Department of Computer Science & Engineering
National Institute of Technology Srinagar

I. Syllabus for Entrance Examination (Broad Outline)

1. Programming Language Concepts and Methodology
2. Discrete Mathematics
3. Data Structures
4. Design and Analysis of Algorithms
5. Operating Systems
6. Computer Architecture and Organization
7. Theory of Computation
8. Computer Networks
9. Wireless Communication
10. Artificial Intelligence
11. Network Security
12. Data base Management

II. Specializations

1. Computer Networks and Security
2. Internet of Things
3. Algorithms
4. Machine Learning
5. Theoretical Computer Science
6. Computational Biology
7. Visual Cryptography
DEPARTMENT OF ELECTRICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

No:- NIT/Elect/19
Dated. 08-01-2019

Chairperson,
Computer Service Centre

The following syllabus for setting of question papers for Ph. D admission for Spring session 2-19 may kindly be got uploaded on the Institute web site for information of the concerned candidates positively by today:

Specialization: Power & Energy System/Power Electronics & Electric Drives

Syllabus

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

3. Electric Measurements & Instrumentation
   Renewable Energy – Solar & Wind

4. Power Electronics – Converters
   Microprocessor & Microcontrollers

5. Circuit Analysis – AC & DC

6. Control System – classical & Modern Control.

7. Engineering Mathematics

(Prof. A.P. Hamid Bhat)
Prof. & Head,
Electrical Engineering Department.
**Syllabus for Ph. D Entrance Test (2018 Session) for ECE Department**


**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, 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


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.

DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

Syllabus for Ph.D. Admission–Session: Spring-2019

I. (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

**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;

**Introduction to Finite Element Analysis** various steps in solving a problem by finite Element Method (displacement approach). Two dimensional method elements.; Formulation of the finite element method using (i) Principle of virtual work (ii) Minimization of total potential energy of a system, Discrete Element Method.
II. (Engineering Geosciences and Rock Engineering)

A. Core Areas (50% Weightage) (Earthquake Engineering)


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 ∆, 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;
III. Structural Engineering:

A. **Core Area (Structural Analysis and Design of Structures) (50% Weightage)**


One Dimensional Finite Elements. Stiffness Matrix for the basic Bar & Beam Element.

Finite Element analysis of Two Dimensional Planar Bodies.


Working stress and plastic method concepts of steel design; riveted, bolted and welded connections. Design of steel, tension members, compression members including built up members. Design of steel flexural members, beams, build up sections and plate girders, steel roof truss. Design of Slender Columns, Corbels & Edge (Spandrel) Beams.

Pre-stressing systems and end anchorages, losses of pre-stress. Analysis and design of members for flexure, shear, bond and bearings. Cable layouts. Design of Pre-stressed Bridges.


Network techniques, construction planning, excavation, form works, cofferdams, construction equipments, control on construction, Construction management, industrial development, financing of civil engineering works, engineering economics of projects, organization of civil engineering works, accounting, money banking an trade.

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

Geo-Technical and Transportation Engineering: Introduction to soil hydraulics, soil compressibility, effective stress, stress distribution, shear strength, bearing capacity, clay mineralogy stability of slopes, bearing capacity of foundations, earth pressure, soil stabilization, soil investigation, Dynamic behavior of soils and its impact on foundation design, stability of

Railway bridges, docks and harbors, alignment, geometric design, pavement, design, Traffic engineering, Highway materials and construction, hill roads, airport geometrics, airport pavement design, airport drainage.

**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.

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

**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.
IV. TRANSPORTATION ENGINEERING AND PLANNING (TE&P)

A. Core Area (Weightage = 50%)

Transportation Planning Process & Surveys: transportation study area, zoning & surveys, transportation planning process- inventory, model building.

Travel Demand Estimation: basic planning stages-trip generation, trip distribution, modal split and route assignment, various techniques of demand estimation and analysis.

Landuse-Transportation Models: Location models - opportunity models, accessibility models.

Traffic Engineering & Studies: traffic elements, characteristics-vehicle, road user and road; traffic studies-speed & delay, traffic volume, O & D, parking and accidents, sample size, study methodology, data collection & presentation.

Traffic Analysis: Speed, volume, parking & accident data analysis, statistical approach, traffic maneuvers, different intersections, conflict points, traffic stream characteristics- relationship between speed, flow and density, fundamental equation of traffic flow, level of service & capacity analysis, traffic forecasting.

Traffic Design: Channelisation of islands for different traffic situations, design of rotaries & at-grade intersections, grade separated intersections, their warrants; facilities for pedestrian & bicycle ways.

