

RURAL DEVELOPMENT AND PANCHAYATS DEPARTMENT
SYLLABUS FOR THE POST OF JUNIOR ENGINEER (ELECTRICAL)

English	05 questions	5 Marks
Punjabi	05 questions	5 Marks
General Knowledge / Awareness	05 questions	5 Marks
Mental Ability /Aptitude/Numerical Ability	05 questions	5 Marks
Computer Proficiency	10 questions	10 Marks
Professional (As per prescribed qualifications for job related)	90 questions	90 Marks
Total	120 questions	120 Marks

PART A- GENERAL (30 Q)

1. ENGLISH (5 Q): Upto 10th standard

2. PUNJABI (5 Q): Upto 10th standard

3. GENERAL KNOWLEDGE / AWARENESS (5 Q):

General information about the state of Punjab, India and world, Economy, Science and Technology, Current Events, Political Awareness/Polity, Persons in News, Places in News, Important Awards & Honors, Sports.

4. Mental Ability /Aptitude/Numerical Ability (5 Q):

Verbal Reasoning, Data Interpretation, Number system, Simplification, HCF & LCM, Percentage, Average, Ratio & Proportion, Profit & Loss, Partnership, Time and Work, Time and Distance, Reasoning Ability: Analogy / Analogous Problems, Distance and Direction, Concept of angles, measurement of angles in degrees.

5. COMPUTER PROFICIENCY (10 Q): Introduction of Computer and History, Operating Systems, PC and System Software, Computer Network, Computer Devices, Windows, Microsoft Office, MS Word, MS Excel, MS PowerPoint, Security Aspects for PC, Various uses of Computers, server types, connectivity (TCP/IP, shell), Applications of internet like: e-mail and browsing, Various Browsers like WWW (World wide web); hyperlinks; HTTP (Hyper Text Transfer Protocol); FTP (File Transfer Protocol).

PART B - PROFESSIONAL (90 Q) - ELECTRICAL ENGINEERING

- 1. Fundamentals of Electrical Engineering: Basic Electrical Engineering:** Basic electrical quantities, DC Circuits, Ohm's law, resistances in series and parallel, Kirchhoff's laws and their applications in solving electrical network problems, Network theorems such as Thevenin's theorem, superposition theorem, Maximum power transfer theorem and Norton's theorem, Star-delta transformation. **Electro-magnetism:** Magnetic field around a straight current carrying conductor and a solenoid, force between two parallel current carrying conductors, Force on a conductor placed in the magnetic field, Series magnetic circuits, simple problems, hysteresis loop and hysteresis loss, Electromagnetic Induction, Faraday's Laws of electromagnetic induction, Lenz's law, Principle of self and mutual induction, self and mutually induced e.m.f., Inductances in series and parallel, Energy stored in a magnetic field, eddy current loss. **A.C. Circuits:** Concept of alternating current and voltage, average value, r.m.s value, form factor, power factor etc., Phasor algebra, AC Circuits, susceptance, conductance and admittance, Active and reactive components of current and their significance, Power, Power factor and its significance, Resonance in series and parallel circuits. **Polyphase Systems:** Advantages of 3 phase over single phase system, Star and delta connections (relationship between phase and line voltages, phase and line currents, Power in 3 phase circuits and measurement by one wattmeter method, Measurement of power and power factor of a 3-phase load by two wattmeter method using balanced/unbalanced load
- 2. Transmission and Distribution of Power :** Layout of power system, selection of voltage for HT & LT lines, comparison between AC & DC systems for power transmission, cost of conductors; Main components of Overhead lines, types of supports – RCC/PCC poles, steel tower, comparison between single circuit and double circuit design, ACSR conductors, concept of ground wire, skin effect and proximity effect, Types of insulators, selection, failure of insulators, string efficiency, methods of improvement of string efficiency; Sag calculations; Electrical features of Overhead line; corona and corona loss; Description of PVC, PILC, FRLS, XLPE cables, Gas filled (SF₆) cables, laying of cables; Performance of Transmission Lines; regulation and efficiency of lines, bundle conductors, transposition of transmission lines, Ferranti Effect, Reactive Power Compensation ; DC and AC Distribution Systems. **Estimation and Costing: Types of wiring:** Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. **Domestic installations:** Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates

including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load) **Industrial installations:** Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single-phase, 3-phase motor load and the light load (3-phase supply system) **Service line connections estimate for domestic and Industrial loads** (over-head and under ground connections) from pole to energy meter. Estimating the material required for a) Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations b) Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KV Substation. Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

