

## **GROUP-06-Draughtsman (Electrical)**

### **Level- 2 Years Diploma in Draughtsman (Electrical)**

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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**Importance of safety and general precautions** observed in the in the industry/shop floor, working of Industrial Training Institute system including stores procedures. Soft Skills: its importance and Job area after completion of training, Introduction of First aid, Introduction of PPEs, Introduction to 5S concept& its application, Response to emergencies e.g.; power failure, fire alarm, etc.

**Familiarisation& information about rules** and regulations of the Institute and Trade, List of the Instruments, equipment's and materials to be used during training.

**Importance of B.I.S.** Introduction of Code for practice of Architectural and  $\square$  Building Drawings (IS: 962-1989, SP-46:2003), Layout of drawing. Lines, Lettering, Dimensioning, Knowledge of different types of scale. Principle of R.F.

### **Basic Concepts**

Concepts of resistance, inductance, capacitance, and various factors affecting them. • Concepts of current, voltage, power, energy and their units. • Network elements: ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; • Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; • Magnetic Circuit – Concepts of flux, mmf, reluctance, Different kinds of magnetic materials, Magnetic calculations for conductors of different configurations e.g., straight, circular, solenoidal, etc. • Electromagnetic induction, self and mutual induction. • Transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits. • Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

### **AC Fundamentals**

• Instantaneous, peak, R.M.S. and average values of alternating waves. • Representation of sinusoidal waveform, simple series and parallel AC Circuits consisting of R.L. and C, Resonance, Tank Circuit. • Poly Phase 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 reactive) and energy, 2 wattmeter method of 3 phase power measurement. • Measurement of frequency and phase angle. • Ammeter and voltmeter (both moving coil and moving iron type), extension of range wattmeter, Multi-meter, Megger, Energy meter AC Bridges. • Use of CRO, Signal Generator, CT, PT and their uses. • Earth Fault detection.

### **Signals and Systems**

• Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete-time signals, Laplace Transform and Z transform

## Electrical Machines

- Single-phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency;
- Three-phase transformers: connections, vector groups, parallel operation;
- Auto-transformer, Electromechanical energy conversion principles;
- DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors;
- Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control;
- Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors;
- Types of losses and efficiency calculations of electric machines
- 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.

## Power Systems

- Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables,
- Series and shunt compensation, Electric field distribution and insulators,
- Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection;
- Circuit breakers, System stability concepts, Equal area criterion, Economic Load Dispatch (with and without considering transmission losses).

## Control Systems

- Mathematical modelling and representation of systems,
- Feedback principle, transfer function,
- Block diagrams and Signal flow graphs,
- Transient and Steady-state analysis of linear time-invariant systems,
- Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators;
- P, PI and PID controllers; State-space model, Solution of state equations of LTI systems, R.M.S. value, average value calculation for any general periodic waveform.

## Generation, Transmission and Distribution

- Power factor improvement, various types of tariffs, types of faults, short circuit current for symmetrical faults.
- Switchgears – rating of circuit breakers, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage / over current, etc. Buchholz's relay, Merz-Price system of protection of generators & transformers, protection of feeders and bus bars.
- Lightning arresters, various transmission and distribution system, comparison of conductor materials, the efficiency of different system.
- Cable – Different type of cables, cable rating and derating factor.
- Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations.

## Estimation and Costing

- Estimation of lighting scheme, electric installation of machines and relevant IE rules.
- Earthing practices and IE Rules.

## The Utilisation of Electrical Energy

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

## Basic Electronics

- Working of various electronic devices e.g., P N Junction diodes, Transistors (NPN and PNP type) BJT and JFET.
- Simple circuits using these devices.
- Static V-I characteristics and firing/gating circuits for

Thyristor, MOSFET, IGBT; • DC to DC conversion: Buck, Boost and Buck-Boost Converters; • Single and three-phase configuration of uncontrolled rectifiers; • Voltage and Current commutated Thyristor based converters; • Bidirectional ac to dc voltage source converters; • Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; • Power factor and Distortion Factor of ac to dc converters; • Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.

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