SYLLABUS FOR THE RECRUITMENT TEST TO THE POST OF ASSISTANT ENGINEERS (CIVIL)

Technical Paper   - 90 Marks (Duration - 3 Hours)
Personal Interview   - 60 Marks (for short listed candidates only)
Total   - 150 Marks

The questions will be of multiple choice.

<u>**Technical Paper (90 Marks)**</u>

The standard of the questions in Engineering subjects will be approximately of the level of Degree in Engineering (Civil) 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:

1. **BUILDING MATERIALS AND CONSTRUCTION PRACTICES:** Properties of engineering materials-brick, stones, aggregates, cement (types and grades), concrete (mix design), Concrete admixtures, Self-compacting Concrete, steel and new materials. - Construction of stone masonry, brick masonry and R.C.C. and block masonry – construction equipments - Building bye - laws and Development regulations practiced in Tamil Nadu - Provisions for fire safety, lighting and ventilation- Acoustics.

2. **ENGINEERING SURVEY:** Survey - computation of areas - Chain Survey - Compass surveying - Plane table survey - levelling - fly levelling - L.S. and C.S. - Contour volumes - Theodolite survey - Traversing - Heights and Distances - Geodetic Observations- Tacheometry and Triangulation - Use of EDM, GPS and Remote sensing techniques.

3. **STRENGTH OF MATERIALS:** Stresses and strains -Thermal stresses- elastic constants - Beams and bending - Bending moment and shear force in beams - Theory of simple bending - deflection of beams - torsion - Combined stresses – stresses on inclined planes - Principal stresses and principal planes - Theories of Failure – Analysis of plane trusses.

4. **STRUCTURAL ANALYSIS:** Indeterminate beams - Stiffness and flexibility methods of structural analysis - Slope deflection - Moment Distribution method – Arches and suspension cables - Theory of columns - moving loads and influence lines – Matrix method- Stability of retaining walls – plastic theory.

5. **GEOTECHNICAL ENGINEERING:** Formation of soils - types of soils - classification of soils for engineering practice - Field identification of soils - Physical properties of soils - Three phase diagram - permeability characteristics of soils - stress distribution in soils - Theory of consolidation, shear strength parameters of soils - Compaction of soils. Soil exploration - Soil sampling techniques - Borelog profile - shallow foundations - Terzhagi's bearing capacity theory - Pile foundation - Group action of piles - settlement of foundations.

6. **ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL:** Sources of water - Ground water Hydraulics - Characteristics of water - Water analysis - water treatment - water borne diseases. Sewerage system - Design of sewerage systems - sewer appurtenances - Pumping of sewage - sewage treatment and disposal - Industrial waste treatment - solid waste management - Air, water and Noise pollution control- e waste management.

7. **DESIGN OF REINFORCED CONCRETE, PRESTRESSED CONCRETE AND STEEL STRUCTURES:** Design of concrete members - limit state and working stress design concepts - design of slabs - one way, two way and flat slabs - Design of singly and doubly reinforced sections and flanged sections -design of columns and footings – prestressing - systems and methods- post tensioning slabs - Design of pre-stressed members for flexure. Design of tension and compression members - Design of Bolted and welded connections design of members of Truss - designs of columns and bases - design of beams, plate girders and gantry girder

8. **HYDRAULICS AND WATER RESOURCES ENGINEERING:** Hydrostatics-applications of Bernoulli equation – flow measurement in channels, Applications of Momentum equation, Kinematics of flow. Water resources - Water resource planning - Master plan for water management flood control –Runoff estimation – hydrograph – flood routing - Stream flow measurement -Stage-discharge curve. Meandering of rivers, river training works. Surface water systems: diversion and storage systems, reservoir – estimation of storage capacity and yield of reservoirs – reservoir sedimentation -useful life of reservoir. Groundwater – Aquifer types and properties – Steady radial flow into a well. Estimation of yield of an open well. - Soil plant water relationship - Water requirement of crops - Irrigation methods –Design of alluvial canal and design of headworks. Waterlogging and land reclamation - Cross drainage works.

9. **URBAN AND TRANSPORTATION ENGINEERING:** Urbanisation trend and impact - Slum clearance and slum improvement programmes - Different modes of transport and their characteristics. Geometric design of highways. –Design and Construction of bituminous and concrete roads - Maintenance of roads. Railways-Components of permanent way - Signalling, Interlocking and train control. Airport planning-Components of Airport - Site selection – Runways – Planning of terminal buildings. Harbours & Ports- Layout of a harbour - Docks - Breakwaters.

10. **PROJECT MANAGEMENT AND ESTIMATING:** Construction management - Construction planning - Scheduling and monitoring - Cost control, Quality control and inspection - Network analysis - CPM and PERT methods of project management - Resources planning and resource management. Types of estimates - Preparation of technical specifications and tender documents - Building valuation - law relating to contracts and arbitration.

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The questions will be of multiple choice.

Technical Paper (90 Marks)

The standard of the questions in Engineering subjects will be approximately of the level of Diploma in Engineering (Civil) 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:

1. **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.

2. **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.

3. **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.

4. **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.

5. **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, Silt 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.

6. **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.

7. **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.

8. **Structural Engineering**

   (i) **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.

   (ii) **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.

   (iii) **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).

   (iv) **Steel Design:** Steel design and construction of steel columns, beams, roof trusses, plate girders etc.