Traffic Control Devices: Traffic signs, markings and signals; principles of signal design, Webster's method, signal coordination.

Traffic Regulation & Management: Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, management techniques-one-way, tidal flow, turning restrictions etc., road safety measures.
**Highway Geometric Design:** Alignment Issues, Cross section elements, sight distance characteristics, horizontal and vertical alignment, hill roads

**Pavement Mix Analysis:** Bituminous mix design – Marshall stability approach, concrete mix design for roads.

**Pavement Basics:** Types & comparison, vehicular loading pattern, loading pattern on airport pavement, factors affecting design and performance of pavements, airport pavement, environmental impact on pavements, sub grade requirements

**Design of Flexible Pavements:** Analytical approach, flexible pavement layers, ESWL, repetitions of load, techniques of design methods, wheel load analysis, traffic analysis, stress distribution in subgrade soil, Burmister's theories, group index method, CBR approach, IRC guidelines, CRV method, triaxial & McLeod method, present practices.

**Design of Concrete Pavements:** Westergaard’s approach, temperature & frictional stresses, design of expansion & longitudinal joints, design of dowel & tie bars, IRC guidelines, present design practices.

**B. Allied Area (Weightage = 25%)**

Nature of soils, engineering soil behaviour, gradation, porosity, void ratio, atterberg limits, classification, compaction characteristics, consolidation, shear strength, UC etc. Subgrade properties, soil stabilization, strengthening, stress distribution, active and passive pressures.

Highway Drainage: Importance, principles of surface drainage, roadside drains- cross-section; design, drains for hill roads, subsurface drains, capillary cut-off treatment.

Cross Drainage Works: Importance of cross drainage, causeways, culverts & bridges- types; estimation of design discharge, fixation of waterway, foundation depth and spans. Classification of bridges, Selection of bridge sites, Bridge alignment, Sub-surface investigations, Bridge Hydrology, Flood discharge, waterways, scour depth, depth of foundation, standards of loadings, types of loads, impact effect, wind loads, seismic focers, buoyancy, earth pressure, loadings on various bridges, traffic requirements, types of low cost bridges, Settlements, Allowable soil pressures, types of
foundations, foundation failures, foundation setting, cofferdams, superstructure elements, Bridge flooring.

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

(i). General Aptitude
   General aptitude and reasoning

(II). Mathematics
Statistics & Probability Base: Various probability distributions & their applications, parameter estimation, hypothesis testing, random variables, method of maximum likelihood.

Linear & Multi-linear Regression and Correlation Analysis: Estimation and analysis of simple regression models, correlation coefficients, analysis of correlation coefficients.

Basics of numerical methods and optimization.
V. (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;
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.

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 ũ generation and reactions.
4. Mechanism of organic reactions: addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species.


6. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic).


9. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).


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; Hückel 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
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-Hückel 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 nano-science and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.
Syllabus outline for PhD Entrance Examination

Thermodynamics
Zeroth law of thermodynamics, temperature scales, first and second laws of thermodynamics, heat engines, concept of entropy, air & vapour power cycles, nozzles, boilers, steam turbines, compressors, refrigeration and air-conditioning, internal combustion engines, gas turbines

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

Fluid Mechanics & Hydraulic Machinery
Fluid statics, manometers, hydrostatic state of stress, buoyancy, flotation, stability, field description of fluid motion, Continuity equation, Momentum equation, energy equation, Euler’s equation, Bernoulli equation, Navier-Stokes equations, boundary layer theory, momentum-integral equation of boundary layer, Turbulent flow, Work output and efficiency of hydraulic machinery, water turbines, pumps, dimensional analysis and similitude

Theory of Machines
Kinematics & kinetics of mechanisms, lower pairs & higher pairs, mechanisms and DOF, inversions, velocity and acceleration analysis, instantaneous centre, Analysis of governors, flywheels, gears and cams, linear mechanical vibrations, free and forced vibrations, vibrations of multiple degree of freedom systems, vibrations of continuous systems

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,

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 diagrams and transfer functions, system response, first and second order systems, response to step, pulse, ramp and sinusoidal inputs, modes of control, proportional, derivative and integral control, stability analysis of control systems, Routh-Hurwitz criterion, frequency response methods, Bode and Nyquist plots, State-Space analysis of control systems, Controllability, Observability.

Measurements and 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 measurement and sensing techniques

Engineering Mathematics
*Linear Algebra*: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.
*Calculus*: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms, evaluation of definite and improper integrals, double and triple integrals, partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green’s theorems.
*Differential equations*: First order equations (linear and nonlinear), higher order linear differential equations with constant coefficients, Euler-Cauchy equation, initial and boundary value problems, Laplace transforms, solutions of heat, wave and Laplace's equations.
*Complex variables*: Analytic functions, Cauchy-Riemann equations, Cauchy’s integral theorem and integral formula, Taylor and Laurent series.

