NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR
OFFICE OF THE REGISTRAR

No. NITS/Estt/Advt/Non-teaching/2023/01 Date: 13.02.2026

NOTIFICATION

The written tests for the post of **Technical Assistant** advertised vide no. NITS/Estt/Advt/Non-Teaching/2023/01 dated 07.07.2023 will be held as per the following schedule:

Date of Examination: 07th March, 2026

Reporting Time: 08:30 AM

Starting Time of Written Test: 10:00 AM onwards

Venue of written Test: New Gallery (Opposite to SBI), NIT Silchar

The online link for downloading the admit card will be made available soon in the institute website. By accessing the link, candidates must select the respective name of the department in which he/she will appear for the written test, after which the admit card can be downloaded. Selection of department once made is final and cannot be changed later.

Candidates can download and take a print of the admit card. He/she must carry a hard copy to the venue along with a valid photo ID proof.

No candidate will be allowed to appear for the tests without the admit card and valid photo identification proof.

All candidates are asked to go through the instructions mentioned in the admit card. For any queries, candidates can sent an email to ***staff_recruitment@nits.ac.in.***

The scheme of written test for the post of **Technical Assistant** is given below:

The examination will be conducted in **two phases**, starting from 10.00 am onwards as outlined below:

Name of the Post	**Technical Assistant**
Date of Written Test	**07.03.2026**
Scheme of Written Test	1. Objective-type test (MCQ) consisting of 80 questions. 2. **Total Marks**: 160 (each question carries 02 marks). 3. **Criteria**: • **General Aptitude (Section-I)** : Questions- 40 Marks - 80 Duration: 01 Hour • **Domain Knowledge (Section-II)**: Questions: 40 Marks - 80 Duration: 01 Hour 4. **Negative Marking**: 0.5 marks will be deducted for each incorrect answer. Unanswered questions will not attract negative marks.

Written Test (Section I) will be qualifying in Nature for evaluation of **Written Test (Section II**). Qualifying marks to be decided on the basis of performance of the candidates.

Evaluation of Written Test (Section-II) will be done only for those candidates who qualifies in **Written Test (Section-I**).

Candidates must appear both the written tests.

The marks obtained in **(Section I) (**General Aptitude) shall be treated as qualifying only. Final Merit list will be drawn on the basis of marks secured by the candidates in **Written Test (Section-II**) (Domain Knowledge).

The distribution of 23 posts of Technical Assistant among various departments is given below:

Sl. No.	**Department**	**Number of Technical Assistant assigned**
1	Civil Engineering	03
2	Mechanical Engineering	03
3	Electronics & Comm. Engineering/ Electronics & Instrumentation Engineering	06
4	Computer Science Engineering	05
5	Electrical Engineering	03
6	Physics	01
7	Chemistry	01
8	Mathematics	01

SYLLABUS OF WRITTEN TEST FOR TECHNICAL ASSISTANT

Broad Syllabus of General Aptitude for the post of Technical Assistant:

General Awareness: Includes questions relating to the Indian constitution, geography, economics, general policy, science & scientific research, national/ international organisations/ institutions, current events, environment etc., questions related to the NIT structure and statutes etc.

Reasoning: Includes questions relating to both verbal and non-verbal types, analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship, concepts, arithmetic reasoning, verbal & figure classification, arithmetical number series etc.

Quantitative Aptitude: Includes questions relating to simplification, decimals, fractions, LCM, HCF, ratio & proportion, percentage, average, profit & loss, discount, simple & compound interest, mensuration, time & work, time & distance, tables & graphs, solving algebraic equations.

BROAD SYLLABUS OF DOMAIN KNOWLEDGE FOR THE POST OF TECHNICAL ASSISTANT

DEPARTMENT OF CIVIL ENGINEERING

Engineering Surveying

Introduction: Classification, Principles of Surveying, Types of Surveying.
Chain and compass survey: Distance measurement, Instruments, Adjustments, Angular measurements, Latitude and departure, Compass traversing.
Accuracy and errors: Errors and corrections in Chain and compass survey.
Levelling: Instruments, Adjustments, Levelling principles, Long sections, Cross sections, Reciprocal levelling.
Theodolite Traversing: Details of instruments, Adjustments, Angular measurement, Horizontal and vertical traversing.
Contouring: Characteristic, Methods & uses.
Plane Table surveying: Equipment, Principles, Operation, Methods, Errors, Advantage and disadvantages.
Tacheometric Survey: Principles, Stadia and Tangential methods.
Curves: Classification, Setting out of circular curve, setting out of Transition curve.
Total Station: Parts, Advantages and Applications, Field Procedure for total station survey

Engineering Materials and Testing

Characteristics of good building stones, gradation of aggregates, classification and testing of bricks, types of tiles/ terracotta/ Stoneware, types of cement, chemical composition and manufacturing process of cement, types of painting, Stress-strain characteristics of mild steel and HYSD bars, yield stress and proof stress, concrete mix design, admixture, types of testing performed using universal testing machine (UTM).

