Syllabus for written examination

Computer Science & Information Technology - CS

1. Digital circuits: Boolean algebra, logic gates, digital IC families, Combinatorial circuits, Sequential circuits, Sample and hold circuits, ADCs, DACs, Semiconductor memories.

2. Microprocessor and Computer Organization: Architecture, programming, memory and I/O interfacing, Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface, Instruction pipelining, Cache and main memory, Secondary storage, Microcontrollers.

3. (a) Programming and Data Structures: Programming in C/C++/JAVA, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps, Hashing, Sorting, Searching.

(b) Algorithms: Analysis, Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

4. Theory of Computation and Compiler Design: Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability, Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

5. Operating System: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

6. Databases: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

7. Computer Networks: ISO/OSI model, LAN technologies (Ethernet, Token ring, etc), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security, basic concepts of public key and private key cryptography, digital signature.

Electronics and Communication Engineering - EC

1. Basic circuit theory: Network graphs, nodal and mesh analysis, Network theorems, Linear constant coefficient differential equations, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits,2-port network parameters, State equations for networks.

2. Analog Circuits: Simple diode circuits, clipping, clamping, rectifier, Amplifiers, Frequency response of amplifiers, Filters, oscillators, Function generators and wave-shaping circuits, 555 Timers.

3. Digital circuits: Boolean algebra, logic gates, digital IC families, Combinatorial circuits, Sequential circuits, Sample and hold circuits, ADCs, DACs, Semiconductor memories.

4. Communications: Probability theory & Statistics Random signals and noise, Analog communication systems: amplitude and angle modulation and demodulation systems, super heterodyne receivers; SNR calculations for amplitude modulation (AM) and frequency modulation (FM), Sampling theorem, Digital communication systems: PCM, DPCM, digital modulation schemes, TDMA, FDMA and CDMA and GSM, Optical fiber communication.

5. Signals and Systems: Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform, LTI-Systems, Signal transmission through LTI systems, Convolution, FIR and IIR Filters, Open loop and closed loop systems, first order, second order, higher order systems.

6. Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring, etc), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security, basic concepts of public key and private key cryptography, digital signature.

7. Microprocessor and Computer Organization: Microprocessor(8085): architecture, programming, memory and I/O interfacing, Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface, Instruction pipelining, Cache and main memory, Secondary storage, Microcontrollers.

Management - MN

For the Ph.D. admission, syllabus covers basic streams of Management like managerial economics, organizational behavior, human resource management, financial management, marketing management, production management, statistical methods, strategic management, entrepreneurship & ethics and management. Detailed course outline of each of the stream is given below:

Managerial Economics: Managerial Economics- Demand Analysis, Production Function, Cost-output Relations, Market Structures, Pricing Theories , Advertising, Macro-economics, National Income Concepts, Infrastructure-Management and Policy, Business Environment, Capital Budgeting.

Organizational Behavior: The concept and significance of organizational behavior- Skills and roles in an organization- classical, Neo-classical and modern theories of organizational structure- Organizational design-Understanding and Managing individual behavior personality- Perception- Values-Attitudes-Learning-Motivation, Understanding and managing group behavior, process-Inter-personal and group dynamics-communication- leadership-managing change-managing conflicts, Organizational development.

Human Resource Management: Concepts and perspectives in HRM; HRM in changing environment, Human resource planning- Objectives, process and techniques, Job analysis- job description, Selecting human resources, Induction, training and development, Exit policy and implications, Performance appraisal and evaluation, Potential assessment , Job evaluation, Wage determination, Industrial relations and Trade unions, Dispute resolution and grievance management, Labour welfare and social security measures.

Financial Management: Financial management- nature and scope, Valuation concepts and valuation of securities, Capital budgeting decisions- risk analysis, Capital structure and cost of capital, Dividend policy-determinant, Long-term and short-term financing instruments, Mergers and Acquisitions.

Marketing Management: Marketing Environment and Environment scanning; Marketing information systems and marketing research; understanding consumer and industrial markets; demand measurement and forecasting; market segmentation- targeting and positioning; product decisions, product mix, product life cycle; new product development; branding and packaging; pricing methods and strategies.

