# Syllabus for the Post of Junior Technician (Electrical)-Level A1

**Essential Qualification:** High School or Class X Equivalent Board Examinations with Science and Trade Certificate in Electrician Trade. Should have Valid Certificate of Competency as Electrical supervisor

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| **Part (A):** General Mental Ability and Aptitude | 20% (20 questions carrying 1 mark each) |

General Mental Ability and Aptitude to test the following:

- Interpersonal Skills
- Logical reasoning/Analytical/Comprehension ability
- Basic Numeracy and Data Interpretation Skills
- General Awareness

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| **Part (B): Subject/Domain Related** | 80 % (80 questions carrying 1 mark each) |

1. Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers. First aid safety practice. Hazard identification and prevention. Personal safety and factory safety. Response to emergencies e.g. power failure, system failure and fire etc.
   Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Electrical Code-2011.
   **Allied trades**: Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Marking tools description and use. Types of drills, description & drilling machines. Various wooden joints.
   Marking tools; calipers Dividers, Surface plates, Angle plates, Scribers, punches, surface gauges Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Description of carpenter's tools Care and maintenance of tools.

2. Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators.Conducting materials and their comparison. Joints in electrical conductors. Techniques of soldering. Types of solders and flux. Underground cables: Description, types, various joints and testing procedure. Cable insulation & voltage grades. Precautions in using various types of cables.

3. Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel network

4. Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance. Series and parallel combinations of resistors.

5. Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor- Different types, functions, grouping and uses.

6. Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc.

Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system. Problems on A.C. circuits.

7. Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Phase sequence meter.

8. Chemical effect of electric current and Laws of electrolysis. Explanation of Anodes and cathodes. Types of cells, advantages / disadvantages and their applications. Lead acid cell; Principle of operation and components. Types of battery charging, Safety precautions, test equipment and maintenance. Basic principles of Electroplating and cathodic protection Grouping of cells for specified voltage and current. Principle and operation of solar cell.

9. I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc. Grading of cables and current ratings. Principle of laying out of domestic wiring. Voltage drop concept.

   PVC conduit and Casing capping wiring system. Different types of wiring - Power, control, Communication and entertainment wiring. Wiring circuits planning, permissible load in sub circuit and main circuit

   Estimation of load, cable size, bill of material and cost. Inspection and testing of wiring installations. Special wiring circuit e.g. godown, tunnel and workshop etc.

10. Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations.Earth resistance and earth leakage circuit breaker

11. Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their applications. Calculations of lumens and efficiency.

12. Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Measurement of various electrical parameters using different analog and digital instruments. Measurement of energy in three phase circuit. Errors and corrections in measurement. Loading effect of voltmeter and voltage drop effect of ammeter in circuits. Extension of range and calibration of measuring instruments.

13. Working principles and circuits of common domestic equipment and appliances. Concept of Neutral and Earth.

14. Working principle, construction and classification of transformer. Single phase and three phase transformers. Turn ratio and e.m.f. equation. Series and parallel operation of transformer. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). Method of connecting three single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Materials used for winding and winding wires in small transformer.

15. General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation. Separately excited and self-excited generators. Series, shunt and compound generators

16. Armature reaction, Commutation, inter poles and connection of inter poles. Parallel Operation of DC Generators. Load characteristics of DC generators. Application, losses & efficiency of DC Generators. Routine & maintenance.

17. Principle and types of DC motor. Relation between applied voltage back e.m.f., armature voltage drop, speed and flux of DC motor. DC motor Starters, relation between torque, flux and armature current. Changing the direction of rotation. Characteristics, Losses & Efficiency of DC motors. Routine and maintenance.

18. Methods of speed control of DC motors. Lap and wave winding and related terms.

19. Working principle of three phase induction motor. Squirrel Cage Induction motor, Slip-ring induction motor; construction, characteristics, Slip and Torque. Different types of starters fornecessity, basic contactor circuit, parts and their functions. Single phasing prevention. No load test and blocked rotor test of induction motor. Losses & efficiency. Various methods of speed control. Braking system of motor. Maintenance and repair. Concentric/ distributed, single/ double layer winding and related terms. Working principle, different method of starting and running of various single phase AC motors. Domestic and industrial applications of different single phase AC motors. Characteristics, losses and efficiency. Concentric/ distributed, single/ double layer winding and related terms. Troubleshooting of single phase AC induction motors and universal motor.

20. Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction.

21. Working principle of synchronous motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement.

22. Rotary Converter, MG Set description and Maintenance

23. Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory.

24. P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier.

25. Basic concept of power electronics devices. IC voltage regulators. Digital Electronics - Binary numbers, logic gates and combinational circuits.

26. Working principle and uses of oscilloscope. Construction and working of SCR, DIAC, TRIAC and IGBT. Principle, types and applications of various multivibrators.

27. Study and understand Layout drawing of control cabinet, power and control circuits. Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc.

28. Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties, sleeves, gromats and clips etc. Testing of various control elements and circuits.

29. Working, parameters and applications of AC / DC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive.

30. Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance.

31. Conventional and nonconventional sources of energy and their comparison. Power generation by thermal and hydel power plants. Various ways of electrical power generation by non-conventional methods. Power generation by solar and wind energy. Principle and operation of solar panel.

32. Transmission and distribution networks. Line insulators, overhead poles and method of joining aluminum conductors. Safety precautions and IE rules pertaining to domestic serviceconnections. Various substations. Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc.

33. Types of relays and its operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching.

34. **Workshop Science and Calculation** :
    - Introduction to Iron and Steel. Differences in Iron & steel.
    - Introduction to Property and uses of C.I. and wrought Iron. , Iron and steel properties and uses.
    - Properties and uses of plain carbon steel and alloy steel.
    - Properties and uses of non ferrous metals and alloys Fraction and decimal - conversion fraction decimal and vice-versa.
    - Properties and uses of copper, zinc, lead, tin, aluminum.
    - Composition, properties and uses of brass, bronze, solder, bearing material, timber, rubber etc.
    - System of units, British, metric and SI units for length, area, volume capacity, weight, time, angle, their conversions. , Effect of alloying elements in the properties of C.I. & steel.
    - Unit of temperature for & related problems. Standard & absolute temp.
    - Mass, volume, density, weight, sp. Gravity & specific weight. S.I. M.K.S. and F.P.S. units of force, weight etc. their conversion to related problems.
    - Inertia, rest and motion, velocity and acceleration.
    - Types of forces, its units and Weight calculation.
    - Revision & Test, Power and roots Factor, Power base exponents number. Multiplication and division of power and root of a number. Square root of number and problems.
    - Heat & temperature, thermometric scales, their conversions.
    - Work energy and power, their units and applied problems.
    - Percentage, changing percentage to decimal and fraction and vice versa. Applied problems.
    - Problem on percentage related to trade.

- Different types of loads, stress, strain, modulus of elasticity. Ultimate strength, different types of stress, factor of safety, examples.
- Ratio & proportion- Ratio, finding forms ratio proportions, direct proportion and indirect proportion. Application of ratio and proportion & related problems.

35. **Engineering Drawing** :
    - Engineering Drawing - introduction to Engg. Drawing and its importance.
    - Use of drawing instruments –Drawing of straight, inclined and curved lines.
    - Exercise on linear and angular measurements.
    - Types of lines their meaning & application as per BIS SP: 46-2003.
    - Simple conventional symbols for material and parts as per BIS SP: 46-2003. , Geometrical construction of rectangles, square, circles.
    - Geometrical construction of polygon and ellipse, parabola & hyperbola.
    - Geometrical construction of involutes, oval, and helix.
    - Free hand sketching of straight lines, rectangles, circles, square, polygons, ellipse.
    - Standard printing style for letters and numbers as per BIS : SP: 46-2003 using stencils
    - Free hand sketching of simple geometrical solids, cube, cone, prism, cylinder, sphere, pyramids.
    - Scales- Types & its use.
    - Revision & Test, Construction of diagonal scale.
    - Simple dimensioning technique, size and location, dimensions of parts, holes angles, taper, screw etc. as per BIS SP: 46-2003.
    - Transferring measurements for linear, angular, circular dimensions form the given object to the related free hand sketches using different measuring instruments.
    - Pictorial drawings, isometric drawings of simple geometrical solids.
    - Oblique/orthographic projection of simple geometrical solids.
    - Orthographic drawings: Application of both the first angle and third angle. Isometric drawing of simple machined & casting blocks.
    - Free hand sketches of trade related hand tools and measuring tools

**Note: The above syllabus is indicative and the questions in the test may include similar other topics pertaining to the level and content of essential qualification.**