

Note-4: Candidates are not permitted to use Mobile Phone or any other electronic / electrical device other than those specifically permitted in Note-2. Candidates must not, therefore, bring Mobile Phone or any other electronic /electrical device not specifically permitted inside the Examination premises. Possession of these items, whether in use or not, will be considered as “use of unfair means” in the Examination and candidature of such candidates will be cancelled forthwith. Such candidates are also liable for debarment upto a period of 5 years and/or criminal prosecution.

Note-5: There will be negative marking of 0.25 marks for each wrong answer in Paper-I. Candidates are, therefore, advised to keep this in mind while answering the questions.

Note-6: Commission will place the answer keys of Paper-I on its website in about 7 days of the Examination. Objections and claims if any, received within the time limit specified while placing answer keys will be examined by the Commission with the help of experts, if necessary.

B. Personality Test (Interview):

100 marks

NOTE-I: Only those candidates who secure at least the minimum qualifying marks in the written examination as may be fixed by the Commission at its discretion, will be eligible to appear in the Interview. The interview will be held at places as may be decided by the Commission.

NOTE-II: SC/ST candidates called for interview will be paid TA as per Government Orders. However, no TA is payable to any candidate for appearing in the written examination.

NOTE-III: **Canvassing in any form whatsoever will lead to cancellation of the candidates.**

Note-IV: The Commission may, its discretion fix minimum qualifying standards in interview.

9. **SYLLABUS**

The standard of the questions in Engineering subjects will be approximately of the level of Diploma in Engineering (Civil/ Electrical/ Mechanical) from a recognized Institute, Board or University recognized by All India Board of Technical Education. All the questions will be set in SI units. The details of the syllabus are given below:

Paper-I

(i) **General Intelligence & Reasoning:** The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.

(ii) **General Awareness:** Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday 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 to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.

(iii) **General Engineering (Civil and Structural), (Electrical & Mechanical):**

Part-A

Civil Engineering

Building Materials, Estimating, Costing and Valuation, Surveying, Soil Mechanics, Hydraulics, Irrigation Engineering, Transportation Engineering, Environmental Engineering.

Structural Engineering – Theory of Structures, Concrete Technology, RCC Design, Steel Design.

Part-B

Electrical Engineering

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.

Part-C

Mechanical Engineering – Theory of Machines and Machine Design, Engineering Mechanics and Strength of Materials,

Properties of Pure Substances, 1st Law of Thermodynamics, 2nd Law of Thermodynamics, Air standard Cycles for IC Engines, IC Engine Performance, IC Engines Combustion, IC Engine Cooling & Lubrication, Rankine cycle of System, Boilers, Classification, Specification, Fitting & Accessories, Air Compressors & their cycles, Refrigeration cycles, Principle of Refrigeration Plant, Nozzles & Steam Turbines.

Properties & Classification of Fluids, Fluid Statics, Measurement of Fluid Pressure, Fluid kinematics, Dynamics of Ideal fluids, Measurement of Flow rate, basic principles, Hydraulic Turbines, Centrifugal Pumps, Classification of steels.

Paper II

Part-A

Civil & Structural Engineering

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, 2II 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.

Transportation Engineering : Highway Engineering – cross sectional elements, geometric design, types of pavements, pavement materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage, Railway Engineering- Components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards. Traffic Engineering – Different traffic survey, speed-flow-density and their interrelationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.

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.

Structural Engineering

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.

Part-B

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 : Kirchoff'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-L and 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 coil 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.

Part- C

Mechanical Engineering

Theory of Machines and Machine Design

Concept of simple machine, Four bar linkage and link motion, Flywheels and fluctuation of energy, Power transmission by belts – V-belts and Flat belts, Clutches – Plate and Conical clutch, Gears – Type of gears, gear profile and gear ratio calculation, Governors – Principles and classification, Riveted joint, Cams, Bearings, Friction in collars and pivots.

Engineering Mechanics and Strength of Materials

Equilibrium of Forces, Law of motion, Friction, Concepts of stress and strain, Elastic limit and elastic constants, Bending moments and shear force diagram, Stress in composite bars, Torsion of circular shafts, Bucking of columns – Euler's and Rankin's theories, Thin walled pressure vessels.

Thermal Engineering

Properties of Pure Substances : p-v & P-T diagrams of pure substance like H₂O, Introduction of steam table with respect to steam generation process; definition of saturation, wet & superheated status. Definition of dryness fraction of steam, degree of superheat of steam. h-s chart of steam (Mollier's Chart).

1st Law of Thermodynamics : Definition of stored energy & internal energy, 1st Law of Thermodynamics of cyclic process, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow; Steady State Steady Flow Energy Equation.

2nd Law of Thermodynamics : Definition of Sink, Source Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator; Thermal Efficiency of Heat Engines & co-efficient of performance of Refrigerators, Kelvin – Planck & Clausius Statements of 2nd Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius Integral, Entropy, Entropy change calculation of ideal gas processes. Carnot Cycle & Carnot Efficiency, PMM-2; definition & its impossibility.