Promotion decisions: Promotion mix; advertising; Personal selling; channel management; vertical marketing systems; Evaluation and control of marketing effort; Marketing of services; Customer relation management, Uses of internet as a marketing medium-other related issues like branding, market development, advertising and retailing on the net.

Production Management: Role and scope of production management; Faculty location; Layout planning and analysis; Production Planning and control- production process analysis; Demand forecasting for operations; Determinations of product mix; Production scheduling; Work measurement; Time and motion study; Statistical Quality Control; Role and scope of operations research; linear programming; sensitivity analysis; duality; transportation model; inventory control; Queueing Theory; decision theory; Markov Analysis; PERT/CPM.

Statistical Methods: Descriptive statistics, Probability theory; probability distributions- Binomial, Poisson, Normal and Exponential; correlation and regression analysis; sampling theory; sampling distributions; tests of hypothesis; large and small samples; t, z, F, Chi-square tests.

Use of computers in managerial applications, technology issues and data processing in organizations, information systems, MIS and decision making, system analysis and design, trends in information technology; internet and internet-based applications.

Strategic Management: Concept of corporate strategy; components of strategy formulation; Ansoff's growth vector; BCG model; porter's generic strategies; competitor analysis; strategic dimensions and group mapping; industry analysis; strategies in industry evaluation, fragmentation, maturity and decline; competitive strategy and corporate strategy; transnationalization of world economy; managing cultural diversity; global entry strategies; globalization of financial system and services; managing international business; competitive advantage of nations; RTP and WTO.

Entrepreneurship: Concepts- types, characteristics; motivation; competencies and its development; innovation and entrepreneurship; small business- concepts government policy for promotion of small and tiny enterprises; process of business opportunity identification; detailed business plan preparation; managing small enterprises; planning for growth; sickness in small enterprises; rehabilitation of sick enterprises; Intrapreneurship (organizational entrepreneurship).

Ethics and Management: Ethics and management system; ethical issues and analysis in management; Value based organizations; Personal framework for ethical choices; Ethical pressure on individual in organizations; Gender issues; Ecological consciousness; Environmental ethics; Social responsibilities of business; Corporate governance and ethics.

Applied Physics-AP

SECTION- A

General information on science and its interface with society to test the candidate's awareness of science, aptitude of scientific and quantitative reasonsing. Common elementary computer science. History of development of computers, Mainframe, Mini, Micro's and Super Computer Systems. General awareness of computer Hardware i..e. CPU and other peripheral devices (input / output and auxiliary storage devices). Basic knowledge of computer systems, software and programming languages i.e. Machine language, Assembly language and higher level language. General awareness of popular commercial software packages other Scientific application packages.

SECTION – B

1. Basic Mathematical Methods: Calculus, Vector algebra and vector calculus, Linear algebra, matrices, Linear differential equations, Fourier – series, Elementary complex analysis.

2. Classical Dynamics: Basic principles of classical dynamics. Lagrangian and Hamiltonian formalisms. Symmetries and conservation laws. Motion in the central field of force. Collisions and scattering. Mechanics of a system of particles. Small oscillations and normal modes. Wave motion – wave equation, phase velocity, group velocity, dispersion. Special theory of relativity – Lorentz transformations, addition of velocities, mass – energy equivalence.

3. Electromagnetics: Electrostatics – Laplace and Poisson equations, boundary value problems. Magnetostatics – Ampere's theorem, Biot – Savart Law, electromagnetic induction. Maxwell's equations in free space and in linear isotropic media. Boundary conditions on the fields at interfaces. Scalar and vector potentials. Gauge invariance. Electromagnetic waves – reflection and refraction, dispersion, interference, coherence, diffraction, polarization. Electrodynamics of a charged particle in electric and magnetic fields. Radiation from moving charges, radiation from a dipole. Retarded potential.

4. Quantum Physics and Applications: Wave – particle duality. Heisenberg's uncertainty Principle. The Schrodinger equation Particle in a box, Harmonic Oscillator, Tunnelling through a barrier. Motion in a central potential, Orbital angular momentum. Angular momentum algebra, spin. Addition of angular momenta. Time – independent perturbation theory. Fermi's Golden Rule. Elementary theory of scattering in a central potential. Phase shifts, partial wave analysis, Born approximation, identical particles, spin – statistics connection.