Solid Mechanics and Structural Analysis

Poisson's ratio, modulus of elasticity, shear modulus of elasticity, compound stresses/ strains, principal stress/ strain, concept of orthotropic material (a non-isotropic material), governing equation for bending of beam, governing equation for torsion of circular shaft, short/ long column, Euler's column buckling formula. Determinate/ indeterminate structures, analysis of determinate truss, shear force and bending moment diagram for determinate beams, deflection of beam (simply supported beam and cantilever).

RCC Design

Basic difference between the working stress method and the limit state design method, prescribed limit state for singly reinforced RC section under bending (IS 456: 2000), reinforcement for balanced RC section, moment of resistance, requirement for doubly reinforced RC section, shear reinforcement for beam, minimum eccentricity for column design, use of interaction diagram of axial load and moment for column design, reinforcement details for slab.

Fluid Mechanics and Hydraulic Engineering

Fluid properties and definitions; fluid statics- hydrostatic pressure, measurement of pressure, pressure on submerged surfaces, buoyancy; fluid kinematics; continuity momentum and energy equations applicable to fluid flow; viscous flow; flow in pipes; pipe networks; losses in pipes; Hydraulic Losses; open channel flow- uniform flow, best channel sections, energy-depth relationships, specific energy, critical flow, gradually varied flow, hydraulic jump; basics of hydraulic machines- pumps and turbines; Bernoulli's Principle & Equation.

Hydrology and Flood Flow

Hydrology cycle; precipitation; evaporation; evapotranspiration; infiltration; watershed; Runoff components; hydrograph and its components; unit hydrograph; stream-flow measurement; occurrence of ground water; soil-water relationship; aquifers; application of Darcy's law; yield from wells for confined and unconfined aquifers; flood estimation- rational, empirical and unit hydrograph methods, design flood; river training works; dams and embankments. Design of lined and unlined canals; head works; design of weirs; water logging and drainage; canal regulatory works- cross- drainage structures, outlets and escapes.

Water Supply Engineering

Water uses; quantity requirements; sources of water-surface and subsurface sources and their characteristics; water quality; drinking water standards; treatment of water- sequence of treatments, aeration, sedimentation, coagulation and flocculation, filtration, disinfection, hardness and chemical softening, base exchange process; principles and methods of design of water distribution systems.

Waste Water Engineering

Quantity of sanitary sewage; sewerage systems and their design principles; sewer construction materials; sewer appurtenances; characteristics of domestic sewage; waste water treatment-methods and their sequence, preliminary treatment, primary treatment, secondary treatment; waste water disposal.

Engineering Drawing

IS code of drawing; Conics and Engineering Curves – ellipse, parabola, hyperbola, cycloid, trochoid, involute; projection of lines – traces, true length; projection of planes and solids; sold objects – cube, prism, pyramid, cylinder, cone and sphere; projection on Auxiliary planes; Isometric projection, isometric scale; section of solids – true shape of section; Top view of solids: Introduction to CAD tools – basics; Introduction of Development and Intersection of surfaces.

Geotechnical Engineering

Origin of soil, phase diagram, void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, grain size distribution. Index properties of soils, Atterberg's limits, soil classification and plasticity chart. Permeability of soil, coefficient of permeability, unconfined and confined aquifers, effective stress, quick sand. Soil compaction, laboratory compaction test, maximum dry density and optimum moisture content. Consolidation of soils, principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, vane shear test, triaxial test. Earth pressure theories, active and passive earth pressures. Shallow and deep foundations, types of shallow foundation, types of deep foundation, bearing capacity of soils, plate load test, standard penetration test, capacity of piles, dynamic Engineering News formula, Hiley's formula, static formula. Soil exploration, trial pits, boring, disturbed and undisturbed samples, presentation of soil investigation result.

Estimation and Costing

Specification of works and materials, estimates, different types, analysis of rates, methods and unit of measurement, method of measurement for different items of work and materials, present market rates of materials & unit rate of items of work, floor area, carpet area and plinth area, F.A.R. Items of work – earthwork, brick work (modular and traditional bricks), RCC work, shuttering, timber work, painting, flooring, plastering, boundary wall, brick building, water tank, septic tank, bar bending schedule, centre line method, mid-section formula, trapezodial formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, hube well, isolates and combined footings, steel truss, piles and pile-caps. Contracts – different types, contract documents, submission and opening of tender, earnest money, security deposit, measurement book, work order book, imprest and temporary advance, material at site account, suspense account. Valuation – value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

Highway Engineering

Introduction to Transportation Engineering: Importance of transportation in national development; Modes of transportation and their characteristics; Role of road transport in India and its socio-economic impact; Scope and applications of highway engineering.
Highway Development and Planning: History of road development in India; Highway planning and alignment surveys; urban transportation planning and road network planning.
Highway Materials and Testing: Types of highway materials: aggregates, bitumen; Tests on aggregates (impact, abrasion, crushing, shape); Bitumen tests (penetration,

ductility, softening point, viscosity) - IS: 1201 to IS: 1220; IRC: SP: 53; California Bearing Ratio Test – IRC: SP: 89.
Geometric Design of Highways: Design of cross-sectional elements (camber, shoulders, road margins, kerb, ROW) – IRC: SP: 73; Sight distances (stopping and overtaking) – IRC: 66; Horizontal and vertical curves; Super elevation.
Basics of Traffic Engineering: Traffic volume, speed, and origin-destination surveys – IRC: 102; Traffic signs, signals, road markings – IRC 35, IRC: 67; Basics of parking studies, and pedestrian facilities.
Pavement Design and Construction: Types of pavements - Flexible and rigid pavements; Pavement components and design factors – IRC: 37 (flexible), IRC: 58 (rigid); Construction practices and quality control tests.

