



## INDUSTRIAL TRADE CERTIFICATE (MOTOR WINDING)

- 1) General awareness, Reasoning, Mathematics, Science, History including Haryana related history, current affairs, literature, Geography, Civics, Environment, Culture etc. - **(Weightage 20%)**
  - 2) Computer terminology, Fundamentals, word software, excel software, Power point, internet, web browsing, Communication, emails, downloading and uploading data on websites etc. - **(Weightage 10%)**
  - 3) Subject related syllabus- **(Weightage 70%)**
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### Introduction

Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units, Fractions & Simplification: Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems Simplification using BODMAS. Square Root: Square and Square Root, method of finding out square roots, Simple problem using calculator, Ratio & Proportion: Simple calculation on related problems, Percentage: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa, Material Science : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys, Mass, Weight and Density: Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals, Work, Power and Energy: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy, Mensuration: Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi-circle. Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.

### Professional Knowledge

**Occupational Safety & Health Basic safety introduction, Personal protection:** - Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Use of Fire extinguishers. Visit & observation of sections. Various safety measures involved in the industry. Elementary first Aid. Concept of Standard.

**Soft Skills:** its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies e.g.; power failure, fire, and system failure.

**Identification of Trade-Hand tools,** Specifications Earthing- Principle of different methods of earthing & selection. i.e., Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB).

**Common Electrical Accessories,** their specifications in line with NEC 2011- Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm & switches, with individual switches, MCB, ELCB, MCCB. Series –parallel testing board & use.

**Solders, flux and soldering technique.** Resistors types of resistors & properties of resistors. Introduction of National Electrical Code. Explanation, Definition and properties of conductors, insulators and semi-conductors. Types of wires & cables, standard wire gauge. Specification of wires & Cables-insulation & voltage grades- Low, medium & high voltage.

**Fundamental of electricity: Fundamental terms-** Current, Voltage definitions, AC, DC, Phase, Neutral, Earth. Units & effects of electric current. Ohm's Law - Simple electrical circuits and problems. Reading of simple Electrical Layout. Resistors -Law of Resistance. Series and parallel circuits & related calculation. Alternating Current -Comparison and Advantages D.C and A.C. Related terms Frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, sine wave, phase and phase difference. Inductive and Capacitive reactance, Impedance (Z), power factor (p.f.). Active and Reactive power. Single Phase and three-phase system etc. Power consumption in series and parallel, P.F. etc. Concept three-

phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Three phase four wire system.

**Electrical Measuring Instruments** - types, indicating types PMMC & MI meter (Ammeter, Voltmeter) - Range extension -Multi-meter (Digital/Analog) -Wattmeter - P.F. meter - Energy meter (Digital/Analog) – Insulation Tester (Megger), Earth tester. -Frequency meter -Phase Sequence meter -Multi-meter –Analog and Digital -Tong tester -Techo-meter.

**Introduction to fitting trade.** Descriptions, General Care & Maintenance of Hammer, Chisels, Try Square, etc Descriptions, General Care & Maintenance of different type of files. Descriptions, General Care & Maintenance of hacksaw, drilling machine, etc Description of taps and dies, types of rivets and riveted joints. Finishing and polishing materials and their process.

**D.C. Machines** - General concept of Electrical Machines. D.C. generator. Parts: Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, Brushes, Laminated core. series, shunt and compound generators. Voltage build-up, loading. Types of D.C. Motor. Starters used in D.C. motors Types of speed control of DC motors in industry. Application of D.C. motors. Care, Routine & preventive maintenance.

**AC Generator:** Explanation of alternator, working principle, voltage build-up, loading, Regulation. Efficiency. Types of prime mover, phase sequence, Specification of alternators.

**Transformers 1ph and 3ph:** Working principle of Transformer. classification C.T., P.T. Instrument and Auto Transformer, Construction, Single phase and Poly phase. Type of Cooling for transformer. Protective devices. Components, Auxiliary parts i.e., breather, Conservator, Buchholz relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer. Bushings and termination.

**Three phase Induction motor** – Working principle –Production of rotating magnetic field, Squirrel Cage Induction motor, Slip-ring induction motor. Control & Power circuit of starters D.O.L Starter, Forward /Reverse starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc Single phasing preventer. Application of Induction Motor Care, Routine & preventive maintenance. Single phase induction motor, working principle, different method of starting and running (capacitor start, permanent capacitor, capacitor start & run, shaded pole technique). FHP motors, Repulsion motor, stepper motor, Application of single-phase motor.

