Syllabus for Junior Engineer Examination

Examination Pattern & Scheme of Examination

Section Name		Marks per item	No. of items
Paper A (30 mins)			
1.	Logical Reasoning	1 mark	10
2.	Numerical Reasoning	1 mark	10
3.	Verbal Reasoning & Knowledge in Computer Applications	1 mark	10
4.	General Awareness	1 mark	10
Total			**40**
Paper B (60 mins)			
1a.	Civil Engineering	1 mark	60
1b.	Electrical Engineering	1 mark	60
Total			**60**

***** Once selected, the choices can't be changed under any circumstances.

Part A

1. Logical Reasoning

It would include questions of both verbal and non-verbal type. This component may include questions on analogies, similarities and differences, space visualisation, spatial orientation, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning and figural classification, arithmetic number series, non-verbal series, coding and decoding, statement conclusion, syllogistic reasoning etc. The topics are Semantic Analogy, Symbolic/Number Analogy, Figural Analogy, Semantic Series, Number Series, Figural Series, Problem Solving, Word Building, Coding & de-coding, Numerical Operations, Symbolic Operations, Trends, Space Orientation, Space Visualisation, Venn Diagrams, Drawing inferences, Punched hole/pattern - folding & un-folding, Figural Pattern-folding and completion, Indexing, Address matching, Date & City matching, Classification of centre codes/roll numbers, Small & Capital letters/numbers coding, decoding and classification, Embedded Figures, Critical thinking, Emotional Intelligence, Social Intelligence & Other sub-topics, if any

2. Numerical Reasoning

The questions will be designed to test the ability of appropriate use of numbers and number sense of the candidate. The scope of the test will be percentage, Ratio & Proportion, Square roots, Averages, Interest, Profit & Loss, Discount, Partnership Business, Mixture and Allegation, Time and distance, Time & work, Basic algebraic identities of School Algebra, Elementary surds, Graphs of Linear Equations, Triangle and its chords, tangents, angles subtended by chords of a circle, common tangents to two or more circles, Triangle, Quadrilaterals, Regular Polygons, Circle, Right Prism, Right Circular Cone, Right Circular Cylinder, Square, Hemispheres, Rectangular Parallelepiped, Regular Right Pyramid with triangular or square base, Trigonometric ratio, Degree and Radian Measures, Standard Identities, Complementary angles, Heights and Distances, Histogram, Frequency Polygon, Bar diagram, Pie chart and any other question of Matriculation level.

3a. Verbal Reasoning

Questions in this component will be designed to test the candidate's understanding and knowledge of English language and will be based on spot the error, fill In the blanks, synonyms, antonyms, spelling/detecting mis-spelt words, idioms & phrases, one word substitution, Improvement of sentences, active/passive voice of verbs, conversion Into direct/indirect narration, shuffling of sentence parts, shuffling of sentences in a passage, comprehension passage and any other English language questions at the level of Matriculation/Higher Secondary.

3b. Knowledge in Computer Applications

The questions on basic computer knowledge will be from Characteristics of Computers, Computer Organisation including RAM, ROM, File System, Input Devices, Computer Software-Relationship between Hardware and Software, Operating System, MS-Office (exposure of Word, Excel/spread sheet, Power point), Information Technology and Society-Indian IT Act, Digital Signatures, Application of information technology in Government for E-Governance, Information Kiosks

4. General awareness

Questions in this component will be aimed at testing the candidate's general awareness of the environment around him and its application to society. Questions will also be designed to test knowledge of current event and of such matters of every day observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring Countries especially pertaining History, Culture, Geography, Economic Scene, General Policy, Indian Constitution & Scientific Research and Others

