles.

Refrigeration and airconditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.

**Section 4: Materials, Manufacturing and Industrial Engineering**

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and

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yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools; additive manufacturing.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.

Inventory Control: Deterministic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

## Section 5: Quality and Reliability

Metrology and Inspection: Accuracy and precision; Types of errors; Limits, fits and tolerances; Gauge design, Interchangeability, Selective assembly; Linear, angular, and form measurements (straightness, flatness, roundness, runout and cylindricity) by mechanical and optical methods; Inspection of screw threads and gears; Surface roughness measurement by contact and non-contact methods.

Quality Management: Quality – concept and costs; Statistical quality control – process capability analysis, control charts for variables and attributes and acceptance sampling; Six sigma; Total quality management; Quality assurance and certification - ISO 9000, ISO14000.

Reliability and Maintenance: Reliability, availability and maintainability; Distribution of failure and repair times; Determination of MTBF and MTTR, Reliability models; Determination of system reliability; Preventive and predictive maintenance and replacement, Total productive maintenance.

## Section 6: Operations research and Operations management

Operation Research: Linear programming – problem formulation, simplex method, duality and sensitivity analysis; Transportation and assignment models; Integer programming; Constrained and unconstrained nonlinear optimization; Markovian queuing models; Simulation – manufacturing applications.

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Engineering Economy and Costing: Elementary cost accounting and methods of depreciation; Break-even analysis; Techniques for evaluation of capital investments; Financial statements; Activity based costing.

Production control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; Aggregate production planning; Master production scheduling; MRP, MRP-II and ERP; Routing, scheduling and priority dispatching; Push and pull production systems, concepts of Lean and JIT manufacturing systems; Logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic inventory models, quantity discount; Perpetual and periodic inventory control systems.

Project management: Scheduling techniques – Gantt chart, CPM, PERT and GERT.

# Electronics and Communication Engineering

**Networks, Signals and Systems**
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. 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.

**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.

**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.

**Digital Circuits**
Number representations: binary, integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, 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. Data converters: sample and hold circuits, ADCs and DACs. Semiconductor

memories: ROM, SRAM, DRAM. Computer organization: Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.

### Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and laglead compensation; State variable model and solution of state equation of LTI systems.

### Communications

Random processes: autocorrelation 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, superheterodyne 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.

### 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 and monopole antennas, linear antenna arrays.