5. Thermodynamic and Statistical Physics: Laws of thermodynamics and their consequences, Thermodynamic potentials and Maxwell's relations. Chemical potential, phase equilibria. Phase space, microstates and macrostates. Partition function. Free Energy and connection with thermodynamic quantities. Classical and quantum statistics, Degenerate electron gas. Blackbody radiation and Planck's distribution law, Bose-Einstein condensation. Einstein and Debye models for lattice specific heat.

6. Experimental Design: Measurement of fundamental constants : e, h, c,. Measurement of High & Law Resistances, L and ; Detection of X – rays, Gamma rays, charged particles, neutrons etc : Ionization chamber, proportional counter, GM counter, Scintillation detectors, Solid State detectors. Emission and Absorption Spectroscopy. Measurement of Magnetic field, Hall effect, magnetoresistance. X-ray and neutron Diffraction. Vacuum Techniques: basic idea of conductance, pumping speed etc. Pumps ; Mechanical Pump, Diffusion pump ; Gauges; Thermocouple, Panning, Pirani, Hot Cathode. Low Temperature: Cooling a sample over a range upto 4 K and measurement of temperature; Measurement of Energy and Time using electronic signals from the detectors and associated instrumentation : Signal processing, A/D conversion & multichannel analyzers, Time-of-flight technique ; Coincidence Measurements ; true to chance ratio, correlation studies.

7. Electronics: Physics of p n junction. Diode as a circuit element ; clipping, clamping ; Rectification, Zener regulated power supply ; Transistor as a circuit element : CC, CB and CE configuration. Transistor as a switch,

OR, AND, NOT gates. Feed back in Amplifiers. Operational amplifier and its applications : inverting, non â€“ inverting amplifier, adder, integrator, differentiator, wave form generator, comparator & Schmidt trigger. Digital integrated circuits NAND & NOR gates as building blocks, X OR Gate, simple combinational circuits, Half & Full adder, Flip-flop, shift register, counters.
Basic principles of A/D & D/A converters ; Simple applications of A/D & D/A converters.

8. Atomic & Molecular Physics: Quantum states of an electron in an atom. Hydrogen atom spectrum. Electron spin. Stern-Geriach experiment. Spin-orbit coupling, fine structure, relativistic correction, spectroscopic terms and selection rules, hyperline structure. Exchange symmetry of wave functions. Paulâs exclusion principle, periodic lable alkali type spectra, LS & JJ coupling, Zeeman, Paschen Back and Stain effects. X-Rays and Auger transitions, Compton effect. Principles of ESR, NMR. Convalent, ionic and Van der Waals interaction.
Rotation Vibration spectra. Raman Spectra, selection rules, nuclear spin and intensity alternation, isotope effects, electronic states of diatomic molecules, Frank Condon principle. Lasers spontaneous and stimulated emission, optical pumping, population inversion, coherence (temporal and spatial) simple description of Ammonia maser, CO_2 and He-Ne Lasers.

9. Condensed Matter Physics: Crystal classes and systems, 2d & 3d lattices, Bonding of common crystal structures, reciprocal lattice, diffraction and structure lector, elementary ideas about point defects and dislocations. Lattice vibrations, Phonons, specific heat of solids, free electron theory Fermi statistics ; heat capacity. Electron motion in periodic potential, energy bands in metals, insulators and semi-conductors ; fight binding approximation ; impurity levels in depend semi-conductors. Electronic transport from classical kinetic theory, electrical and thermal conductivity, Hall effect and thermoelectric power transport in semiconductors. Dielectric Polarization mechanisms, Clauslus equation, Plezo, Pyto and ferroelectricity. Dia and Para magnetism ; exchange interactions, magnetic order, ferro, anti ferro and ferrimagnetism. Super conductivity basic phenomenology; Meissner effect, Type 1 and Type 2 Super conductions, 8CS, Paining mechanism.

Applied Mathematics-AM

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Ordinary Differential Equations (ODEs): Existence and Uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Linear programming problem: Simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.