Department of Computer Science

National Institute of Technology

Broad Syllabus Topics for PhD Entrance Exam

1. Operating Systems
2. Data Structures
3. Algorithms
4. Computer Networks
5. Network and Computer Security
6. Theory of Computation
7. DBMS
8. Computer Architecture
9. C/C++ Programming
10. Engineering Mathematics and General Aptitude.

Department of Chemistry,

National Institute of Technology, Srinagar.

Syllabus for M. Phil. /Ph.D. Entrance test-2018

Inorganic Chemistry:

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Analytical chemistry: separation, spectroscopic, electro- and thermoanalytical methods.
9. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.

Organic Chemistry:

1. Stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
2. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.

3. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes.
4. Mechanism of organic reactions: addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species.
5. Common named reactions and rearrangements – applications in organic synthesis.
6. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic).
7. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
8. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
9. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
10. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
11. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunnelling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.

5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Interdisciplinary topics:

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

ELECTRONICS & COMMUNICATION ENGINEERING DEPARTMENT

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

SYLLABUS FOR PH. D ENTRANCE TEST (2018 SESSION) FOR E C E DEPARTMENT

ELECTRIC CIRCUITS & NETWORKS: NETWORK GRAPHS: MATRICES ASSOCIATED WITH GRAPHS; INCIDENCE, FUNDAMENTAL CUT SET AND FUNDAMENTAL CIRCUIT MATRICES. SOLUTION METHODS: NODAL AND MESH ANALYSIS. NETWORK THEOREMS: SUPERPOSITION, THEVENIN'S AND NORTON'S MAXIMUM POWER TRANSFER, 3 PHASE AND WYE-DELTA TRANSFORMATION. TRANSIENT AND STEADY STATE ANALYSIS OF AC AND DC CIRCUITS. TIME DOMAIN ANALYSIS OF SIMPLE RLC CIRCUITS, SOLUTION OF NETWORK EQUATIONS USING LAPLACE TRANSFORM: FREQUENCY DOMAIN ANALYSIS OF RLC CIRCUITS. 2-PORT NETWORK PARAMETERS: DRIVING POINT AND TRANSFER FUNCTIONS. STATE EQUATIONS FOR NETWORKS. FILTERS.

SIGNALS AND SYSTEMS: DEFINITIONS AND PROPERTIES OF LAPLACE TRANSFORM, CONTINUOUS-TIME AND DISCRETE TIME FOURIER SERIES, CONTINUOUS-TIME AND DISCRETE-TIME FOURIER TRANSFORM, DFT AND FFT, Z-TRANSFORM. SAMPLING THEOREM. LINEAR TIME-INVARIANT (LTI) SYSTEMS: DEFINITIONS AND PROPERTIES; CAUSALITY, STABILITY, IMPULSE RESPONSE, CONVOLUTION, POLES AND ZEROS, PARALLEL AND CASCADE STRUCTURE, FREQUENCY RESPONSE, GROUP DELAY, PHASE DELAY. SIGNAL TRANSMISSION THROUGH LTI SYSTEMS.

ELECTRONIC DEVICES & CIRCUITS: ENERGY BANDS IN SILICON, INTRINSIC AND EXTRINSIC SILICON. CARRIER TRANSPORT IN SILICON: DIFFUSION CURRENT, DRIFT CURRENT, MOBILITY, AND RESISTIVITY. GENERATION AND RECOMBINATION OF CARRIERS, P-N JUNCTION DIODE, ZENER DIODE, TUNNEL DIODE, BJT, JFET, MOS CAPACITOR, MOSFET, LED, P-I-N AND AVALANCHE PHOTO DIODE, BASICS OF LASER. DEVICE TECHNOLOGY: INTEGRATED CIRCUITS FABRICATION PROCESS, OXIDATION, DIFFUSION, ION IMPLANTATION, PHOTOLITHOGRAPHY, N-TUB, P-TUB AND TWIN-TUB CMOS PROCESS. SMALL SIGNAL EQUIVALENT CIRCUITS OF DIODES, BJTS AND MOSFETS. SIMPLE DIODE CIRCUITS, CLIPPING, CLAMPING, RECTIFIER. BIASING AND BIAS STABILITY OF TRANSISTOR AND FET AMPLIFIERS. AMPLIFIERS: SINGLE-AND MULTI-STAGE, DIFFERENTIAL AND OPERATIONAL, FEEDBACK, AND POWER. FREQUENCY RESPONSE OF AMPLIFIERS. SIMPLE OP-AMP CIRCUITS. SINUSOIDAL OSCILLATORS; CRITERION FOR OSCILLATION.

DIGITAL CIRCUITS: BOOLEAN ALGEBRA, MINIMIZATION OF BOOLEAN FUNCTIONS; LOGIC GATES; COMBINATORIAL CIRCUITS: ARITHMETIC CIRCUITS, CODE CONVERTERS, MULTIPLEXERS, DECODERS, PROMS AND PLAS. SEQUENTIAL **CIRCUITS:** LATCHES AND FLIP-FLOPS, COUNTERS AND SHIFT-REGISTERS. SAMPLE AND HOLD CIRCUITS, ADCS, DACS. MICROPROCESSOR (8085): ARCHITECTURE, PROGRAMMING, MEMORY AND I/O INTERFACING.

