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
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).
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.
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.
Syllabus for Ph. D Entrance Test (2018 Session) for ECE Department

Electronics & Communication Engineering Department  
National Institute of Technology Srinagar


**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.


**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, superheterodyne 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


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
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


5. Electric Measurements & Instrumentation

6. Power Electronics

7. Microprocessor & Microcontrollers

8. General Aptitude

9. Engineering Mathematics

(Dr. S. A. Lone)
Prof. & Head
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  
12. Embedded Systems  
13. Information Security  
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.;


**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,

**Structural 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)


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


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 trigonometrical leveling; Theodolite surveying; Tacheometry, Geodetic surveying, areas and volume, curves,
Structural 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;
A. Core Areas (50% Weightage)


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:

5. Tunnelling Technology:


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

**Surveying:** principles of surveying, types of surveying; Leveling and trigonometrical 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 \( \Delta \), 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;
Syllabus for M.Phil/Ph.D. Entrance Exam in Physics for
The Year -2018.

MATHEMATICAL METHODS FOR PHYSICS

Unit I

Complex Variables:

Unit II

Multivalve functions; integral representations

Unit III

Laplace transforms and Green Function


Text Books
4. W.W Bell: Special functions for scientists and engineers.
Unit I
Lagrangian Formulation


Unit II
Central Force Problem


UNIT III
Canonical Transformations


Unit IV
Theory of Relativity


Text Books
5. A.P French: Special Relativity.
QUANTUM MECHANICS

UNIT I

Fundamental Concepts


UNIT II

Angular Momentum

Definition of generalized angular momentum, operators for \( J_x, J_y, J_z \) commutation relation of angular momentum with \( r & p \). Spectrum of Eigen values of \( J^2 \) and \( J_z \), 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 \( J^2, J_x, J_y, J_z \) 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


Text Books
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
CLASSICAL ELECTRODYNAMICS

UNIT I

Electrostatics


UNIT II

Magnetostatics,


UNIT III

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
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 reservoir, expression of entropy, Canonical partition function, Helmholtz free energy, systems in contact with a particle reservoir, 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


Text Books
4. H.B Callen: Thermodynamics and an introduction to thermostatics.
UNIT I

Hydrogen atom Gross Structures:

Schrödinger’s equation, stationary states, Solution of Schrödinger’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:


Forteat 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

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 deutron -The tensor forces.

UNIT II

Experimental Methods of Nuclear & Particle Physics

Interaction of charged particles with matter. Stopping power and range. 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
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.


UNIT III

Operational Amplifiers and Digital Circuits


Text Books
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, Navier-stokes integral 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
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