3. **Electrical Machines:** Faraday's laws, magnetisation curve, constructional features of generators and motors, Hetero-polar and homopolar configurations, Space distribution of flux density and time-variation of voltage. **D.C. Machine:** basic principles, emf equation, description of different parts and working, different types, characteristics and applications of D.C. machines. **Transformers:** Constructional details: selection of core material and winding materials, insulating materials, core and coil construction, Transformer oil, Accessories: tank & radiator, breather, conservator, bucholtz relay, bushings, pressure relief valve {PRV} & explosion vent, Different types of cooling methods. **1-phase Transformers:** E.m.f. equation, phasor diagram under no-load and load conditions, equivalent circuit and circuit parameters, Regulation, Losses and efficiency (including all-day efficiency), S.C. and O.C. Distribution and power transformers, 1-phase Autotransformer, tertiary winding, Parallel operation of transformers and their significances. **Three-phase transformer:** Single unit or 3 single-phase units connections, Vector grouping, Scott-connected transformer, 3-phase transformers in parallel. **Alternator:** Construction details, Cylindrical and Salient type alternators, their salient features, merits and applications; Armature winding – Single layer and multilayer, Concentrated and distributed, 1-phase and 3-phase, E.M.F. equation; Brushless and static excitation systems; No-load characteristics and Load Characteristics at various p.f., Synchronous reactance, O.C. and S.C. tests; Phasor diagrams of cylindrical rotor m/c at different p.f. loads, Voltage regulation – sync. Imp. Method. Short circuit ratio (SCR) – concept & significance. Power characteristics of cylindrical rotor m/c - Synchronizing Power & Torque, Effect of Load and excitation on: Isolated synchronous Generator and Synchronous generator on infinite bus; Parallel operation of alternators – advantages, synchronizing using three lamps and Synchroscope, Load sharing between two alternators; **Synchronous Motor:**

Principle of steady state constant speed operation, Methods of starting, hunting & damper winding, effect of variation of Load, speed torque characteristics, V and inverted V-curves, Applications; **3-phase Induction Motor** : Production of rotating magnetic field, construction, Principle of operation, Induction motor as transformer, equivalent circuit; various power stages and their relation, losses, efficiency, torque - starting, running and max torque, slip-torque characteristics. Effect of rotor resistance on torque, Cogging & crawling, Starters for both slip-ring and Squirrel cage induction motors, Speed control, Double cage rotor, braking of induction motors. **F.H.P. Motors:** Construction, principle of operation and applications of 1-ph Induction motor – split phase motors, 1-phase Synchronous motors – Reluctance Motors, AC – series motor: Universal motors

4. **Power Generation:** Amount of generation of electric power from Conventional and non-conventional sources of energy in India. Steam power station: Schematic arrangement, advantages and disadvantages, choice of site, efficiency of steam power station, Types of prime movers, characteristic, speed control & auxiliaries. Environmental aspects for selecting the sites and locations of thermal power stations. Hydro power station: Schematic arrangement, advantages and disadvantages, choice of site constituents of hydro power plant, Hydro turbine. Environmental aspects for selecting the sites and locations of hydro power stations. Nuclear power station: Schematic arrangement, advantages and disadvantages, selection of site, types of reactors, Hazards, Environmental aspects for selecting the sites and locations of nuclear power stations. Tariff and Economic aspects in power Generation: Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, Tariffs
5. **Measurement & Instruments of Electric Energy:** Static and dynamic characteristics, Classification of instruments, Deflection torque and methods of production, Controlling torque and controlling system, Damping torque & methods of damping, **Different types of instruments:** construction & operating principle, Merits and demerits, Errors and remedies, Practical ranges, Applications of – PMMC, MI, Electrodynamometer type, Thermocouple instruments and Induction type instruments. Digital instruments- voltmeter, ammeter, multimeter, energy-meter; Wheatstone Bridge, Working principle & construction of simple D.C. potentiometer; **Methods of measuring Electrical quantities:** Measurement of Low resistance, medium and high resistances, Measurement of 3-phase power by two-wattmeter & 3-wattmeter method; 1-phase Induction type energy meter, Errors adjustments, Phantom loading, A.C. Bridges

6. **Utilization of Electric Energy & Control of Drives: Heating and welding:** Electric Heating, Resistance ovens, Radiant Heating, Induction Heating, High frequency Eddy Current Heating, Dielectric Heating, The Arc Furnace, Heating of Buildings, Air – Conditioning, Electric Welding, Modern Welding Techniques. **Electrolytic Electro – Metallurgical Process:** Ionization, Faraday’s Laws of Electrolysis, Definitions, Extraction of Metals, Refining of Metals, Electro Deposition. **Illumination:** Introduction, Radiant Energy, Definitions, Laws of Illumination, Polar Curves, Photometry, Measurement of Mean Spherical Candle Power by Integrating Sphere, Illumination Photometer, Energy Radiation and luminous Efficiency, electric Lamps, Cold Cathode Lamp, Lighting Fittings, Illumination for Different Purposes, Requirements of Good Lighting. **Control of DC And AC Motor:** SCR power supply for DC motor, speed regulation by armature voltage control, Speed control of AC induction motor. **Braking:** Introduction, Regenerative Braking with Three Phase Induction Motors, Braking with Single Phase Series Motors, Mechanical braking, Magnetic Track Brake, Electro – Mechanical Drum Brakes