COMMUNICATIONS: RANDOM SIGNALS AND NOISE: PROBABILITY, RANDOM VARIABLES, PROBABILITY DENSITY FUNCTION, AUTOCORRELATION, POWER SPECTRAL DENSITY. ANALOG COMMUNICATION SYSTEMS: AMPLITUDE AND ANGLE MODULATION AND DEMODULATION SYSTEMS, SPECTRAL ANALYSIS OF THESE OPERATIONS, SUPER-HETERODYNE RECEIVERS; ELEMENTS OF HARDWARE, REALIZATIONS OF ANALOG COMMUNICATION SYSTEMS; SIGNAL-TO-NOISE RATIO (SNR) CALCULATIONS FOR AMPLITUDE MODULATION (AM) AND FREQUENCY MODULATION (FM) FOR LOW NOISE CONDITIONS. FUNDAMENTALS OF INFORMATION THEORY AND CHANNEL CAPACITY THEOREM, DIGITAL COMMUNICATION SYSTEMS: PULSE CODE MODULATION (PCM), DIFFERENTIAL PULSE CODE MODULATION (DPCM), DIGITAL MODULATION SCHEMES: AMPLITUDE, PHASE AND FREQUENCY SHIFT KEYING SCHEMES (ASK, PSK, FSK), MATCHED FILTER RECEIVERS, BANDWIDTH CONSIDERATION AND PROBABILITY OF ERROR CALCULATIONS FOR THESE SCHEMES. BASICS OF TDMA, FDMA AND CDMA.

ANTENNAS & WIRELESS COMMUNICATIONS

TRANSMISSION LINES- DISTORTION LESS & DISSIPATION LESS LINES, OPEN AND SHORT CIRCUIT LINES AND LINES OF DIFFERENT LENGTHS. BASIC ANTENNA PARAMETERS, ANTENNA ARRAYS, PARABOLIC REFLECTOR, FOLDED DIPOLE.

CELLULAR CONCEPTS, FREQUENCY REUSE, CO CHANNEL INTERFERENCE, CELL SPLITTING. RADIO PROPAGATION CHARACTERISTICS; MODELS FOR PATH LOSS, SHADOWING AND MULTIPATH FADING. DIVERSITY TECHNIQUES AND RAKE DEMODULATOR. WAVE PROPAGATION THROUGH VARIOUS MEDIA.

COMPUTER NETWORKS

REVIEW OF DATA COMMUNICATION TECHNIQUES. DATA TRANSMISSION, LINE CODING, ERROR CONTROL CODING. SWITCHING. LAN TOPOLOGIES AND PROTOCOLS. MAC PROTOCOLS, ROUTING AND CONGESTION CONTROL. QUALITY OF SERVICE. NETWORK SECURITY: SERVICES, ATTACKS AND MECHANISMS. CRYPTOGRAPHY: SECRET AND PUBLIC KEY. HASH FUNCTIONS, DIGITAL SIGNATURES

COMPUTER ORGANIZATION AND ARCHITECTURE:COMPUTER CYCLE CONTROL, CPU ORGANIZATION, MEMORY ORGANIZATION, I/O ORGANIZATION, PIPELINING

PROGRAMMING AND DATA STRUCTURES: PROGRAMMING IN C; FUNCTIONS, RECURSION, PARAMETER PASSING, BINDING; ABSTRACT DATA TYPES, ARRAYS, STACKS, QUEUES, LINKED LISTS, TREES, BINARY SEARCH TREES, BINARY HEAPS.

BASIC MATHEMATICS & GENERAL APTITUDE

IT IS ALSO INFORMED THAT

WRITTEN TEST SHALL BE BASED ON MULTIPLE CHOICE QUESTIONS (MCQ)

FOR ANY QUERIES PLEASE CONTACT:

OFFICE ECE DEPARTMENT

(2ND FLOOR) ECE NEW BLOCK

Department of Electrical Engineering
National Institute of Technology Srinagar

SYLLABUS FOR Ph. D ENTRANCE EXAMINATION 2018

1. Electric Machines – Transformers, D.C Machines, Induction Machines, Synchronous Machines.

2. Control Systems – Classical & Modern Control.

3. Circuit Analysis – AC & DC

4. Power Systems – Transmission distribution, fault analysis & Stability, Renewable Energy Systems.

5. Electric Measurements & Instrumentation

6. Power Electronics

7. Microprocessor & Microcontrollers

8. General Aptitude

9. Engineering Mathematics

(Dr. S. A. Lone)
Prof. & Head

DEPARTMENT OF INFORMATION TECHNOLOGY

NIT SRINAGAR

Broad Syllabus Topics for PhD Entrance Examination

1. C & Data Structures
2. Software Engineering
3. DBMS
4. Operating System
5. Microprocessors
6. Data communication
7. Big data and Cloud Computing
8. Computer Networks
9. Wireless Mobile Communication
10. Artificial Intelligence
11. Computer Graphics and Image Processing
12. Embedded Systems
13. Information Security
14. General Aptitude and Engineering Mathematics.