Part B

1a. Civil Engineering

- **Building Materials:** Physical and Chemical properties, Classification, Standard tests, Uses and manufacture/quarrying of materials e.g., Building stones, Silicate-based materials, Cement (Portland), Asbestos products, Timber and wood-based products, Laminates, Bituminous materials, Paints, Varnishes.
- **Estimating, Costing and Valuation:** Estimate, Glossary of technical terms, Analysis of rates, Methods and unit of measurement, Items of work – Earthwork, Brick work (Modular & 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, Trapezoidal formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, Tube well, isolates and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, Scrap value, Salvage value, Assessed value, Sinking fund, Depreciation and obsolescence, Methods of valuation.
- **Surveying:** Principles of surveying, Measurement of distance, Chain surveying, Working of prismatic compass, Compass traversing, Bearings, Local attraction, Plane table surveying, Theodolite traversing, Adjustment of theodolite, Levelling, Definition of terms used in levelling, Contouring, Curvature and refraction corrections, Temporary and permanent adjustments of dumpy level, Methods of contouring, Uses of contour map, Tachometric survey, Curve setting, Earth work calculation, Advanced surveying equipment.
- **Soil Mechanics:** Origin of soil, Phase diagram, Definitions-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 curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. Permeability of soil, Coefficient of permeability, Determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, Quick sand, 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. Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, Earth pressure theories, Active and passive earth pressures, Bearing capacity of soils, Plate load test, Standard penetration test.
- **Hydraulics:** Fluid properties, Hydrostatics, Measurements of flow, Bernoulli's theorem and its application, Flow through pipes, Flow in open channels, Weirs, Flumes, Spillways, Pumps and turbines.
- **Irrigation Engineering:** Definition, Necessity, Benefits, III effects of irrigation, Types and methods of irrigation, Hydrology – Measurement of rainfall, Run off coefficient, Rain gauge, Losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, Duty, Delta and Base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, Types of canal irrigation, Loss of water in canals. Canal lining – types and advantages. Shallow and deep to wells, Yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, Causes and effects, Methods of flood control, Water logging,

Preventive measure. Land reclamation, Characteristics of affecting fertility of soils, Purposes, methods, Description of land and reclamation processes. Major irrigation projects in India.

- **Environmental Engineering:** Quality of water, Source of water supply, Purification of water, Distribution of water, Need of sanitation, Sewerage systems, Circular sewer, Oval sewer, Sewer Appurtenances, Sewage treatments. Surface water drainage. Solid waste management – types, effects, engineered management system. Air pollution – pollutants, causes, effects, control. Noise pollution – cause, health effects, control.
- **Theory of structures:** Elasticity constants, Types of beams – Determinate and indeterminate, Bending moment and shear force diagrams of simply supported, Cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, Bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, Slope deflection of simply supported and cantilever beams, Critical load and columns, Torsion of circular section.
- **Concrete Technology:** Properties, Advantages and uses of concrete, Cement aggregates, Importance of water quality, Water cement ratio, Workability, Mix design, Storage, Batching, Mixing, Placement, Compaction, Finishing and Curing of concrete, Quality control of concrete, Hot weather and cold weather concreting, Repair and maintenance of concrete structures.
- **RCC Design:** RCC beams - flexural strength, shear strength, bond strength, Design of singly reinforced and double reinforced beams, Cantilever beams, T-beams, Lintels. One-way and two-way slabs, Isolated footings. Reinforced brick works, Columns, Staircases, retaining wall, Water tanks (RCC design questions may be based on both Limit State and Working Stress methods).
- **Steel Design:** Steel design and construction of steel columns, beams roof trusses plate girders.

1b. Electrical Engineering

- **Basic concepts:** Concepts of Resistance, Inductance, Capacitance, and Various factors affecting them. Concepts of current, voltage, power, energy and their units. Circuit law : Kirchhoff's law, Simple Circuit solution using network theorems. 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.
- **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.
- **Measurement and measuring instruments:** Measurement of power (1 phase and 3 phase, 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, Multimeters, Megger, Energy meter AC Bridges. Use of CRO, Signal Generator, CT, PT and their uses. Earth Fault detection.
- **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.
- **Fractional Kilowatt Motors and Single-Phase Induction Motors:** Characteristics and applications.
- **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.
- **Generation, Transmission and Distribution:** 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.

- **Estimation and costing:** Estimation of lighting scheme, Electric installation of machines and relevant IE rules. Earthing practices and IE Rules.
- **Utilization of Electrical Energy:** Illumination, Electric heating, Electric welding, Electroplating,
- **Electric drives and motors. 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.