DEPARTMENT OF ELECTRICAL ENGINEERING

Outline of the Subjects/Topics Covered:

Basic concepts, Circuit law, Magnetic Circuit, AC Fundamentals, Measurement and Measuring
instruments, Electrical Machines, Fractional Kilowatt Motors and single-phase induction Motors, Synchronous Machines, Generation, Transmission and Distribution, Estimation and Costing, Utilization and Electrical Energy, Basic Electronics, Switchgear & Protection, Electrical Engineering materials.

Detailed syllabus:

1. Basic concepts: Concepts of resistance, inductance, capacitance, and various factors affecting them. Concepts of current, voltage, power, energy and their units.
2. Circuit law**:** Kirchhoff's law, Simple Circuit solution using network theorems.
3. Magnetic Circuit: Concepts of flux, mmf, reluctance, Different kinds of magnetic materials, Magnetic calculations for conductors of different configuration e.g. straight, circular, solenoidal, etc. Electromagnetic induction, self and mutual induction.
4. AC Fundamentals: Instantaneous, peak, R.M.S. and average values of alternating waves, Representation of sinusoidal wave form, simple series and parallel AC Circuits consisting of R.L. and C, Resonance, Tank Circuit. Poly Phase system – star and delta connection, 3 phase power, DC and sinusoidal response of R-Land R-C circuit.
5. Measurement and measuring instruments: Measurement of power (1 phase and 3 phases, both active and re-active) and energy, 2 wattmeter method of 3 phase power measurement. Measurement of frequency and phase angle. Ammeter and voltmeter (both moving oil and moving iron type), extension of range wattmeter, Mustimeters, Megger, Energy meter AC Bridges. Use of CRO, Signal Generator, CT, PT and their uses. Earth Fault detection.
6. Electrical Machines: (a) D.C. Machine – Construction, Basic Principles of D.C. motors and generators, their characteristics, speed control and starting of D.C. Motors. Method of braking motor, Losses and efficiency of D.C. Machines. (b) 1 phase and 3 phase transformers – Construction, Principles of operation, equivalent circuit, voltage regulation, O.C. and S.C. Tests, Losses and efficiency. Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase /3 phase transformers. Auto transformers. (c) 3 phase induction motors, rotating magnetic field, principle of operation, equivalent

circuit, torque-speed characteristics, starting and speed control of 3 phase induction motors. Methods of braking, effect of voltage and frequency variation on torque speed characteristics.

7. Fractional Kilowatt Motors and Single-Phase Induction Motors: Characteristics and applications.
8. Synchronous Machines: Generation of 3-phase e.m.f. armature reaction, voltage regulation, parallel operation of two alternators, synchronizing, control of active and reactive power. Starting and applications of synchronous motors.
9. Power Systems: Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, short circuit current for symmetrical faults. Switchgears – rating of circuit breakers, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage / over current, etc. Buchholtz relay, Merz-Price system of protection of generators & transformers, protection of feeders and bus bars. Lightning arresters, various transmission and distribution system, comparison of conductor materials, efficiency of different system. Cable – Different type of cables, cable rating and derating factor, faults detection in cables. Various types of insulators for overhead lines and switchgear.
10. Estimation and costing: Estimation of lighting scheme, electric installation of machines and relevant IE rules. Earthing practices and IE Rules.
11. Utilization of Electrical Energy: Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.
12. Basic Electronics: Working of various electronic devices e.g. P N Junction diodes, Transistors (NPN and PNP type), BJT and JFET. Simple circuits using these devices.
13. **Switchgear & Protection:** Different types of Relays for Line, Generator and transformer protection, different types of switchgears for power system, Line faults, transformer faults.
14. **Electrical Engineering material:** Different types of electrical materials – Conductor, insulators, dielectric materials, properties of the electrical engineering materials.
15. **Maintenance of Appliances:** Maintenance of DG, Underground cables, overhead lines and electrical panels.

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT-I **Introduction to Mechanical Engineering**

Basic areas and concepts of Mechanical Engineering, Role of mechanical engineers in industries and society

UNIT-II **Engineering Mechanics and Solid Mechanics**

Units & Dimensions, Dynamics, Circular motion, Forces, Rotational dynamics, Simple stress & strain, Shear stress & strain, Thermal stress & strain, Friction, Properties of sections, Torsion of shafts & springs, Theory of simple bending and deflection of beams.