National Institute of Technology

Department of CIVIL Engineering

Syllabus for Ph.D. admission–Session: Autumn-2018

(Geotechnical Engineering)

A. Core Areas (50% Weightage)

Soil Mechanics; Soil and its formation, processes and agencies involved in formation, types of soils, three phase soil model, index properties and classification of soils. Flow through soils, Laplace equation for steady flow. Effective stress concept and pore pressure, Compaction of soils and its field application; stress distribution under loaded plates; Clay Mineralogy, Basic structural units, Isomorphic substitution, base exchange capacity, inter automatic and inter molecular bonds, different clay minerals; Engineering properties of clay minerals, permeability, swelling & shrinkage and stress – strain characteristics of soil and consolidation theory; review of conventional shear stress factors affecting shear strength of soils – pore pressure in soils – pore pressure measurements in triaxial test and field measurements – total and effective shear stress parameters, stress path, total stress path and effective stress path – Horslave shear parameters – shear strength , thixotropy and liquefaction of soils.; Compressibility of Soils**:** Concept of Stress, Principal Stress and Strain, Stress – Strain relations, plane Stress, Plane Strain, Mohr's diagram.; Settlement and consolidations: ultimate Settlements (Consolidation Test), Time rate of Consolidation, Effect of Layers and changes in parameters on the rate of consolidations.;

Shallow and Deep Foundations**;** Soil Investigations: Factors affecting site investigation, Planning sub soil exploration programme, Methods of soil exploration, Spacing and depth of borings, Location of borrow areas, bore log,; Types of Shallow Foundations: Strip pad, Combined, Raft Foundations; Bearing Capacity: Terzaghi's factors, Accuracy of Terzaghi's factors, Effect of footing shape, Net bearing capacity, General formulae, Soil layers of finite depths, Non uniform soils, Strength increasing with depth, Footings on slopes, Layered soils.; Settlement: Limits of settlement, Settlement computation, theory of elasticity, 1-D Conditions, 3-D problems,; Rate of settlement, Settlement of footings on sand, determination of BC based on settlement and bearing criteria.; Raft Foundations: Strip raft, Circular raft, rectangular raft, foundation – soil materialization – Beams & Plates on El Found.; Foundation – Soil Structure Interaction: Idealized soil behavior – Foundation behavior, Interface behavior, Analytical techniques, Scope of soil – Foundation interaction analysis.; Beams on Elastic Foundations: Winkler and Modified Winkler Models ;Theory of sub grade reaction, Applications of solution of beams on elastic foundations for footings and rafts, Finite Difference Method.;

Deep Foundations: Criteria for Design, types of Piles, Pile Load Capacity, Group Effects ; Design charts and equations for single pile, pile group settlement, pile load testing, Butter Piles, Negative Skin friction, Settlements and deformation prediction, Lock – Socketed Piles.; Well Foundations: Shapes of wells and component parts, Depth of well foundation and bearing capacity, Forces acting on a well foundation, Analysis of well foundation, well curb, cutting edge, staining and bottom plug, Well sinking.;

Earth Pressure and Retaining Structures; Earth Pressure Theories and Retaining Walls: conventional retaining wall, Gravity and Cantilever walls, shut pile walls Cantilever & Anchored)..; Strutted excavations: Stability of slopes to open excavations, Support of excavations, Structural Design of Supports to excavation, Over all stability, inward yielding and settlement of ground surrounding excavation.; Reinforced Earth Walls: Concepts – Designs

B- Allied Areas-------(25% Weightage):

Surveying; principles of surveying, types of surveying; Leveling and trignometrical leveling; Theodolite surveying; Tacheometry, Geodetic surveying, areas and volume, curves,

Strucrural Engineering: Analysis of stress and strain, flexural and torsional load analysis, determinate and indeterminate structures, bending and shear stresses, compound stresses, slopes and deflections, columns.

Fluid mechanics and Hydraulics: Basic fluid flow concepts, fluid statics, fluid kinematics and dynamics, pressurized flow, water hammer, laminar and turbulent flow; open channel hydraulics, irrigation engineering; water quality and waste treatment.

C. General Aptitude & Mathematics ---------(25% Weightage)

i) General Aptitude

ii) Mathematics

The calculus of the Finite Difference : Differences, Differences Formulae, Difference table, Operator E, Properties of the operator E and Δ, Leibnitz rule – Interpolation with equal intervals, unequal intervals, Central difference interpretation formulae.; Numerical Differentiation and Integration and Inverse Interpolation; Numerical solution of ordinary difference equations of the first and second order; Simultaneous linear algebraic equations – methods of solution using the inverse of the matrix, method of successive elimination.; Iterative method – gauss Siedel method, Relaxation methods;

National Institute of Technology

Department of CIVIL Engineering

Syllabus for Ph.D. admission–Session: Autumn-2018

(Water Resources Engineering)

A. Core Areas (50% Weightage)

Fluid Mechanics and Hydraulics: Properties of fluids, principal of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, vertical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

Hydrology:- Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

Irrigation : Duty , delta, estimation of evapo- transpration. Crop water requirements. Design of: lined and unlined canals, water ways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

Water Quality: Quality standards, basic unit processes an operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards, Domestic wastewater treatment, quantity of characteristics of domestic waste water , primary and secondary treatment. Unit operations and unit processes of domestic waste water sludge disposal.

Air pollution; Types of pollutants, their sources and impact, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal solid wastage: Characteristics, generation , collection and transportation of solid wastes, engineered systems of solid waste management (reuse/recycle, energy recovery, treatment and disposal.

B- Allied Areas-------(25% Weightage):

Surveying; principles of surveying, types of surveying; Leveling and trignometrical leveling; Theodolite surveying; Tacheometry, Geodetic surveying, areas and volume, curves,

Strucrural Engineering: Analysis of stress and strain, flexural and torsional load analysis, determinate and indeterminate structures, bending and shear stresses, compound stresses, slopes and deflections, columns.