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


Sd/-
Babar Ahmad
Head, MED
Prospective Research Areas:


Industrial Engineering, Decision Sciences, Ergonomics, Innovations and Entrepreneurship, Data mining and Manufacturing Strategies

Tribology of Ceramics & Nano-Ceramics, Life Cycle Engineering, Tribology & Maintenance Engineering, Aircraft wing vibration, Smart Structures, Finite Elements Method

IC Engine (Performance, Emission and Combustion), Utilization of Bio fuels, Combustion of Alternative fuels, Emission control

Haptics, Robotics, Multi-body Dynamics, Fault tolerant Control System, MEMS (modeling and simulation), Direct Methanol Fuel Cells (DMFCs)

Wear Modeling and Tribology, Nano Lubrication and Materials

Smart Structures and Material Characterization, FEM, Production Technology, Welding, Materials Processing, Machining, Optimization and Modeling, Composites, High temperature Tribology

Sd/-
Babar Ahmad
Head, MED
A. CORE SUBJECTS

Mass Transfer
Molecular diffusion in fluids, mass transfer coefficient in laminar and turbulent flows, mass, heat and momentum transfer analogies, Fick’s law of diffusion. Gas liquid operations-humidification, gas absorption, distillation, extraction, crystallization, multi component distillation.

Process Thermodynamics
First law of Thermodynamics, Second law of Thermodynamics, gas and vapour mixtures, reactive mixtures, Thermo-physical properties of pure fluids. Equilibrium properties.

Transport Phenomena
Definition of transport properties, their measurement and estimation. Shell balance approach for developing equations for moment, heat & mass transport. Solution of problems involving transport in one dimension.

Chemical Reaction Engineering

Fluid Mechanics

Heat transfer
Conduction, convection and radiation, Process design considerations, Double pipe, Shell & tube & Compact heat exchanger design.

Biochemical Engineering
Kinetics of fermentation, bioreactor design, sterilization, bio-separation, cell structure, media formulation. Enzyme Kinetics, Structure function & usage of carbohydrates, proteins, DNA & RNA.
B. ALLIED SUBJECTS

**Polymer Science and Technology**
Chemistry of Polymerisation Reaction, Polymerisation Kinetics, Molecular Weight Estimation, Polymerisation Processes.

**Environmental Engineering & Waste management**
Ecology and Environment, Sources of air, water and solid Wastes, Air Pollution. Fate of pollutants, air pollution control technologies centrifugal collectors, electrostatic precipitators, bag filter, & wet scrubber. Combustion generated pollutants, vehicle emission control. Water Pollution.

**Petrochemical Technology**

**Food Technology**
Food Processing and Preservation, Chemistry of Food, Sensory Evaluation of Food, Food Microbiology and Food Safety, Food Engineering and Packaging, Technology of Plant and Animal Foods

**Conventional and Non Conventional sources of Energy**
Fossil fuels, alternate sources of energy, energy management in process industries, characterization of fuels. Bioenergy.

**Safety in Process Industries**

C. General Aptitude/ Mathematics.
1. Laplace Transforms
2. Numerical Methods
3. Statistical Methods- Bayes Theorem
4. Complex Variables & Special Functions
Metallurgical and Materials Engineering Department  
National Institute of Technology Srinagar

Dean Academic  
NIT Srinagar  

Syllabus for Ph.D Entrance Examination for Metallurgical & Materials Engineering  
Department, January 2019 / Spring 2019

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<td>2</td>
<td>Diffusion in solids, Fick's laws and Kirkendall effect.</td>
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<td>3</td>
<td>Heat treatment - various processes and their applications.</td>
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<tr>
<td>4</td>
<td>Blast furnace stoves and blast preheating. Physico-Chemical principles involved in direct and indirect reduction of iron.</td>
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<tr>
<td>5</td>
<td>Steel making by Bessemer and side blown converters O.H and Duplex/Triplex methods, Electric-Arc and Induction processes.</td>
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Dr. Atikur Rahman  
HOD MMED  

HEAD  
Metallurgical & Materials Engineering Department  
National Institute of Technology Srinagar  
Hazratbal, Srinagar, Kashmir-190006
I. Mathematical Methods of Physics


II. Classical Mechanics


III. Electromagnetic Theory


IV. Quantum Mechanics


V. Thermodynamic and Statistical Physics