UNIT-III **Thermal Science & Its Applications**

Thermodynamic systems and processes; Temperature and Zeroth law of thermodynamics; Thermodynamic concept of energy; Modes of work and heat transfer; Statements of zeroth, first, second and third law of thermodynamics and their applications. Thermodynamic air cycles, Steady flow energy equation and applications, Air compressors, Fuels, Combustion of fuels. I.C engines, Performance of I.C engines, Steam boilers, Nozzles and turbines, Heat transfer.

UNIT-IV **Fluid Mechanics and Hydraulic Machineries**

Properties of fluids, Fluid pressure and its measurement, Kinematics and dynamics of fluid flow, Flow through orifices, notches, pipe, & nozzles. Fluid power: Hydraulic system, Pumps, Turbines.

UNIT-V **Refrigeration and Air Conditioning**

Principle of Refrigeration, Air Refrigeration System, Vapour compression refrigeration cycle. Refrigeration equipments, Refrigerants, Application of refrigeration, Air conditioning, Low temperature refrigeration. Principle of psychometry.

UNIT-VI **Power Plant Engineering**

Steam Generators, Properties of steam, Thermodynamic vapour cycle, Steam engine, Steam turbines, Steam condensers, Gas turbine, Diesel power plant, Nuclear power engineering, Renewable sources engineering.

UNIT-VII **Design Elements in Mechanical Engineering**

Mechanical Properties, Stress and strain, elastic constants, thermal stresses, beams; mechanisms and linkages, degree of freedom, cam, gear, gyroscope; Introduction to machine elements: riveted and welded joints, shafts and coupling, rolling and sliding contact bearings, pressure vessel.

UNIT-VIII **Materials & Manufacturing**

Engineering materials, classification of materials, engineering applications of materials, material properties, selection of materials. Introduction to manufacturing, the need for manufacturing, the basics of various manufacturing processes: casting, welding, forming, machining, etc., selection of manufacturing processes, and application to industries. Computer Aided Design and geometric modelling, Computer aided manufacturing methods. Basics of robotics, Flexible Manufacturing system. Basic concepts of NC and CNC, Programming CNC machines, Machining Centres & Turning Centres, Broaching machines, Gear manufacture, Press tool, Processing of plastics, Jigs & Fixtures, Jig boring, Grinding, Surface finishing methods, Non-conventional machining, Powder metallurgy, Additive manufacturing

UNIT-IX **Industrial Engineering & Management**

Organisation structure, Production planning and control, Inspection & Quality control. Control charts, Estimating and costing, Value Engineering, Material handling, Plant maintenance.

UNIT-X **Machine Drawings**

Fundamentals of Engineering drawings, Dimensioning, Tolerances, Standard symbols used in drawings, Fits, Process sheets, etc.

Mathematical Methods: Calculus of single and multiple variables, partial derivatives, Jacobian, imperfect and perfect differentials, Taylor expansion, Fourier series. Vector algebra, Vector Calculus, Multiple integrals, Divergence theorem, Green's theorem, Stokes' theorem. Matrices and determinants, Algebra of complex numbers.

Mechanics and General Properties of Matter: Newton's laws of motion and applications, Velocity and acceleration in Cartesian, polar and cylindrical coordinate systems, uniformly rotating frame, centrifugal and Coriolis forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. System of particles, Centre of mass, equation of motion of the CM, conservation of linear and angular momentum, conservation of energy, variable mass systems. Elastic and inelastic collisions.

Oscillations, Waves and Optics: Differential equation for simple harmonic oscillator and its general solution. Superposition of two or more simple harmonic oscillators. Lissajous figures. Damped and forced oscillators, resonance. Wave equation, traveling and standing waves in one- dimension. Energy density and energy transmission in waves. Group velocity and phase velocity. Sound waves in media. Doppler Effect. Fermat's Principle. General theory of image formation. Thick lens, thin lens and lens combinations. Interference of light, optical path retardation. Fraunhofer diffraction. Rayleigh criterion and resolving power. Diffraction gratings. Polarization: linear, circular and elliptic polarization. Double refraction and optical rotation.

Electricity and Magnetism: Coulomb's law, Gauss's law. Electric field and potential. Electrostatic boundary conditions, Solution of Laplace's equation for simple cases. Conductors, capacitors, dielectrics, dielectric polarization, volume and surface charges, electrostatic energy. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction, Self and mutual inductance. Alternating currents. Simple DC and AC circuits with R, L and C components. Displacement current, Maxwell's equations and plane electromagnetic waves, Poynting's theorem, reflection and refraction at a dielectric interface, transmission and reflection coefficients (normal incidence only). Lorentz Force and motion of charged particles in electric and magnetic fields.