Soil Mechanics: Origin of soils, soil classification, three-phase system, fundamental definitions, permeability and seepage effective stress principle, consolidation , compaction, shear strength

C. General Aptitude & Mathematics ---------(25% Weightage)

i) General Aptitude

ii) Mathematics

The calculus of the Finite Difference : Differences, Differences Formulae, Difference table, Operator E, Properties of the operator E and Δ, Leibnitz rule – Interpolation with equal intervals, unequal intervals, Central difference interpretation formulae.; Numerical Differentiation and Integration and Inverse Interpolation; Numerical solution of ordinary difference equations of the first and second order; Simultaneous linear algebraic equations – methods of solution using the inverse of the matrix, method of successive elimination.; Iterative method – gauss Siedel method, Relaxation methods;

National Institute of Technology

Department of CIVIL Engineering

Syllabus for Ph.D. admission–Session: Autumn-2018

(Engineering Geosciences and Rock Engineering)

A. Core Areas (50% Weightage)

(Earthquake Engineering)

1. Engineering Seismology (Earthquake Engineering) Engineering Seismology, Seismology and Seismic Exploration (Definitions). Introduction to Seismic Hazard and Earthquake Phenomenon. Global seismicity - Analysis of earthquake focal mechanisms. Seismotectonics and Seismic Zoning of India. Microzonation. Mechanism of Faulting. Earthquake Prediction. Site Response to Earthquakes: Local geology and soil conditions. Site investigations and soil tests. Dynamic design criteria for a given site. Earthquake Monitoring and Seismic Instrumentation. The Seismograph – Principles of Seismometer. Location of the epicenter of an earthquake. Earthquake size and intensity. Energy released in an earthquake. Earthquake: Risk and Preparedness. Earthquake: Social Consequences; Codes and Public Policy.

2. Engineering Geology:

Physical Geology; geology and its relevance to civil engineering, geological work of wind, rivers, glaciers and seas. Petrology; formation of rocks, types/field classification, weathering of rocks, origin of soils. Structural Geology; folds, faults, joints, unconformities. Engineering Geology; geological considerations in tunnels, dams, bridges, building sites; landslides; Earthquakes; basic definitions, types and causes, distribution in the world, seismic zones.

3. Materials:

Stones; their engineering properties; bricks, classification and strength requirements; tiles and their uses. Timber; properties, defects, seasoning, decay and prevention. Lime; types, properties and tests.

4. Rock Mechanics:

Introduction to rock mechanics and rock engineering. Terminology, Rock Classification Systems. Physical and Mechanical Properties of Rocks. Laboratory Testing. Rock masses: strength, deformability, failure criteria. Foundations and slope stability: foundations on discontinuous rock, slope instability basic mechanisms. Rock reinforcement and rock support: underlying principles, similarities and differences. Rock Bolting.

5. Tunnelling Technology:

Introduction to tunnelling: Fundamental definitions, tunnelling art and engineering, historical development, Classification of tunnels. Geological aspects of tunnelling: Geological investigation, evaluation and appreciation, importance of geological knowledge, aim of geological investigation, principal elements of exploration programme, Influence of geological conditions on design and construction of tunnels. Methods of Tunnelling in soft and hard rock. Lining of tunnels. Tunnel supports.

***B- Allied Areas-------(25% Weightage)*:**

***Surveying*;** principles of surveying, types of surveying; Leveling and trignometrical leveling; Theodolite surveying; Tacheometry, Geodetic surveying, areas and volume, curves,

Soil Mechanics: Origin of soils, soil classification, three-phase system, fundamental definitions, permeability and seepage effective stress principle, consolidation , compaction, shear strength

***Water Resources Engg.*:** Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

C. General Aptitude & Mathematics ---------(25% Weightage)

i) General Aptitude

ii) Mathematics

The calculus of the Finite Difference : Differences, Differences Formulae, Difference table, Operator E, Properties of the operator E and Δ, Leibnitz rule – Interpolation with equal intervals, unequal intervals, Central difference interpretation formulae.; Numerical Differentiation and Integration and Inverse Interpolation; Numerical solution of ordinary difference equations of the first and second order; Simultaneous linear algebraic equations – methods of solution using the inverse of the matrix, method of successive elimination.; Iterative method – gauss Siedel method, Relaxation methods;

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Syllabus for M.Phil/Ph.D. Entrance Exam in Physics for The Year -2018.

MATHEMATICAL METHODS FOR PHYSICS

Unit I

Complex Variables:

Complex numbers. Equations to curves in the plane in terms of z and z*. The Riemann sphere and stereographic projection. Analytic functions of z and the Cauchy Riemann conditions. The real and imaginary parts of an analytic function. The derivative of an analytic function. Power series as analytic functions. Convergence of power series. Cauchy's integral theorem. Singularities, removable singularity, simple pole, multiple pole, essential singularity. Laurent series. Singularity at infinity. Accumulation point of poles. Meromorphic functions. Cauchy's integral formula Solution of differential equations using generating functions and contour integration. Summation of series using contour integration. Evaluation of definite integrals using contour integration.

Unit II

Multivalve functions; integral representations

Branch points and branch cuts. Algebraic and logarithmic branch points, winding point. Riemann sheets. Contour integrals in the presence of branch points. An integral involving a class of rational functions. Contour integral representation for the gamma function. Contour integral representations for the beta function and the Riemann zeta function. Connection with Bernoulli numbers. Zeroes of the zeta function. Statement of the Riemann hypothesis. Contour integral representations of the Legendre functions of the first and second kinds. Singularities of functions defined by integrals. End-point and pinch singularities, examples. Singularities of the Legendre functions. Dispersion relations for the Legendre functions.

