NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Ref: No. NITS/Estt/Advt/Non-teaching/2023/01 dated. 07.07.2023

SCHEME AND SYLLABUS OF EXAMINATION FOR JUNIOR ENGINEER

Name of the Post	**Junior Engineer**
Tentative scheme of Examination	1. Objective-type test consisting of 50 questions. 2. Total Marks: 100 (each question carries 2 marks). 3. Negative Marking: 0.5 marks will be deducted for each incorrect answer. Unanswered questions will not attract negative marks. 4. Duration of examination: 2 hours. 5. Venue: NIT Silchar.

Syllabus for the Written Test for the post of Junior Engineer (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.

Syllabus for the Written Test for the post of Junior Engineer (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.

N.B: *For any queries, an email may be sent to* ***staff_recruitment@nits.ac.in***

Date of Written Test will be notified soon. You are requested to visit Institute's website regularly for further updates.

Sd/-

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