Modern Physics, Solid State Physics, Devices and Electronics: Blackbody radiation, photoelectric effect, Compton effect, Bohr's atomic model, X-rays. Wave-particle duality, Uncertainty principle, the superposition principle, calculation of expectation values, Schrodinger equation and its solution for one dimensional box. Reflection and transmission at a step potential, Pauli Exclusion Principle. Structure of atomic nucleus, mass and binding energy. Radioactivity and its applications. Laws of radioactive decay. Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law; Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. Fermi level. P-n junction diode, I-V characteristics, Zener diode and its applications, BJT: characteristics in CB, CE, CC modes. Single stage amplifier, two stage R-C coupled amplifiers, OPAMP and applications: Inverting and non-inverting amplifier. Boolean algebra: Binary number systems; conversion from one system to another system; binary addition and subtraction. Logic Gates AND, OR, NOT, NAND, NOR and XOR; Truth tables; combination of gates; de Morgan's theorem.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Basic of C programming language: Fundamental concepts like data types, operators, control flow (if/else, loops), functions, arrays, strings, and pointers

The concept of object-oriented programming language: Fundamental OOP concepts like classes, objects, inheritance, polymorphism, and encapsulation,C++

Concept of DBMS: data modeling, database design, relational algebra and calculus, SQL, transaction management, concurrency control, and data storage and retrieval

Concept of Operating Systems: Fundamental concepts like process management, memory management, file systems, and I/O systems, along with process synchronization and deadlock handling; case study on windows operating system and Linux operating system

Basics of cyber security: network security, cryptography, risk management, incident response, and cloud security

Basics of Networking: Fundamental concepts like network types, topologies, OSI model, TCP/IP, routing, switching, network management, protocols, security, wireless networking, IPv6. Practical skills like network installation, configuration, troubleshooting, Network Monitoring, Familiarization of Networking Devices(Switch,Hub,Router etc)

MS Office: MS Word, MS Excel, MS PowerPoint

Knowledge of Computer Hardware and software

(DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING AND DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING)

1. **Basic Electrical Engineering:** DC Networks, Single phase AC circuits, Magnetic circuits, Three-phase AC circuits.

2. **Network Theory:** Overview of Network Theorems, Two Port Networks and Network functions, Resonance and Coupled circuits, Laplace Transform for Network Analysis, Network Synthesis, Network Topology, Passive Filter.

3. **Electronic Circuits:** Amplifiers Design and Analysis – Single Stage and multi stage, Feed Back Amplifier, Oscillators.

4. **Electronic Devices:** Energy Bands and Charge Carriers in Semiconductors, PN Junction Diode, Bipolar Junction Transistors, Field Effect Transistors.

5. **Analog System Design:** Fundamentals of Operational Amplifier, Linear Op-amp Circuit, Non-linear Circuit Applications, Signal Generators, Limitations of Practical Op-amps, Voltage Reference, Voltage Regulators, D/A and A/D converters, Active Filters.

6. **Digital Electronic Circuits:** Basics of Digital Electronics Circuits, Logic gates, Boolean Algebra, Combinational logic circuits, Sequential logic circuits, Logic Families.

7. **Signals and Systems:** Basic of Signals and Systems, LTI Systems, Fourier Analysis-continuous time, Sampling and Reconstruction, Laplace Transform & Z-Transform

8. **Analog Communication:** Amplitude Modulation, Angle Modulation, Radio Receivers, Noise, Pulse Modulation

9. **Digital Communication:** DM (Delta Modulation), DPCM (Differential Pulse Code Modulation)

10. **Electromagnetic Theory, Basic Concepts**

11. **Microprocessor:** Architecture of Microprocessor, Programming of Microprocessor, Data Transfer, Interfacing, Advanced microprocessors

12. **Microcontrollers and Embedded System:** Basics of Microcontrollers, 8051 Microcontroller

13. **Instrumentation and Electronic Measurements:** Measurement and Error, Bridges, Electromagnetic Instruments (D-Arsonval, etc), Electronic Instruments (Multimeter, Frequency Meter, Oscilloscopes, Digital Storage Oscilloscopes, etc)

14. **(A) Control System:** Basic elements of control system, Control system terminology, Mathematical Model, Transfer function; Feedback control system, Open loop and close loop transfer function, Error transfer function, Poles and zeros of a transfer function, Order and type of a system, Characteristic equation , characteristic roots of a system, Close loop stability of a system; Block diagram and block diagram reduction technique; Signal Flow graph, Mason's Gain Formula

    (B) Analysis of Control System: Standard Test signals, impulse response of a system, step and ramp response of a first order system, step response of a 2^{nd} order system, Transient response specification of a second order system; Static Error analysis, Classification of close loop system based on type number, Steady state error and Static error coefficients-Position error constant, velocity error constant and acceleration error constant. Steady state error of type-0, type-1 and type-2 system with unit step ramp and unit parabolic signal.

    (C) Stability Theory: Concept of stability, Effect of location of poles on stability, Necessary conditions of stability, Routh-Hurwitz criterion, Routh's test-difficulties and remedies.

    (D) Root Locus Method: Open loop and close loop pole of a system, Angle and magnitude condition of a transfer function, Properties of root locus, Rules for construction of root locus.

15. **Power Electronics:** Semiconductor switches devices- SCR , TRIAC, GTO, IGBT, SCR Characteristic , Triggering and commutation circuit, Turn-On and Turn-Off Characteristics of SCR

Controlled rectifier using SCR, Half control and Full control. Three Phase Circuit- Three phase, three pulse, three phase six pulse, three phase twelve pulse circuit. Inverter circuit- Basic principle, Series inverter, parallel inverter circuit using SCR, DC to DC conversion, Chopper circuit, Step up chopper , AC to AC conversion, Cyclo-Converter, single phase and three phase circuit.