Unit III

Laplace transforms and Green Function

Definition of the Laplace transform. The convolution theorem. Laplace transforms of derivatives. The inverse transform, Mellin's formula. The LCR series circuit. Laplace transform of the Bessel and modified Bessel functions of the first kind. Laplace transforms and random processes: the Poisson process. Laplace transforms and random processes: biased random walk on a linear lattice and on a d-dimensional lattice.

Green functions. Poisson's equation. The fundamental Green function for thelaplacian operator. Solution of Poisson's equation for a spherically symmetric source. The Coulomb potential in d dimensions. Ultraspherical coordinates. A divergence problem. Dimensional regularization. Direct derivation using Gauss' Theorem. The Coulomb potential in d = 2 dimensions.

Text Books

1. L.A. Pipes and L.R. Harvill, Applied Mathematics for Engineers and Physicists, McGraw-Hill (1970).
2. G. B. Arfken and H.J. Weber, Mathematical Methods for Physicists, 5th edition, Academic Press (2001).
3. E. Kreyszig, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons Inc. (1999).
4. W.W Bell: Special functions for scientists and engineers.
5. J. Mathews and R L Walker: Mathematical Methods of Physics.

CLASSICAL MECHANICS

Unit I

Lagrangian Formulation

Newtonian mechanics and its limitations. Constrained motion. Constraints and their classification. Principle of virtual work. D' Alembert's principle. Generalized coordinates. Deduction of Lagrange's equations from D' Alembert's Principle. Generalized momenta and energy. Cyclic or ignorable coordinates. Rayleigh' s dissipation function. Integrals of motion. Symmetries of space and time with conservation laws. Problems. Rotating frames. Inertial Forces. Electromagnetic analogy of inertial forces. Terrestrial and astronomical applications of Conolis force. Foucault's pendulum. Problems.

Unit II

Central Force Problem

Central force. Definition and properties of central force. Two-body central force problem. Stability of orbits. Conditions for closure. General analysis of orbits. Kepler's laws. Kepler's equation. Artificial satellites. Rutherford scattering. Problems.

Principle of least action. Hamilton's principle. The calculas of variations. Derivation of Hamilton's equations of motion for holonomic systems from hamilton's principle. Hamilton's principle and characteristic functions.

UNIT III

Canonical Transformations

Generating functions. Poisson bracket. Poisson's Theorem. Invariance of PB under canonical transformations. Angular momentum PBs. Hamilton-Jacobi equation. Connection with Classical Mechanics canonical transformation. Problems. Small oscillations. Normal modes and coordinates. Problems.

Unit IV

Theory of Relativity

Principles and postulates of relativity, Lorentz Transformation, Effects thereof, Tensors, transformation properties, symmetric and anti-symmetric properties, Four Vector notation, Energy Momentum four vector for a particle, relativistic invariance of Physical Laws. Lagrangian and Hamiltonian of a relativistic particle.

Text Books

1. H. Goldstein, C. poole and J. Safko, Classical Mechanics, 3nd edition, Addison & Wesley(2000).
2. L.D. Landau and E.M. Lifshitz, Mechanics, Buttorworth-Heinemann (1976).
3. W. Greiner, Classical Mechanics – Point particles and Relativity, Springer-Verlag (1989).
4. N.C Rana and P.S Joag, Classical Mechanics.
5. A.P French: Special Relativity.

QUANTUM MECHANICS

UNIT I

Fundamental Concepts

Basic postulates of quantum mechanics. Linear operators Hermitian operators. Orthogonality of Eigen functions of a Hermitian operator. Completeness of Eigen functions. Commuting operators and their Eigen functions. Dirac's bra and ket notation. Representation of operators as matrices. Change of basis. Unitary transformation and its significance. Equations of motion. Schrodinger picture and Heisenberg picture. Interpretation of the wave function. Schwartz Inequality and Uncertainty Principle. Classical limit of the Schrodinger equation. operator methods in Q Mechanics, Double Stren-Gerlach experiment for spin half system.

UNIT II

Angular Momentum

Definition of generalized angular momentum, operators for J_+, J_- , J_z commutation relation of angular momentum with r & p. Spectrum of Eigen values of J^2 and Jz, operators for orbital angular momentum L in spherical polar coordinates, Eigen values and Eigen functions of L^2 & L_z. Spin angular momentum, Eigen values and Eigen functions of S^2 & S_z.

Matrix representation of J^2, J_z, J_+, J_-, J_x, J_y for j=1/2, 1. Pauli's Spin Matrices and their properties. Addition of two angular momenta, coupled & uncoupled representation, Clebsch Gorden co-efficients, Spectrum of eigen values of total angular momentum. Calculation of C.G. co-efficients when (1) j_1=1/2, j_2=1/2 (2) j_1=1/2, j_2= 1

UNIT III

Approximate Methods

Time independent perturbation theory. Perturbation of non-degenerate states. First order perturbation. Second order perturbation. Perturbation of an oscillator. Perturbation of degenerate states. Removal of degeneracy. First order Stark effect in hydrogen atom. Time dependent perturbation theory. Transition probability. The variation method with simple applications. Green's functions incoming and outgoing solutions.

Text Books

1. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw-Hill (1977).
2. J.L. Powell and B. Crasemann, Quantum Mechanics, Narosa Publishing House (1993).
3. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley (1999).
4. E. Merzbacher: Quantum Mechanics.
5. Cohen and Tanandji: Quantum Mechanics.

