SYLLABUS

(Asst. Foreman (Electrical) (Trainee), T&S Gr-C (E&M)

PART -A	**GENERAL ASSESSMENT** i. General Knowledge and Current Affairs ii. Reasoning & Mathematical Ability iii. Awareness about Coal Industries	20 questions	20 Marks
PART -B	**DOMAIN KNOWLEDGE** **Electricity Theory (Elementary Knowledge)** **Principles of Electricity** - Electric voltage, Current and resistance, Ohm's law - specific resistance, Laws of resistance and their application for calculating voltage drop, series and parallel circuits, Practical units of voltage, current, resistance, power and energy. Relation between electrical power unit (KW) and Mechanical Power Units (HP). **Electro Magnetism** - Concept of Electro Magnetic Force (EMF), production of E.M.F., Flemings Right and Left Hand Rules, Magnetic, Chemical and heating effects of electric current. Magnetic properties of material, Electromagnets and their various applications. **Materials** - Conductors, Semiconductors and insulator materials and their relative merits. Transformer oil, Effect of heat and moisture on insulation. Lubricants and their uses. Different types of wires, cables, switches, circuit breakers, cutouts, etc. ***Generation of Electricity* -** Sources of natural energy. Renewable and Non-Renewable source methods of production of electricity both Alternating Current and Direct Current. **A.C. Generators (Alternators)** - Essential components and constructional feature. Methods of voltage and frequency control conditions and methods for synchronizing, simple associated switchboard and its accessories. **D.C. Generators** - Essential components and constructional features, Shunt, series and compound dynamos and their characteristics, causes for sparking. Commutators and their maintenance. Carbon brushes, their adjustment and care. Methods	80 questions	80 Marks

	of voltage regulation. Conditions for parallel operation, simple associated switch board and its accessories. **Batteries** - Primary cells, Dry cells, Lead acid cells, Nickel, Iron or Alkaline cells. Initial and subsequent charging of batteries. Charging circuits and their calculations. Series and parallel circuits. Maintenance of batteries. Use of Hydrometers. **A.C. Motors** - Theory of induction (squirrel cage and slip-ring type) synchronous and commutator motors, their uses, installation, method of starting, speed control and reversal of direction. **D.C. Motors** - Theory of series, shut and compound wound type motors, their uses, installation, method of starting, speed control and reversal of direction. **A.C. Circuits** - Knowledge of vectors. Phase and phase difference. Resistance, inductance and capacitance in an A.C Circuit. Periodicity or Frequency. Power and power factor. Single phase and three phase systems, star and delta connections, Phase Sequence. **Controlling and Regulating Gear** - Knowledge of various types of switches, circuit breakers, cutouts, starters, regulators and protective devices for both A.C. and D.C. motors and their wiring with the motors. **Transformation** - Knowledge of single phase and three phase transformers, their construction, use and maintenance. Phasing out, parallel working, auto transformer, transformer tappings, temperature rise, instrument transformer. **<u>Transmission and Distribution-</u>** **Overhead Lines** - Simple calculations and general principles of construction of low, medium and high voltage lines. Size of conductors, length of spans, sag, strength of poles, spacing of conductor, cross arms, effect of temperature, wind pressure, ice and snow, tension on wire. Insulators, brackets, stays, struts, guard wires and other protective devices. Earthing, lightning arrestors, lighting conductors and their testing and fault location. **Underground Cables** - underground cables, simple calculations and general principles of laying cables direct in ground, in troughs and pipes. Handling, bending, jointing, plumbing. Underground and above ground junction boxes. Distribution board, Joint box		

	compound, melting of compound and filling boxes with compound. Testing and fault location. **Illumination** - Metal filament lamps, fluorescent lamp circuits, Photometric units and simple measurements. General requirements of efficient lighting and elementary calculations. Street lighting. Time switches. **<u>Generation:-</u>** a) DC and AC power supply for auxiliaries, arrangement of unit auxiliary and station service boards, station lighting and automatic changeover. Station batteries and charging methods. Stand by and emergency power and lighting systems. b) Testing & Measurement - Working principle and basis of instrument and measurements. Details of measuring instruments for pressure, flow, temperature, level, alignment and current, voltage, power, reactive power, frequency, energy, winding temperature, auto controllers, recorder, insulation, tester, its use for primary detection of faults, data acquisition system, digital distributed control, UPS etc. Testing of electrical and mechanical equipments. c) Control & Protection - Sequential operation & interlocks, general machine start/stop, sequence of operation. **Electricity Utilization for –** **Domestic installation –** WIRING - Wiring layout of different types for lighting and power installations in residential premises together with the necessary switchgear, estimate of materials and cost of different types of installations. Wiring of temporary installations and portable appliances. CIRCUIT DIAGRAM - Electrical connections of various circuits for (i) House wiring including those for main and sub-distribution boards, switches and cutouts etc.		