Air standard Cycles for IC engines : Otto cycle; plot on P-V, T-S Planes; Thermal Efficiency, Diesel Cycle; Plot on P-V, T-S planes; Thermal efficiency.

IC Engine Performance, IC Engine Combustion, IC Engine Cooling & Lubrication.

Rankine cycle of steam : Simple Rankine cycle plot on P-V, T-S, h-s planes, Rankine cycle efficiency with & without pump work.

Boilers; Classification; Specification; Fittings & Accessories : Fire Tube & Water Tube Boilers.

Air Compressors & their cycles; Refrigeration cycles; Principle of a Refrigeraton Plant; Nozzles & Steam Turbines

Fluid Mechanics & Machinery

Properties & Classification of Fluid : ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids.

Fluid Statics : Pressure at a point.

Measurement of Fluid Pressure : Manometers, U-tube, Inclined tube.

Fluid Kinematics : Stream line, laminar & turbulent flow, external & internal flow, continuity equation.

Dynamics of ideal fluids : Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equation.

Measurement of Flow rate Basic Principles : Venturimeter, Pilot tube, Orifice meter.

Hydraulic Turbines : Classifications, Principles.

Centrifugal Pumps : Classifications, Principles, Performance.

Production Engineering

Classification of Steels : mild steel & alloy steel, Heat treatment of steel, Welding – Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques i.e. TIG, MIG, etc. (Brazing & Soldering), Welding Defects & Testing; NDT, Foundry & Casting – methods, defects, different casting processes, Forging, Extrusion, etc, Metal cutting principles, cutting tools, Basic Principles of machining with (i) Lathe (ii) Milling (iii) Drilling (iv) Shaping (v) Grinding, Machines, tools & manufacturing processes.

10. GENERAL INSTRUCTIONS TO BE COMPLIED BY THE CANDIDATES IN THE WRITTEN EXAMINATION:

- (i) Candidates must write the papers/indicate the answers in their own hand.
- (ii) Candidates are not permitted to use calculators and other electronic gadgets except as specified in the Notice. They should not, therefore, bring the same inside the Examination Premises / Venue for papers for which their use is not permitted.
- (iii) If any candidate is found to possess mobile phones or any other means of wireless communication in the working or switched off mode, his/her candidature shall be cancelled forthwith.
- (iv) Wherever applicable, the candidates must indicate /write the answer either in Hindi or in English. If answers are indicated/written partly in Hindi and partly in English and vice versa, the Answer script will not be evaluated and the candidate will be awarded zero marks.
- (v) In the question papers, wherever necessary, the Metric systems of weights and measures only will be used.

- (vi) OMR Type of Answer Sheets will be supplied by the Commission to candidates for recording their answers of Multiple Choice Objective Type Questions. Candidates are advised to read very carefully, the instructions, placed on the Commission's website(Candidate's Corner), and instructions on OMR sheets/Question Papers in their own interest. Model OMR sheet is also provided on the website to enable the candidates to practice proper marking of the answers in objective type papers.

(a) PART A AND PART B OF OMR ANSWER SHEET TO BE FILLED IN BLUE/BLACK BALL POINT PEN ONLY.

- (b) Candidate should write his/her name, Roll Number, Ticket Number, Name of the Examination , Date of birth and Test Form Number correctly, in the relevant places in OMR Answer Sheet. Answer Sheet not bearing candidate's Name, Roll Number, Ticket Number, Test Form No. signature and left hand thumb impression or in which such details have not been properly shaded will not be evaluated and 'Zero' marks will be awarded to them.

Note-1: Paper-II of only such candidates who are shortlisted on the basis of their performance in Paper-I will be evaluated.

Note-2: The Commission will fix separate qualifying standards in Paper-II of the written examination.

11. MODE OF SELECTION:

Candidates will be shortlisted for Interview on the basis of their total marks in the Written Examination subject to Note-I and 2 below para 10. Candidates who qualify for Interview will be recommended for appointment by the Commission on the basis of total marks in the Written Examination and Interview.

Provided that SC, ST, OBC and PH (OH/HH) candidates, who are selected on their own merit without relaxed standards, along with candidates belonging to other communities, will not be adjusted against the reserved share of vacancies. Such SC, ST, OBC and PH candidates will be accommodated against the general/unreserved vacancies as per their position in the overall Merit List. The reserved vacancies will be filled up separately from amongst the eligible SCs, STs, OBCs and PH candidates which will thus comprise of SC, ST, OBC and PH candidates who are lower in merit than the last general candidate on merit list of unreserved category but otherwise found suitable for appointment even by relaxed standard. A Physically Handicapped category candidate who qualifies on the basis of relaxed standards viz., age limit, experience or qualifications, permitted number of chances in written examination, extended zone of consideration, etc. will be counted against reserved vacancies and not against general vacancies subject to fitness of such candidate for selection. Such candidates may also be recommended at the relaxed standards to the extent the number of vacancies reserved for them, to make up for the deficiency in the reserved quota, irrespective of their rank in the order of merit.

Success in the examination confers no right of appointment unless government is satisfied after such enquiry as may be considered necessary that the candidate is suitable in all respects of appointment to the service/post.