C.V. RAMAN COLLEGE OF ENGINEERING, BHUBANESWAR
OFFICE OF THE DEAN ACADEMICS

CVRCE/DEAN-AP/10/47 /18 **Date:-27.11.18**

NOTICE

CONDUCT OF SCREENING TEST AND INTERVIEW FOR PH. D PROGRAMME

The screening test and interview for admission in Ph. D Programme shall be held as per the following schedule.

EVENT	DATE	TIME
Screening Test	10.12.2018	10 AM to 12 NOON
Interview in the Department	10.12.2018	2.30 PM onwards

The number of scholars to be admitted in different Departments and specialization is as follows:

Department	Specialization	No. of Scholars to be admitted
COMPUTER SCIENCE AND ENGINEERING	Wireless Network, Mobile Computing, IoT, Big Data, VANET, Social Network, CRN, Machine Learning, Data Mining , Real Time System, Software Engg.	2
	WSN, Ad-hoc network, CRN, IoT and Machine Learning, SDN	2
CS & IT	Image and Video processing, Cloud and Fog Computing, Application of machine learning and CI	2
	Opinion Mining & Sentiment Analysis, Machine Learning Application, Natural language Processing, Data Mining	2
ELECTRONICS AND TELECOMMUNICATIONS	Image and Video processing, Signal Processing, Communication, Machine Learning, VLSI.	6
ELECTRICAL ENGINEERING	Control System, Power Electronics, H.V Engineering and Energy Conservation	3
	Power System Engineering, Renewable energy, Micro grid and Smart grid, Machine Learning application	3
	Power System Economics, FACTS, Renewable energy, Power Quality	2
MECHANICAL ENGINEERING	Smart Material/Composite Materials/Vibration	1
	Mineral Processing & Material	1

	Characterization	
	Macro and Nano Composite Materials	1
	Cryogenic Process Design/ Refrigeration/ Enhanced heat Transfer	1
	Welding Technology	1
	Metallurgy & material science/ Nano composite	1
	Welding Technology/ Advance Machining	1
	Tribology/ Surface Engineering/ Advance Machining	1
	Biodiesel Production, characterization & combustion analysis	1
PHYSICS	Fiber & Integrated Optics	1
	Nano-material, ferroelectric and piezoelectric	1
	Nano-material, ferroelectric and piezoelectric	1
	Solid oxide fuel cell	1
	Experimental Plasma Physics and Nano -structured thin films	1
	Polymer Composite materials	1
CHEMISTRY	Catalysis, Photo catalysis	2
	Biochemistry, computational biochemistry, natural product, medicinal chemistry	2
	Electrochemical preparation of metals and materials, waste material treatment, waste utilization through electrochemical route	2
	Supramolecular Chemistry, metal organic polyhedra, self-assembly	2
MATHEMATICS	Graph Theory	1
	Inventory Model	2
	Mathematical Epidemiology	1
	Fuzzy Optimization	1
	Cosmology	1
	Fluid Dynamics	1
	Differential Equation	1
MBA	Organisational Behavior, Human Resource Management, Training & Development, Industrial Relations, Labour Laws	1
	Financial Management, Behavioral Finance, Financial Risk Tolerance, Banking & Financial Services	1
	Organisational Behavior, Human resource Management, Training & Development, Organisational Change, Human Resource Development	1

Some Additional Information:

- ***No TA, DA, shall be paid for attending the screening test and interview. The aspirants shall have to make their own arrangement for accommodation.***
- ***Annual Course Fees is Rs.90, 000/-.***
- ***Scholarship/Stipend of Rs. 10,000/- per month shall be paid to each full time Ph. D Scholar.***

Note:- The syllabus/content for screening test for each branch is given below:

SYLLABUS FOR PHD SCREENING TEST

DEPARTMENT OF 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.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Section 2: Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

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; 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, manometry, buoyancy, 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.

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, behaviour 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 air-conditioning*: 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.

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 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, design of jigs and fixtures.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

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

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

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.

DEPARTMENT OF ELECTRICAL ENGINEERING

Electric Circuits:

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two port networks, Three phase circuits, Power and power factor in ac circuits.

Electromagnetic Fields:

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magneto motive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Signals and Systems:

Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

Electrical Machines:

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and

speed control of dc motors; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Power Systems:

Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per unit quantities, Bus admittance matrix, Gauss Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Control Systems:

Mathematical modelling 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, Lag, Lead and Lead/?Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Electrical and Electronic Measurements:

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Analog and Digital Electronics:

Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback, amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

Power Electronics:

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase

configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

DEPARTMENT OF MATHEMATICS

Section 1: Linear Algebra

Finite dimensional vector spaces; Linear transformations and their matrix representations, rank; systems of linear equations, eigenvalues and eigenvectors, minimal polynomial, Cayley-Hamilton Theorem, diagonalization, Jordan-canonical form, Hermitian, Skew- Hermitian and unitary matrices; Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, self-adjoint operators, definite forms.

Section 2: Complex Analysis

Analytic functions, conformal mappings, bilinear transformations; complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle; Zeros and singularities; Taylor and Laurent's series; residue theorem and applications for evaluating real integrals.