AC and DC motor speed control. Basic Principle of speed control, various method of speed control

16. **Optical Fibre(Optoelectronics):** R1 profile, modes of optical fibre, Ray theory of transmission, Total internal reflection, acceptance angle, NA, skew rays, Numerical problems, Fibre attenuation and losses, absorption, scattering, bend losses, dispersion, numerical problems.

Fibre couplers, LED & LASER source, PIN diodes, APD detectors, Attenuation, dispersion, R1 profile, NA, scattering.

DEPARTMENT OF MATHEMATICS

Differential Calculus: Limit of a function, algebra of limits, related results and problems, continuity (ε - δ definition), related theorems and problems, types of discontinuities, differentiability of functions, successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions, Tangents and normals, subtangents and subnormals, radius of curvature, tracing of Cartesian and parametric curves, Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x, $\log(1 + x)$, $(1 + x)^m$, Maxima and Minima Indeterminate forms.

Differential Equations: First order exact differential equations, Integrating factors, rules to find an integrating factor, First order higher degree equations solvable for x, y, p, Methods for solving higher – order differential equations, basic theory of linear differential equations, Solving a differential equation by reducing its order linear homogeneous equations with constant coefficients, linear non – homogeneous equations, the method of variation of parameters, The Cauchy – Euler equation, simultaneous differential equations, Total differential equations, Order and degree of partial differential equations, concept of linear and non – linear partial differential equations, Formation of first order partial differential equations.

Real Analysis: Finite and infinite sets, examples of countable and uncountable sets, Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, Intervals, open and closed subsets of R, their properties, nested interval theorem, concept of cluster points and Bolzano – Weierstras theorem, Real sequence, Bounded Sequence, Cauchy Convergence Criterion for Sequences, Cauchy's theorem on limits, Order preservation and squeeze theorem, Monotone sequences and their convergence, infinite series, Cauchy convergence criterion for series, positive term series, Geometric series, Comparison test, Convergence of p-series, Root test, Ratio test, Alternating series, Leibnitz's test, Definition and examples of absolute and conditional convergence, Sequential criterion of limit and

continuity and the equivalence of sequential criterion with epsilon – delta definition, properties of continuous functions, related theorems on continuous functions.

Abstract Algebra: Definition, examples and properties of groups, examples of abelian and non – abelian groups, the group Z_n of integers under addition modulo n, the group *U(n)* of units under multiplication modulo n, group of complex roots of unity, the general linear group GL(n, R), Cyclic groups, subgroups and related theorems, problems, Cosets and their properties, Index of subgroup, Lagrange's theorem, order of an element of a group, Normal subgroups: their definition, examples and characterizations, Quotient groups, group homomorphism: definition, example and related problems, Rings, Integral domains and Fields : Definitions, properties, examples and related theorems.

Linear Algebra: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, Linear transformations, null space, range, rank and nullity of a linear transformation, matrix of a linear transformation, Algebra of linear transformations, isomorphisms, isomorphism theorems, invertibility and isomorphisms, Eigenvalues, eigenvectors and eigen space of a linear operator, invariant subspaces, Cayley-Hamilton theorem, Inner product spaces, norm generated by inner product, Cauchy-Scwartz's inequality, Bessel's inequality.

Classical Algebra & Trigonometry: Idempotent, nilpotent, involutory matrices, transpose of a matrix, conjugate of a matrix, symmetric and skew symmetric, Hermitian , skew Hermitian, orthogonal, unitary matrices; Adjoint of a square matrix , Jacobi's Theorem ; inverse of a square matrix, Elementary transformation on matrices , rank of a matrix ,echelon form, normal form, elementary matrices, inverse of a matrix from elementary matrices; Solution of a system of linear equations by matrix inverse and by Gaussian elimination method, Descartes' rule of signs, relation between roots and coefficients of polynomial equations, symmetric functions of roots, transformation of equations, reciprocal and binomial equations, De-Moivre's theorem (for rational indices), Expansions of sin $n\theta$, cos $n\theta$, Expansions of sin θ, cos θ in ascending powers of θ, Functions of complex arguments, Gregory's series; summation of trigonometric series; Hyperbolic functions.

Linear Programming: Formulation of LPP and its graphical solution (including the cases of unbounded feasible region and multiple optimal solutions); Convex sets and their properties; Slack and surplus variables, Standard form of an LPP, Simplex method; Artificial variables techniques : Big M method and two-phase method, related problems, Duality, formulation of the dual problem, primal-dual relationships, theorems on duality; Transposrtaion problems : mathematical formulation and methods of determining initial basic feasible solution - North West corner, Row minima, Column minima, matrix minima, Vogel's approximation methods; Unbalanced transportation problems, Optimality tests for transportation problems and MODI method for obtaining optimal solution, degeneracy in transportation problems; Assignment problems, Hungarian method of solution, Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Integral Calculus: Integration as the reverse of differentiation, integration by substitution, integration of rational functions, Definite integrals and their properties, definite integral as the limit of a sum, Reduction formulae, derivations and illustrations of reduction formulae of the type R $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n\,dx$, $\int \sin^m x \cos^n x\,dx$, $\int \sin^m x \cos nx\,dx$, Cartesian and Parametric

equations of plane curves, rectification of plane curves, Areas of surfaces of revolution and volumes of solids of revolution.