SOLID STATE PHYSICS

UNIT I

Crystal Structure

Bravais lattices- primitive vectors, primitive unit cells, conventional unit cells, Wigner Seitz Cell, Symmetry operations and classifications of two and three dimensional Bravias lattices, crystal structure, simple crystals, Miller indices, lattice planes, Bragg's law (SS), structure determination, Laue's method, powder crystal method, rotating crystal method, electron diffraction, neutron diffraction, reciprocal lattice, Ewald's construction, symmetry operations.

UNIT II

Energy band theory of solids

Classical free electron theory of metals, drift current, conductivity, mobility, Hall effect (SS). Wave mechanical treatment of electron in a box, electrons in a periodic potential, Bloch's theorem, Kronig-Penney Model, Brillouin zones, energy band structure in conductors, semiconductors, insulators, Fermi-Dirac distribution, Fermi energy density of states, Fermi surface, effective mass.

UNIT III

Magnetism Properties of solids

Classification of magnetic materials, Langevin's theory of paramagnetism, ferromagnetism, hysteresis, ferromagnetic domains, antiferromagnetism, ferrimagnetism, ferrites, Curie's law, magnetic ordering, Weiss theory of paramagnetism, quantum theory of para & ferromagnetism, paramagnetic resonances, Nuclear magnetic resonance

Text Books

1. Charles Kittel, Introduction to Solid State Physics, Wiley Eastern, 5th edition (1983).
2. B.S. Saxena, R.C. Gupta, P.N.Saxena, Fundamentals of solid state physics, Pragati prakashan, 7th edition (1999).
3. M.A. Wahab: Fundamentals of Solid State Physics.
4. O. Pillay: Solid State Physics.
5. J.P Srivastava: Elements of Solid State Physics.

CLASSICAL ELECTRODYNAMICS

UNIT I

Electrostatics

The concept of a scalar potential. Poisson's and Laplace's equations for scalar potential. Green's theorem, Electrostatic field energy density. Solutions of Laplace's equation in rectangular, spherical and cylindrical coordinates using the method of separation of variables. Multipole expansion of potential due to a localized charge distribution. Dipole and quadrupole fields. Interaction energy of dipole and quadrupole in an external field. Electrostatics in matter; Polarization and electric displacement vector. Electric field at the boundary of an interface. Clausius - Mossotti equation.

UNIT II

Magnetostatics,

Foundations of Magnetostatiscs, Scalar and Vector potentials, Magnetic moment of a current distribution. Macroscopic magnetostatics, Magnetization. M and H vectors, Maxwell's displacement current. Maxwell's equations. Vector and scalar potential. Lorentz and Coulomb gauge. Conservation of energy and momentum of a system of charged particles and electromagnetic fields. Field energy and field momentum.

UNITIII

Solutions of Maxwell's Equations and Radiation

Plane waves in dielectric media. Polarization, reflection and refraction at a plane interface between dielectrics, Fresnel's equations. Phase velocity and group velocity, spreading of a pulse propagating in a dispersive medium, propagation in a conductor, skin depth. Waveguides and cavity resonator. Radiation due to localized oscillatory source, near and far zones, radiated power due to an electric dipole, magnetic pole, example of a centre - fed linear antenna as an electric dipole radiator. Retarded Green's function.

Text Books

1. J.D. Jackson, Classical Electrodynamics, John Wiley & Sons, 2nd edition (1990).
2. D. J. Griffiths, Introduction to Electrodynamics, Pearson Prentice Hall, 3rd edition (1999).
3. J.R. Reitz., F.J. Milford and R.W. Christy, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House (1979).
4. L.C Landau and E.M. Lifshitz Classical theory of fields.
5. Panofsky and Phillips: Classical Electrodynamics.

THERMODYNAMICS AND STATISTICAL MECHANICS

UNIT I

Thermodynamics and its Statistical Basis

Review of thermodynamic concepts required for Statistical Mechanics, the macroscopic and the microscopic states, specification of states of a thermodynamic system, the principle of maximum entropy, thermodynamic potentials, contact between statistical mechanics and thermodynamics, Euler's equation and the Gibbs-Duhem relation, the Legendre transformation , classical ideal gas, entropy of mixing and Gibb's paradox.

Systems in contact with heat reserviour, expression of entropy, Canonical partition function, Helmholtz free energy, systems in contact with a particle reserviour, chemical potential, grand canonical partition function, fluctuation of particle number, Chemical potential of ideal gas.

UNIT II

Classical Statistical Mechanics

Micro-canonical ensemble, phase space, trajectories and density of states, Liouville's theorem, canonical and grand canonical ensembles; partition function, calculation of statistical quantities, Energy and density fluctuations.

UNIT III

Quantum Statistical Mechanics

Density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwell-Boltzmann, Fermi-Dirac and Bose Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.

Real gases, Mayer's cluster expansion for a classical gas, Viral equation of state, Using model, mean-field theories of the Ising model in two and one dimensions. Landau theory of phase transition, critical indices, scale transformation and dimensional analysis. Calculations of exponents from mean field Theory and Laundos theory, Upper critical dimension.

Text Books

1. F. Reif, Fundamentals of Statistical and Thermal Physics, International Students edition, Tata McGraw-Hill (1988).
2. K. Haung, Statistical Mechanics, Wiley Eastern (1991).
3. F.W. Sears and G.L. Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd edition, Narosa Publishing House (1998).
4. H.B Callen: Thermodynamics and an introduction to thermostatics.
5. R. Kubo: Statistical Mechanics.