Section 3: Real Analysis

Sequences and series of functions, uniform convergence, power series, Fourier series, functions of several variables, maxima, minima; Riemann integration, multiple integrals, line, surface and volume integrals, theorems of Green, Stokes and Gauss; metric spaces, compactness, completeness, Weierstrass approximation theorem; Lebesgue measure, measurable functions; Lebesgue integral, Fatou's lemma, dominated convergence theorem.

Section 4: Ordinary Differential Equations

First order ordinary differential equations, existence and uniqueness theorems for initial value problems, systems of linear first order ordinary differential equations, linear ordinary differential equations of higher order with constant coefficients; linear second order ordinary differential equations with variable coefficients; method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties.

Section 5: Algebra

Groups, subgroups, normal subgroups, quotient groups and homomorphism theorems, automorphisms; cyclic groups and permutation groups, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings and irreducibility criteria; Fields, finite fields, field extensions.

Section 6: Functional Analysis

Normed linear spaces, Banach spaces, Hahn-Banach extension theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, Riesz representation theorem, bounded linear operators.

Section 7: Numerical Analysis

Numerical solution of algebraic and transcendental equations: bisection, secant method, Newton-Raphson method, fixed point iteration; interpolation: error of polynomial interpolation, Lagrange, Newton interpolations; numerical differentiation; numerical integration: Trapezoidal and Simpson rules; numerical solution of systems of linear equations: direct methods (Gauss elimination, LU decomposition); iterative methods 34 of 72

(Jacobi and Gauss-Seidel); numerical solution of ordinary differential equations: initial value problems: Euler's method, Runge-Kutta methods of order 2.

Section 8: Partial Differential Equations

Linear and quasilinear first order partial differential equations, method of characteristics; second order linear equations in two variables and their classification; Cauchy, Dirichlet and Neumann problems; solutions of Laplace, wave in two dimensional Cartesian coordinates, Interior and exterior Dirichlet problems in polar coordinates; Separation of variables method for solving wave and diffusion equations in one space variable; Fourier series and Fourier transform and Laplace transform methods of solutions for the above equations.

Section 9: Topology

Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, connectedness, compactness, countability and separation axioms, Orison's Lemma.

Section 10: Probability and Statistics

Probability space, conditional probability, Bayes theorem, independence, Random variables, joint and conditional distributions, standard probability distributions and their properties (Discrete uniform, Binomial, Poisson, Geometric, Negative binomial, Normal, Exponential, Gamma, Continuous uniform, Bivariate normal, Multinomial), expectation, conditional expectation, moments; Weak and strong law of large numbers, central limit theorem; Sampling distributions, UMVU estimators, maximum likelihood estimators; Interval estimation; Testing of hypotheses, standard parametric tests based on normal, distributions; Simple linear regression.

Section 11: Linear programming

Linear programming problem and its formulation, convex sets and their properties, graphical method, basic feasible solution, simplex method, big-M and two phase methods; infeasible and unbounded LPP's, alternate optima; Dual problem and duality theorems, dual simplex method and its application in post optimality analysis; Balanced and unbalanced transportation problems,

Vogel's approximation method for solving transportation problems; Hungarian method for solving assignment problems.

DEPARTMENT OF MBA

Managerial Economics:

Demand Analysis, Production Function, Cost-Output Relation, Market Structures, Pricing Theories, Advertising, Macro Economics, National income Concept

Organizational Behavior:

Skills and Roles in an Organization- Classical, Neo Classical and Modern theories of Organization Structure, Organizational Design, Understanding and Managing individual Behaviour-Personality, Perception, Values, Attitudes, Learning and Motivation, Understanding and Managing Group Behavior, Managing Change, Organizational Development.

Human Resource Management:

HRP, Process and techniques of Job Analysis, Job Description, Job Specification, Training & Development, Performance Appraisal, Job Evaluation, Wage determination, Industrial Relations

Financial Management:

Nature and Scope, Valuation Concepts and Valuation of Securities, Capital Budgeting Decisions, Capital Structure, Cost of Capital, Dividend Policies

Marketing Management:

Marketing Environment and Environmental Scanning, Marketing information System, Marketing Research, Understanding Consumer and Industrial Market, Demand measurement and Forecasting, STP, Marketing Mix

Research Methodology:

Measures of Central Tendency, Measures of Dispersion, Co-relation and Regression Analysis, Sampling theory, Sampling Distribution, Test of Hypothesis, Large and Small samples: t, z, F, Chi-square test.

DEPARTMENT OF CHEMISTRY

Physical Chemistry:-

Basic principles and applications of quantum mechanics – hydrogen atom, angular momentum.Variational and perturbational methods. Basics of atomic structure, electronic configuration, shapes of orbitals, hydrogen atom spectra. Theoretical treatment of atomic structures and chemical bonding.Chemical applications of group theory .Basic principles and application of spectroscopy – rotational, vibrational, electronic, Raman, ESR, NMR. Chemical thermodynamics. Phase equilibria. Statistical thermodynamics.Chemical equilibria. Electrochemistry – Nernst equation, electrode kinetics, electrical double layer, Debye-Hückel theory. Chemical kinetics – empirical rate laws, Arrhenius equation, theories of reaction rates, determination of reaction

mechanisms, experimental techniquesfor fast reactions. Concepts of catalysis. Polymer chemistry. Molecular weights and their determinations. Kinetics of chain polymerization. Solids - structural classification of binary and ternary compounds, diffraction techniques, bonding, thermal, electrical and magnetic properties Collids and surface phenomena. Data analysis.