	APPARATUS - Installations and maintenance of heaters, cookers, refrigerators and other domestic appliances. Electric bells and indicators. Small motors for pumps and electric lifts. ENERGY MEASUREMENT AND CHARGES - Energy meters both D.C. and A.C. for house service. SIMPLE CALCULATION - Simple calculations relating to cost of energy, elementary knowledge of methods of charging for energy. TESTING AND FAULT ATTENDANCE - Detection and location of faults in domestic appliances and wiring installations. Insulation and continuity test. Rectification of faults. Tests for insulation resistance to earth. Earth testing. PROTECTIVE DEVICES - Elementary knowledge of the use of fuses and cutouts, earthing of domestic appliances, motors etc. use of lightning arrestors. **Industrial installation-** WIRING - Wiring layouts of different types for lighting and power installations in industrial premises together. with the necessary switchgears. Estimates of materials and cost of different types of installations. Wiring of temporary installations and portable appliances. CIRCUIT DIAGRAMS - Electrical connections for D.C. & A.C. Motors, their starters regulators. Main and sub- distributing boards with circuit breakers, switches, fuse units with load statement for each circuit, D.C. & A.C. Motors, their starters regulators, Battery charging equipments, Converting machinery, Lifts with their safety devices. PUMP INSTALLATIONS - General principles and elementary calculations of head, power and energy requirements. APPARATUS - Installation and maintenance of generators, electric motors electric welding machines, haulage and winding machines, cooling and heating appliances. POWER AND ENERGY MEASUREMENT AND CHARGES Measurement of power, Watt meters, energy meters both D.C. & A.C. power factor correction by capacitors.		

	SIMPLE CALCULATION - Simple calculations relating to cost of power and energy, elementary knowledge of methods of charging for demand and energy. TESTING AND FAULT ATTENDANCE - Detection and location of faults in D.C. & A.C. generators, motors, overhead distribution lines and underground cables, electric instruments and apparatus and wiring installations. Rectification of faults, Insulations and continuity tests. Tests for insulations resistance to each earth testing. PROTECTIVE DEVICES - Elementary knowledge of earthing of generators, motors, machines, installations and appliances. Use of lightning arrestors, fuses including high rupturing capacity fuses, cutouts, circuit breakers, over load and no volt protections, thermal trips, filed breaking switches and over speed protection. **<u>Overhead Lines</u>** • Survey, Design, Construction Standards, Foundation Erection, Stringing and Construction equipments. • Testing, fault locations, commissioning, maintenance and protections including safety devices and testing equipments. • Selection of supports, cross arms, brackets, stays struts insulators and associated hardwares. • Types and size of conductors, length of spans, sag, spacing of conductors, effect of temperature, wind pressure, ice and snow on tension of conductors, lighting on conductors. • Earthings, lightning arresters, guard wires, relays and other proactive devices. **<u>Cables</u>** • Classification of cables, criteria for the selection of power cables, PVC & XLPE underground cables. Classification of tests for cables laying, safe handling of cable drums, cable joints, cable terminations, crimp connections, maintenance of electric cable, flexible		

	cable, flexible cables for portable machines, faults in underground cables system, methods of fault location underground cable system. **<u>Sub-Stations and Control Room:</u>** • Layout, design, construction standards of HT transformers and associated equipments (i.e. CBs, Isolators, Las, Capacitors, CTs, PTs, etc) • Power and distribution transformers - their erection, commissioning, fault locations, and maintenance. • Protective relays and measuring equipments and their networking. Transformer protection, Generator, Diesel Generator protection. • Testing commissioning, fault locations, maintenance and protection of cables and testing equipments. • Design and installation of capacitor banks and their maintenance. • Erection, testing, commissioning and maintenance of control room equipments including station batteries and communication system. **<u>Motors and Generators (DC and AC):</u>** • Installation, testing, commissioning, protection and control and maintenance of industrial motors. **Operational knowledge for the following:-** Operational knowledge on measuring instruments i.e Ammeters, Voltmeters, Multimeters, Tongue Testers, Meggers, HV testing kits etc. Illumination, fire fighting and earthing systems including maintenance. Preparation, representation, interpretation of electrical drawings and execution of electrical work. Flame proof equipment/		

	intrinsically safe for underground switch board, panels, breakers etc for underground. **SAFETY RULES**- Working Knowledge of- • Safety regulation-2023 of CEA (Measures relating to safety and electric supply) All regulations including Regulations for mining installation. • Fire safety procedures, fire protection of generators, transformers and fire fighting and protection. • Protection and restoration of person suffering from electric shock.		
	TOTAL	**100 questions**	**100 marks**

SYLLABUS

(Technician (Electrician) (Trainee), Cat-III (E&M)