ATOMIC AND MOLECULAR PHYSICS

UNIT I

Hydrogen atom Gross Structures:

Schrödinger's equation, stationary states, Solution of' Schroedinger's equation for Coulomb field, quantum numbers n, l, m, Comparison with Bhor's model, the hydrogen spectrum Problems. The hydrogen atom Fine structure: Electron Spin, Stern-Gerlach experiment, the interaction terms, relativistic correction, spin-orbit interaction, vector model, spectroscopic terms and selection rules, lamb shift, summary of the hydrogen spectrum, Problems.

UNIT II

Two electron system:

Electrostatic interaction and exchange degeneracy ground and excited states of helium, Electron spin functions and Pauli's exclusion principle, periodic table. The central field approximation: the central field, Thomas Fermi-potential, The gross structure of alkalis atoms. Problems

UNIT III

Angular problems in many-electron atoms:

The LS-coupling approximation, allowed term in LS coupling, fine structure in LS coupling, J-J coupling. Problems, hyperfine structures. Interaction with external field: Zeeman, Paschen-Back and Stark effects, problems.

Covalent ionic and Vander Waal's interaction. Rotational, Vibrational, Rotational-Vibrational and electronic spectra of di-atomic molecules, selection rules, Frank-Condon principle. Raman effect and Raman spectra.

Fortrat diagram, Electronic angular momentum in diatomic and classification of states with example of spectrum of molecular hydrogen. Basic principle and use of ESR, NMR and Mossbauer spectroscopy.

Text Books

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill, New York (2004).
2. Manas chanda, Atomic Structure and Chemical Bond, Tata McGraw-Hill, New Delhi (2003).
3. Arthur Beiser, Concepts of Modern Physics, 6th edition, Tata McGraw-Hill, New Delhi (2003).
4. G. Aruldhas, Molecular Structure and Spectroscopy, Prientice Hall of India, NewDelhi (2002).
5. B.H Bransden and C.J Joachain: Physics of atoms and Molecules.

NUCLEAR AND PARTICLE PHYSICS

UNIT I

Nuclear Properties

Basic nuclear properties, Nuclear size and distribution of nucleons, Energies of nucleons in the nucleus, Angular momentum, Parity and symmetry, Magnetic dipole moment and electric quadrupole moment, Energy levels and mirror nuclei. Characteristics of nuclear forces - Range and strength, Simple theory of two nucleon system-deuterons, Spin states of two nucleon system, Effect of Pauli's exclusion principle, Magnetic dipole moment and electric quadrupole moment of deuteron -The tensor forces.

UNIT II

Experimental Methods of Nuclear & Particle Physics

Interaction of charged particles with matter. Stopping power and raige. Detectors for energetic charged particles; Solid State or Semiconductor detector; Bubble chamber; Nuclear emulsions. Composite relations. E rays, Ionization and scattering measurements in nuclear emulsions, Identification of particles. Need for accelerator of charged particles, Classification of types of accelerators, Proton Synchrotron, Betatron; alternating gradient accelerator, Colliding beam accelerator.

UNIT III

Nuclear reactions and fission

Different types of reactions, Quantum mechanical theory, Resonance scattering, Compound nucleous formation, Statistical theory of nuclear reactions and evaporation probability.

Classification and properties of elementary particles, Leptons, Baryons, mesons particles and antiparticles excited states and resonances. Various types of interactions - gravitational, electromagnetic, weak and strong interactions and their mediating quanta, Conservation rules in fundamental interactions. Charge symmetry and charge independence, Parity and charge conjugation, Conservation of parity and its violation in different types of interactions. Strange particles, associated production, strangeness and decay modes of charged Kaons, Isospin and its conservation. Idea of eight fold way and quarks.

Text Books

1. Heral Enge, Introduction to Nuclear Physics, Addison Wesley (1981).
2. D.C. Tayal, Nuclear Physics, 4th edition, Himalaya House, Bombay (1980).
3. W.C. Burcham, Elements of Nuclear Physics, ELBS (1979).
4. Kenneth S. Krane, Introductory Nuclear Physics, John Wiley & Sons, New York (1988).
5. J.S Lilley: Nuclear Physics.

Electronics

UNIT I

Transistors

Types operation and characteristics, Ebers-Moll model, CE, CB and CC configuration input, output characteristics and graphical analysis of basic amplifier circuits, Biasing and Bias stability, Low frequency, h-parameter model, Analysis and Design of transistor amplifier circuits using h-parameters. High frequency hybrid – pi model, analysis and design of transistor amplifier circuits at high frequencies. Multistage amplifiers, phototransistors, Transistor as a switch, SCR's and Thyistors. Operation and characteristics, model Application at low and high frequency, amplifiers, switching circuits, MOSFET TYPES, Operation and characteristics.

UNIT II Semiconductor Devices, Amplifiers and Oscillators

p-n junction diodes: tunnel diode, Schottky barrier diode – Microwave diodes: varactor diode, p-i-n diode – Optoelectronic devices: solar cell, photodetector, LED, semiconductor laser – basic principles, biasing and characteristics of BJT and JFET – MOSFET: enhancement and depletion modes of operation – basic idea of charge coupled devices.

Low frequency and high frequency amplifiers – power amplifiers – oscillator principle – oscillator types – frequency stability, response – phase shift oscillator – Wein bridge oscillator – LC tunable oscillators – multivibrators – monostable and astable – sine wave and triangle wave generation – clamping and clipping – crystal oscillators and their applications.