Vector Analysis: Scalar and vector triple products of vectors, Vector equations of lines, planes and spheres, Vector functions, limits, continuity and differentiation of vector functions, related problems, Gradient, Divergence and Curl, their identities and related problems, Integration of vector functions, line integrals, related problems, Applications of vectors: Tangential and normal components of velocity and acceleration, conservation of momentum and energy, principle of work.

Analytical Geometry: Change of origin, rotation of axes, invariants in orthogonal transformation, pair of straight lines, bisector of angles between pair of straight lines, Orthogonal circles, radial axis, radical centre of three circles, circles through intersection of two circles, circles through intersection of a circle and a straight line, condition of tangency of a straight line to a circle, Properties of parabola, ellipse and hyperbola, equations of chords, tangents and normals, polar equation of a conic, Shortest distance and equation of shortest distance line, general equation of a sphere, sphere through origin and having intercepts on the axes, section of a sphere by a plane, great circle, sphere through a given circle, the curve of intersection of two spheres, tangent plane to a sphere at a given point on it, Equations of Cones and cylinders, related problems.

DEPARTMENT OF CHEMISTRY

Physical Chemistry

Atomic and Molecular Structure: Planck's black body radiation, Photoelectric effect, Bohr's theory, de Broglie postulate, Heisenberg's Uncertainty Principle; Schrödinger's wave equation (including mathematical treatment), postulates of quantum mechanics, normalized and orthogonal wave functions, its complex conjugate (idea of complex numbers) and significance of Ψ^2; Operators; Particle in one- dimension box, radial and angular wave functions for hydrogen atom, radial probability distribution; Finding maxima of distribution functions (idea of maxima and minima), energy spectrum of hydrogen atom; Shapes of s, p, d and f orbitals; Pauli's Exclusion Principle; Hund's rule of maximum multiplicity.

Gaseous State: Kinetic molecular model of a gas: collision frequency; collision diameter; mean free path and viscosity of gases; Maxwell-Boltzmann distribution: molecular velocities, law of equipartition of energy, molecular basis of heat capacities; Ideal gases, and deviations from ideal gas behaviour, van der Waals equation of state; critical state, law of corresponding states.

Liquid State: Physical properties of Liquid, vapour pressure, surface tension and co-efficient of viscosity and their applications; effect of concentration of solutes on surface tension and viscosity; effect of temperature on viscosity of liquids.

Solid State: Unit Cells, Miller indices, crystal systems and Bravais Lattices, elementary applications of vectors to crystal systems; X-ray diffraction, Bragg's Law, Structure of NaCl, CsCl, and KCl, diamond, and graphite; Close packing in metals and metal compounds, semiconductors, insulators; Defects in crystals, lattice energy; isomorphism; heat capacity of solids.

Chemical Thermodynamics: Mathematical treatment: Exact and in-exact

differentials, partial derivatives, Euler's reciprocity, cyclic rule; Reversible and irreversible processes; Laws of thermodynamics, thermochemistry, thermodynamic functions, such as enthalpy, entropy, and Gibbs free energy, their properties and applications; Partial molar quantities, dependence of thermodynamic parameters on composition, Gibbs Duhem equation, chemical potential and its applications.

Chemical and Phase Equilibria: Law of mass action; K_p, K_C, K_X and K_n; Effect of temperature on K; Le-Chatelier principle; Ionic equilibria in solutions; pH and buffer solutions; Salt hydrolysis; Solubility and solubility product; Acid – base titration curves; Indicators; Dilute solutions; Raoult's and Henry's Laws and their applications; Colligative properties; Gibbs phase rule; Phase equilibria; single and two- component phase diagrams.

Electrochemistry: Conductivity, equivalent and molar conductivity and their properties; Kohlrausch law; Debye Hückel-Onsager equation; Ionic velocities, mobilities, transference numbers; Applications of conductance measurement; Quantitative aspects of Faraday's laws of electrolysis, applications of electrolysis in metallurgy and industry; Electromotive

force of a cell, Nernst equation; Standard electrode potential, Electrochemical series; Concentration cells with and without transference; Applications of EMF measurements including potentiometric titrations.

Chemical Kinetics: Order and molecularity of a reaction, differential and integrated form of rate expressions - basic ideas of integration and differentiation; Kinetics of opposing, parallel, and consecutive reactions; Steady state approximation in reaction mechanisms; Chain reactions; Uni-molecular reaction (Lindemann mechanism); Temperature dependence of reaction rates, Arrhenius equation; activation energy; Collision theory of reaction rates; Types of catalysts, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; Enzyme catalysis (Michaelis-Menten mechanism, Double reciprocal plot), Acid-base catalysis.