**Electro-Mechanical assemblies:** (1) Complete component identification. Knowledge of various mechanical and magnetic parts such as stampings, housings, keys, shafts, commutators, slipping assemblies, cooling fans, poles, etc. (2) Job instruction on handling and storing of the assemblies. (3) Concept of Jigs and fixtures as applicable in the winding job. (4) Details of shrink fit, welding as applicable in the winding job. (5) Reconditioning/replacing of defective parts, Testing of Magnetic core loss.

**Coil winding and insulation preparation:** (1) Insulating materials: Solid, Liquid and gaseous insulating materials H Class, Kapton tape, Nomex paper, Tetrafluoroethene, Fibre glass tape, mica tape, silicon tape, thermal classification, properties, typical schemes of insulation used in the windings. Methods of test of insulating materials. Reference to relevant Indian/International standards. (2) Conductors: Conductors materials such as copper, aluminium, brass etc. their shape, size and current carrying capacity. Insulation used on winding wires, their types, size, voltage and temperature ratings. End connection lead cables. Specification of relevant to Indian / international standard. (3) Windings: Different types of windings used in AC/DC rotating machines and Transformers. winding terminology, Finding Armature winding data i.e., calculate Speed, Pole, Pole pitch, coil pitch, parallel paths, prepare winding Diagrams as per data given (LAP & WAVE) winding, AC & DC Machines winding. (4) Calculations for making formers for different types of windings.

**D.C. m/c Winding**— Introduction to armature winding, Winding terms - pole pitch, coil pitch, back pitch, front pitch, Types of winding - Lap & Wave winding, Progressive and retrogressive winding. Winding materials, winding hand tools, coil winding machine, winding calculations and tables. Conditions to be fulfilled for Lap & Wave winding. Growler –construction details & testing of armature rewinding by growler. Impregnation / varnish & baking High voltage test & Insulation resistance test.

**REWINDING OF AC MOTOR-** A.C. m/c Winding - Introduction to stator winding, Terminology used in single phase and three phase winding like pole pitch, coil pitch etc., rules for end connection of 3 $\phi$  & single-phase motors. Winding materials, winding tools, coil winding machine, winding calculations and tables, Testing the motor before declaring for rewinding. Principle of different winding techniques /

methods Impregnation methods of armature after rewinding. Varnish the armature winding Testing the motor after rewinding. Insulation Resistance & High voltage test.

**Impregnation:** Theoretical knowledge with reference to the process of preheating of armature, Vacuum Pressure impregnating plant and baking. Types of impregnating varnishes, thinners and solvents used. Types of air-drying varnishes, details of equipment used. Balancing: Principle of static and dynamic balancing. Description of machine used.

**Final assembly test to be conducted after rewinding** armature No load test, observe humming, commutator flashing, On load test (Hopkins test), IR value, HV test, High speed test, Temperature test. Procedure of repairs of common electrical machines such as 3-phase and single-phase motors, Alternators, welding generators, and transformers DC machines.

## **Occupational Safety, Health & Environment Education**

1 Safety & Health Introduction to Occupational Safety and Health importance of safety and health at workplace. 2 Occupational Hazards Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention. 3 Accident & safety Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures. 4 First Aid Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person 5 Basic Provisions Idea of basic provision legislation of India. of safety, health, welfare under legislation of India. 6 Ecosystem Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance. 7 Pollution and pollutants including liquid, gaseous, solid and hazardous waste. 8 Energy Conservation of Energy, re-use and recycle. 9 Global warming Global warming, climate change and Ozone layer depletion. 10 Ground Water Hydrological cycle, ground and surface water, Conservation and Harvesting of water 11 Environment Right attitude towards environment, Maintenance of in-house environment.

## **Labour Welfare Legislation**

Welfare Acts Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.

## **Quality Tools**

1 Quality Consciousness: Meaning of quality, Quality Characteristic 2 Quality Circles: Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles. 3 Quality Management System: Idea of ISO 9000 and BIS systems and its importance in maintaining qualities. 4 House Keeping: Purpose of Housekeeping, Practice of good Housekeeping. 5 Quality Tools Basic quality tools

**Important Note: The Weightage as mentioned against the syllabus is tentative & may vary.**