UNIT III

Operational Amplifiers and Digital Circuits

Ideal operational amplifier: characteristics, feedback types – *Applications:* basic scaling circuits – current to voltage and voltage to current conversion – sum and difference amplifiers – integrating and differentiating circuits – A.C.amplifiers – instrumentation amplifiers, comparators, filters, PLL. Logic gates – half adder, full adder – comparators, decoders, multiplexers, demultiplexers – design of combinational circuits – sequential circuits – *Flip-flops:* RS flip-flop, JK flip- flop, JK master-slave flip-flops, T flip-flop, D flip-flop – synchronous and asynchronous counters, registers – A/D and D/A conversion – characteristics.

Text Books

1. C.L Wadhwa, Network Analysis and Synthesis, New Age International Publishers, (2007).
2. J. Milman and C.C. Halkias, Electronic Devices and Circuits, McGraw-Hill (1981).
3. R. L. Boylsted and L. Nashelsky, Electronic Device and Circuits, Pearson Education (2003).
4. R.J. Higgins, Electronics with Digital and Analogue Integrated Circuits, Prentice Hall (1983).
5. A.P. Malvino, Electronics: Principles and Applications, Tata McGraw-Hill (1991).

Mechanical Engineering Department
National Institute of Technology Srinagar
Syllabus outline for PhD Entrance Exam, Autumn 2018

Thermodynamics

Zeroth law, First law & Second law of thermodynamics, air & vapor power cycles, nozzles, boilers, steam turbines, compressors, refrigeration and air-conditioning, internal combustion engines, gas turbines

Theory of Machines

Kinematics & kinetics of particles, lower pairs & higher pairs, mechanisms and DOF, inversions, velocity and acceleration analysis, instantaneous centre, governors, flywheels, gears & cams, torsional vibrations, various types of damping, forced harmonic vibration

Mechanics of Materials

Free body diagrams, section forces in beams, analysis of stress and strain, pressure vessels, mechanical properties of solids, symmetric & unsymmetrical beam bending, theories of elastic failure, columns, torsion of circular shafts, strain energy due to normal and shear stresses, Castigliano's theorem, complementary energy theorem, slopes and deflections, theories of failure, stresses in hollow and solid discs, stresses in rotating disc of constant thickness, closed coiled helical springs, leaf springs, conical springs,

Fluid Mechanics & Hydraulic Machinery

Fluid at rest, manometers, hydrostatic pressure thrusts, buoyancy, flotation, stability, scalar and velocity fields, flow field and description of fluid motion, Continuity equation, Momentum equation, energy equation, Euler's equation, Bernoulli equation, Navier-stokes equation, boundary layer equations, momentum-integral equation of boundary layer, Turbulent flow, Work output and efficiency, water turbines, pumps, dimensional analysis

Heat Transfer

Fourier's law of heat conduction, three dimensional heat conduction equation in Cartesian, cylindrical and spherical coordinates, heat conduction with heat generation, fins, unsteady heat conduction with negligible internal temperature gradients, free and forced convection, thermal radiation, boiling heat transfer

Machine Design

Introduction to design, objectives of design, design process, concept of factor of safety in design, design of riveted joints, welded joints, screw jack, design of brakes, gear design, bearing design, Various types of loading in mechanical systems, stress concentration, endurance limit, SN curves and fatigue, manufacturing consideration in design, standardization of design of friction elements, design of internal combustion engine components, introduction to fracture mechanics based design

Manufacturing Technology

Introduction to basic manufacturing processes and engineering materials, casting technologies, introduction to metal cutting, machine processes and machine tools, metal forming, hot working and cold working, forging, extrusion, press-work operations, explosive forming, electromagnetic forming, fabrication of composites, welding, resistance welding, ultrasonic welding, laser beam welding, defects in welding

Material science

Classification of materials, modern and advanced materials, primary and secondary bonds and energy related concepts, structure of metals and ceramics, concept of unit cell and lattice arrangements, ceramic crystals and density computations, crystal systems, polycrystalline materials, and single crystalline material, atomic densities (linear and planar), x-ray diffraction, diffusion mechanism, deformation and strengthening mechanisms, phase diagrams

Industrial Engineering

Productivity, work study, facility layout & location, material management & its techniques, SQC, techniques of operation research

Automatic Control

Open and closed loop systems, servo-mechanisms, block diagram and transfer functions, system response, first and second order systems, response to step and pulse, ramp and sinusoidal inputs, modes of control, stability of control systems, Routh's criteria, frequency response analysis, Bode and Nyquist stability criteria

Instrumentation

Generalized measurement system, standards, calibration, uncertainty, errors, Hydraulic and pneumatic load cells, instruments for high, mid and low pressure measurement, flow measuring devices, temperature sensing techniques

Mathematics

Laplace transforms, numerical Methods, statistics and probability, complex variables, ordinary and partial differential equations, complex variables

DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL NSTITUTE OF TECHNOLOGY SRINAGAR

SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION, Autumn- 2018

A. CORE SUBJECTS (Weightage 50%)

Mass Transfer

Thermodynamics

Process Dynamics And Control

Transport Phenomena

Chemical Reaction Engineering

Heat Transfer

Plant Design

B. ALLIED SUBJECTS (Weightage 25%)

Fluid Mechanics

Environmental Engineering

Energy

C. General Aptitude/ Mathematics (Weightage 25%)

Engineering Mathematics

General Aptitude