Inorganic Chemistry:-

Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules. Concepts of acids and bases.Chemistry of the main group elements and their compounds.Allotropy, synthesis, bonding and structure.Chemistry of transition elements and coordination compounds – bonding theories, spectral and magnetic properties, reaction mechanisms.Inner transition elements – spectral and magnetic properties, analytical applications. Organometallic compounds - synthesis, bonding and structure, and reactivity. Organometallics in homogenous catalysis. Cages and metal clusters. Analytical chemistry- separation techniques.Spectroscopic electro- and thermoanalytical methods. Bioinorganic chemistry – photosystems, porphyrines, metalloenzymes, oxygen transport, electron- transfer reactions, nitrogen fixation. Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-, NQR, MS, electron spectroscopy and microscopic techniques. Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Organic Chemistry:-

IUPAC nomenclature of organic compounds. Principles of stereochemistry, conformational analysis, isomerism and chirality.Reactive intermediates and organic reaction mechanisms. Concepts of aromaticity. Pericyclic reactions. Named reactions. Transformations and rearrangements. Principles and applications of organic photochemistry. Free radical reactions. Reactions involving nucleophotic carbon intermediates. Oxidation and reduction of functional groups.Common reagents (organic, inorganic and organ metallic) in organic synthesis.Chemistry of natural products such as steroids, alkaloids, terpenes, peptides, carbohydrates, nucleic acids and lipids.Selective organic transformations – chemo selectivity, regioselectivity, stereo selectivity, enantioselectivity. Protecting groups. Chemistry of aromatic and aliphatic heterocyclic compounds. Physical characterisation of organic compounds by IR, UV-, MS, and NMR.

DEPARTMENT OF PHYSICS

I. Mathematical Methods of Physics

Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Tensors: covariant and contravariant tensor, Levi-Civita and Christoffel symbols. Introductory group theory: SU(2), O(3).

II. **Classical Mechanics**

Dynamical systems, Phase space dynamics, Central force motions. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion:Coupled oscillations, normal modes. Special theory of relativity-Lorentz transformations, relativistic kinematics and mass–energy equivalence. Poisson brackets and canonical transformations.

III. **Electromagnetic Theory**

Solutions of electrostatic and magnetostatic problems including boundary value problems, Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Poynting vector, Poynting theorem, Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

IV. **Quantum Mechanics**

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. 2

V. **Thermodynamic and Statistical Physics**

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. first and second order phase transitions, phase equilibria, critical point.

VI. **Condensed Matter Physics & Electronics**

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility and effective mass; optical, dielectric and magnetic properties of solids; elements of superconductivity: Type-I and Type II superconductors, Meissner effect, London equation.

Semiconductor devices: diodes, Bipolar Junction Transistors, Field Effect Transistors; operational amplifiers: negative feedback circuits, active filters and oscillators; regulated power supplies; Opto-electronic devices (solar cells, photo-detectors, LEDs), Logic fundamentals, Boolean theorem, Logic gates-RTL,DTL,TTL, RS flip flop, JK flip-flops Boolean algebra, De Morgan theorem, AND, NAND, NOT, NOR gates Logic Circuits.

VII. **Atomic & Molecular Physics**

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

VIII. **Nuclear and Particle Physics**

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING/ CS & IT

Operating System

Introduction to OS

Process Management:

Deadlock

Memory Management:

File System & Storage Management

Database Management Systems / Database Engineering

Data Base Management System and ER Data Model

Relational Data Model

Relational Algebra and Relational Calculus

Normalization

Transaction Management

Computer Networking

Data Communication Fundamentals

Modulation and Switching Techniques

Physical & Data Link Layer

Network and Transport Layer

Application Layer

Programming in C

C Programming Basics

Arrays and Strings

Functions and Pointers

Structures and Unions

File Handling in C

Electronics & Telecom Engineering Department

Section 1: Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, 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, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stoke's theorems.

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

Section 2:

Networks, Signals and Systems

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye - Delta transformation; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2 - port network parameters: driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Section 3:Analog and Digital Electronic Devices

Energy bands in intrinsic and extrinsic silicon; 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; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process. Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation. Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaughmap, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip - flops, counters, shift - registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Section 4: 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 lag-lead compensation; State variable model and solution of state equation of LTI systems.

Section 5: Analog and digital 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, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital

modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Section 6 General Aptitude

Verbal Ability: English grammar, sentence completion, verbal analogies, word groups, instructions, critical reasoning and verbal deduction.

Numerical Ability: Numerical computation, numerical estimation, numerical reasoning and data interpretation.

NB: 70% of the questions will be from section 1 to 5 and 30% of questions will be from section 6.

27/11/2018

for **DEAN ACADEMICS**