Adsorption: Gibbs adsorption equation; adsorption isotherm; types of adsorption; surface area of adsorbents; surface films on liquids.

Spectroscopy: Beer-Lambert's law; fundamental concepts of rotational, vibrational, electronic and magnetic resonance spectroscopy.

Inorganic Chemistry

Periodic Table: Periodic classification of elements, Aufbau's principle, periodicity; Variations of orbital energy, effective nuclear charge, atomic, covalent, and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity with atomic number, electronic configuration of diatomic molecules (first and second row elements).

Chemical Bonding and shapes of molecules: lonic bond: Packing of ions in crystals, radius ratio rule, Born-Landé equation, Kapustinskii expression, Madelung constant, Born-Haber cycle, solvation energy, polarizing power and polarizability; Fajan's rules; Covalent bond: Lewis structure, valence bond theory. Hybridization, molecular orbital theory, molecular orbital diagrams of diatomic and simple polyatomic molecules and ions; Multiple bonding (σ and π bond approach) and bond

lengths; van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, instantaneous dipole- induced dipole interactions, hydrogen bonding; Effect of intermolecular forces on melting and boiling points, solubility energetics of dissolution process; Bond dipole, dipole moment, and molecular polarizabilities; VSEPR theory and shapes of molecules; ionic solids.

Main Group Elements (s and p blocks): Reactions of alkali and alkaline earth metals with oxygen, hydrogen and water; Alkali and alkaline earth metals in liquid ammonia; Gradation in properties of main group element in a group; Inert pair effect; Synthesis, structure and properties of diborane, ammonia, silane, phosphine and hydrogen sulphide; Allotropes of carbon; Oxides of nitrogen, phosphorus and sulphur; Oxoacids of phosphorus, sulphur and chlorine; Halides of silicon and phosphorus; Synthesis and properties of borazine, silicone and phosphazene; Synthesis and reactions of xenon fluorides.

Transition Metals (d block): Characteristics of d-block elements; oxide, hydroxide and salts of first row metals; coordination complexes: structure, isomerism, reaction mechanism

and electronic spectra; VB, MO and crystal field theoretical approaches for structure, color and magnetic properties of metal complexes; Organometallic compounds with metal-ligand single and multiple bonds (such as metal carbonyls, metal nitrosyls and metallocenes); Homogenous catalysis involving Wilkinson's catalyst.

Acids and Bases: Brönsted-Lowry concept of acid- base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, classification of Lewis acids, hard and soft acids and bases (HSAB). Application of HSAB principle.

Bioinorganic Chemistry: Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+}, and Zn^{2+}; structure and function of myoglobin, hemoglobin and carbonic anhydrase.

Instrumental Methods of Analysis: Basic principles; instrumentations and simple applications of conductometry, potentiometry and UV-vis spectrophotometry; analyses of water, air and soil samples.

Analytical Chemistry: Principles of qualitative and quantitative analysis; Acid-base, oxidation- reduction and complexometric titrations using EDTA; Precipitation reactions; Use and types of indicators; Use of organic reagents in inorganic analysis; Radioactivity, nuclear reactions, applications of isotopes

Environmental Chemistry: Water pollution-types, sources, dissolved oxygen, BOD, COD, TDS, turbidity, chlorides, break point chlorination, Air pollutant-sources, classification, and properties, photochemical smog, green-house effect, inorganic and organic particulate matter

Organic Chemistry

Basic Concepts in Organic Chemistry and Stereochemistry: Electronic effects (resonance, inductive, hyperconjugation) and steric effects and its applications (acid/base property); optical isomerism in compounds with and without any

stereocenters (allenes, biphenyls); conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems, substituted cyclohexanes, and polycyclic (*cis* and *trans* decalins) systems.

Organic Reaction Mechanism and Synthetic Applications: Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes); nucleophilic substitution, elimination reactions and mechanisms; Hofmann-Curtius- Lossen rearrangement, Wolff rearrangement, Simmons-Smith reaction, Reimer-Tiemann reaction, Michael reaction, Darzens reaction, Wittig reaction and McMurry reaction; Pinacolpinacolone, Favorskii, benzilic acid rearrangement, Baeyer-Villeger reaction; oxidation and reduction reactions in organic chemistry; Organometallic reagents in organic synthesis (Grignard, organolithium , organocopper and organozinc (Reformatsky only), functional group inter- conversions and structural problems using chemical reactions.

Qualitative Organic Analysis: Identification of functional groups by chemical tests; elementary UV, IR and ^{1}H NMR spectroscopic techniques as tools for structural elucidation of simple organic molecules.

Natural Products Chemistry: Chemistry of alkaloids, steroids, terpenes, carbohydrates, amino acids, peptides and nucleic acids.

Aromatic and Heterocyclic Chemistry: Monocyclic, bicyclic and tricyclic aromatic hydrocarbons, and monocyclic compounds with one hetero atom: synthesis, reactivity and properties, aromaticity; Electrophilic and nucleophilic aromatic substitution reactions.

N.B: *For any queries, an email may be sent to* ***staff_recruitment@nits.ac.in.***
You are requested to visit Institute's Website regularly for further updates.

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