PART -A	**GENERAL ASSESSMENT** i. General Knowledge and Current Affairs ii. Reasoning & Mathematical Ability iii. Awareness about Coal Industries	20 questions	20 Marks
PART -B	**DOMAIN KNOWLEDGE** 1) **Electrical Fundamentals:** Ohm's Law, Kirchoff's Law, Series & Parallel combination of Resistors, Inductors & Capacitors. Wheatstone bridge, PVC wires, Conductors & cables. Wire joints, Soldering. Heating, Lighting, magnetic & chemical effect of electric current. Joule's law. Electrolysis & its laws. Cells and Batteries - Primary & secondary cell, Lead Acid battery, Hybrid cell, Alkaline cell. Charging of battery. Care & maintenance of Battery. 2) **Magnetic Circuits:** Terminology used in magnetic circuits. Principle of electromagnet. Capacitor & its types. Faraday's laws of Electromagnetic Induction. Fleming's rule, B-H Curve. RLC circuit- series & parallel resonance. 3) **A.C. Generators (Alternators)** - Working principle, Types, Essential components, constructional features, Efficiency & Applications. 4) **DC Generators:** Working principle, Types- Series, Shunt & Compound Generator, EMF equation, Characteristics, commutation, Efficiency, Regulation & Applications. 5) **A.C. Motors**- Construction, parts, working principle, Concept of rotating magnetic field, Applications, Trouble shooting, Care and maintenance. Types of starters - DOL, Star delta, Auto transformer starter. 6) **DC Motors:** Principle, Types- Series, Shunt & Compound Motors. Characteristics curve, commutation. Applications of DC Motors. Necessity of starter, working of starters (3 point & 4 point). Speed control of DC Shunt motor (Armature & Field control). Trouble shooting - Care and maintenance. 7) **Active & Reactive Power:** Calculation for Work, Power & Energy, Power factor. Causes & effects of low power factor. Methods of improving power factor. Calculation of capacitor banks. Automatic power factor correction (APFC) panels. Three phase three wires & three phase four wires system. Three phase power.	80 questions	80 Marks

8) **Transformers:** Working Principle, Construction. Classification of Transformers, EMF equation, rating, Loading, Losses & Efficiency Regulation, Parallel Operation, Cooling methods, Transformer oil testing. Care and maintenance, Protective devices. Tap changer - ON load OFF load. Auto transformer, Instrument Transformer - CT & PT, Welding Transformer.

9) **Measuring Instruments:** PMMC, MI Meters working principle and construction. Digital meters. Megger & Earth tester, Multimeter. Calibrations of meters. Terminology used in Illumination and calculations. Types of Lamps - Incandescent Lamp and Discharge Lamp fluorescent, HPMV, HPSV Lamps, Drum Switch, Lighting calculations, Energy efficient lighting systems (CFL, LED etc), Two watt meters method of 3 phase power measurement.

10) **Semi-conductor Devices:** Diodes, Characteristics, Zener diode, Rectifiers & filter circuits. etc. Rotor resistance type starter. Introduction to Speed control of 3 phase Induction motor. Torque - speed characteristics. Losses, efficiency, classification, working principle & uses. AC motor stator Re-winding. Single phase & Three phase winding development diagram.

11) **Electric Drives:** DC drive, AC drive. Preventive & Break down maintenance of DC/AC machines, Voltage stabilizer, UPS, Inverter.

12) **Basics Of Wiring:** Power & control circuits wiring. Machine control cabinet/ control panel layout, assembly. Control elements -Push button switches, contactor, overload Relay etc. Concept of neutral and earth. Earthing, types, methods of reducing earth resistance, Earth tester. Star & Delta connections. Concept-Principle of plan estimation and cost-preparation of wiring layout domestic/ Industrial/ Commercial. I.E rules for multi-storied building. National Electrical Code, SWG, common electrical Accessories - MCB, ELCB, MCCB, RCCB etc. Comparison between different types of wirings, Installation, Testing methods - Wiring estimations & cost.

13) **Basics of Thermal Power:** Plant layout, components and working principle of thermal power plant.

14) **Non-conventional energy resources:** Working principle of wind and solar power generation.

15) **Electrical Substation:** Single Line Diagram of Substations. Electric supply system EHVAC transmission. Advantages of high voltage transmission Overhead lines: - Poles & Towers,

	bushings, Insulators & its types. Corona effect, Bundle conductors, Sag, Skin effect & Ferranti effect. Fault studies. 3 phase service-cable fault. Sub-station HT/LT-Function, equipment, types of distribution system. Protective relays-overcurrent, IDMT, overvoltage, differential, distance relay. Circuit breakers-lightning arrestor used in HT line. Cable - different types of cables, cable rating, derating factor. Firefighting, Safe handling Tools & Equipment's, Rescue of person who is in contact with live wire, Treat a person for electric shock/ injury. Etc. as per the courses offered by the Recognized Institutes. 16) **SAFETY RULES** - Working Knowledge of - Safety regulation - 2023 of CEA (Measures relating to safety and electric supply) All regulations including Regulations for mining installation.		
	TOTAL	**100 questions**	**100 marks**