SYLLABUS FOR THE RECRUITMENT TEST TO THE POST OF JUNIOR ENGINEERS (ELECTRICAL/MECHANICAL)

Total   - 150 Marks

Technical Paper   - 90 Marks   - (Duration - 3 Hours)

Personal Interview   - 60 Marks   - (for short listed candidates only).

The questions will be of multiple choice.

1. 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 Circuits: 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. Polyphase 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 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.

2. ELECTRICAL MACHINES

DC Machines - Construction, Basic Principles of DC motors and generators, their characteristics, speed control and starting of DC Motors, Method of braking motor, Losses and efficiency of D.C. Machines.

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.

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.

3. GENERATION, TRANSMISSION AND DISTRIBUTION

<u>Power Stations</u> - 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.

<u>Switchgears</u> - 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 busbars, Lightning arresters, various transmission and distribution system, comparison of conductor materials, efficiency of different system.

<u>Cable</u> - Different type of cables, cable rating and de-rating factor.

4. UTILIZATION OF ELECTRICAL ENERGY

Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.

5. FUNDAMENTAL OF COMPUTER AND APPLICATION

Basic concept, bus architecture, operating system, Basic computer system, memory organization, input/output device, storage device. MS application.

6. THEORY OF MACHINES

Momentum, Energy and Impulse: Simple Mechanism; Friction; Belt, Rope and Chain Drive; Gears; Governors; Cams.

7. FLUID MECHANICS

Units and Dimensions; Fluid Properties; Buoyancy; Types of Flow; Bernoulli's Theorem; Orifices; Flow in Pipes; Streamlines; Viscous Flow; Flow around Immersed Bodies.

8. TURBOMACHINERY

Gas turbines, Compressors, Hydraulic turbines and Pumps

9. THERMODYDAMICS

Properties of Gases; Properties of Steam; Power Cycles; Steam Boilers; Steam Engines; Condenser; Fuels; Combustion of Fuels.

10. HEAT TRANSFER

Modes of Heat Transfer; Fourier's Law and Heat Exchangers.

11. MECHANICAL MEASUREMENTS

Measurement of Displacement; Velocity; Acceleration; Force; Torque; Strain; Speed; Temperature; Pressure Flow; Shock; Vibration and Sound.

12. <u>Electrical and Mechanical</u>

1. Basic Electricity
2. D.C. Circuits
3. Batteries
4. Capacitors
5. A.C. Fundamentals
6. Electrical Engineering Materials
7. Elements of Mechanical Engineering

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Technical Paper (90 Marks)

1. **ELECTRO MAGNETIC THEORY.**
    Electric and magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane Wave propagating in dielectric and conducting media. Transmission lines.

2. **ELECTRICAL MATERIALS**
    Band Theory, Conductors, Semiconductors and Insulators. Superconductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics properties and applications. Hall effect and its applications. Special semiconductors.

3. **NETWORK THEORY**
    Circuits elements. Kirchoff's Laws. Mesh and nodal analysis. Transient response and steady state response for arbitrary inputs.

4. **ELECTRICAL MACHINES**
    Magnetic Circuits Analysis and Design of Power transformers. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Autotransformer, 3 phase transformer. Parallel operation. Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.

    D.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing, Losses and efficiency.

    Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient pole machine, Parallel operation. Hunting. Short circuit transients.

    Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single phase synchronous and induction motors.

5. **MEASUREMENT AND INSTRUMENTATION**
    Units and Standards. Error analysis, measurement of current, Voltage, power, Power factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of nonelectrical quantities like temperature, pressure, flowrate displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

6. **ELECTRICAL POWER SYSTEM**
Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors. Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. ZBus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady state stability of power systems. Equal area criterion. Power system Transients. Power system Protection Circuit breakers. Relays. HVDC transmission.

7. **ANALOG AND DIGTAL ELECTRONICS AND CIRCUIT**
switching behaviour of diodes and transistors. Digital logic gate families, universal gates combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

8. **POWER ELECTRONICS AND DRIVES**
Semiconductor power diodes, transistors, thyristors, triacs, triggering circuits; principles of inverters; basis concepts of adjustable speed dc and ac drives.

9. **MICROPROCESSORS**
Microprocessor architecture, Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Microprocessors in power system.

10. **THEORY OF MACHINES.**
Simple Mechanism; Friction; Belt, Rope and Chain Drive; Gears; Governors; Brakes and Dynamometers; Cams; Gyroscope.

11. **MANUFACTURING SCIENCE.**
Basic Machining Process; Types of Machine Tools; Extrusion; Welding; Drilling; Shaping; Boring; Reaming; Milling; Grinding; Finishing Processes; Patternmaking and Foundry.

12. **INDUSTRIAL ENGINEERING.**
Plant Layout; Material Handling; Work Study; Economic Analysis; Break Even Analysis; Present Value Criterion; Inventory Control; Network Analysis; PERT; CPM.

13. **FLUID MECHANICS.**
Hydrostatics; Buoyancy; Hydrokinematics; Hydrodynamics; Orifices, Mouthpieces and Nozzles; Flow over Notches and Weirs; Flow in Pipes, Open Channels; Viscous Flow; Flow around Immersed Bodies.

14. **HYDRAULIC MACHINES.**
Hydraulic Turbines; Pumps;

15. **THERMO-DYDAMICS**
Properties of Gases; Properties of Steam; Power Cycles; Steam Boilers; Steam Engines; Condenser; Fuels; Combustion of Fuels.

16. **HEAT TRANSFER, REFRIGERATION.**
Refrigeration Cycles; Refrigeration Equipments; Refrigerants; Psychometrics; Comfort, Cooling and Dehumidification.