SYLLABUS FOR COMPUTER BASED TEST FOR DRAFTSMAN

Section-I

1. **General Intelligence & Reasoning**: The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.

2. **General Awareness**: Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.

Section-II: Branch/ Stream Electrical & Mechanical (50% each)

Stream: Electrical

1. **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.

2. **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-Land R-C circuit.

3. **Measurement and Measuring Instruments**
   - Measurement of power (1 phase and 3 phase, both active and re- active) and energy, 2 wattmeter method of 3 phase power measurement.
   - Measurement of frequency and phase angle.
   - Ammeter and voltmeter (both moving oil and moving iron type), extension of range wattmeter, Multimeters, Megger, Energy meter AC Bridges.
   - Use of CRO, Signal Generator, CT, PT and their uses.
   - Earth Fault detection.

4. **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.

5. **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, torquespeed 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.

6. **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.

7. **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).

8. **Control Systems**
   - Mathematical modeling 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.

9. **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. Buchholtz relay, Merz-Price system of protection of generators & transformers, protection of feeders and bus bars.
   - Lightning arresters, various transmission and distribution systems, comparison of conductor materials, the efficiency of different system.
   - Cable – Different types 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.

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

11. **The Utilization of Electrical Energy**

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

12. **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 thyristorbased 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.

Branch/Stream: Mechanical

1. **Engineering Drawing and Design:**

- Nomenclature, description, and use of drawing instruments &various equipment's used in drawing office. Their care and maintenance.
- Lay out and designation of a drawing sheet as per Sp -46 :2003.
- Recommended scale of engineeringdrawingasperSp-46:2003 Types of Lines and their application.
- Folding of prints for filing Cabinets or binding as per SP: 46-2003.
- Type of lettering proportion and spacing of letters and words.
- Terminology – feature, functional feature, functional dimension, datum dimension, principles.
- Units of dimensioning, System of dimensioning, Method of dimensioning& common features.
- Methods of obtaining orthographic view. Position of the object, selection of the views, three views of drawing. Planes and their normal projections First angle and third angle projection. Types of sectional views & their uses.Cutting plane and its representation. Selection of views for construction of orthographic drawings for clear description of the object.
- Knowledge of solid section. Projection of solids like prism, cones, pyramids and their frustums.

- Methods of free hand sketching for machine parts.
- Conventional signs, symbols, abbreviations & hatching for different materials.
- Solution of problems to find out the true shape of surfaces when solids are cut by different cutting planes.
- Definition of development, its need in industry & different method of developing the surfaces.
- Development of surfaces bounded by lane of revolution intersecting each other.
- Development of an oblique cone with elliptical base etc. Calculation of developed lengths of geometrical solids.
- Definition of Intersection & interpenetration curve. Common method to find out the curve of interpenetration.
- Principle of isometric projection and Isometric drawing. Methods of isometric projection and dimensioning. Isometric scale. Difference between Isometric drawing & Isometric projection.
- Principles of making orthographic views from isometric drawing.
- Principle and types of oblique projection.
- Advantage of oblique projection over isometric Projection.

2. **Machine Design**
- Screw threads, terms nomenclature, types of screw thread, proportion and their uses, threads as per SP-46:2003 conventions.
- Types of bolts, nuts and studs, and their proportion, uses.
- Different types of locking devices. Different types of machine screws, cap screws, set screws as per specification. Different types of foundation bolts and their uses.
- Description of Welded Joints and their representation (Actual and Symbolic) Indication of Welding Symbol on drawing as per SP-46.
- Different types of keys (Heavy duty and Light duty) cotters, splined shaft, pins and circlips. Calculation of sizes and proportions of keys.
- Pipe Joints: selection of materials as per carrying fluid and conditions. Description of different pipe joints fitted on pipe. Expansion joint, loop and other pipe fittings.
- Types of rivets, their size proportion sand uses. Types of riveted joints, terms and proportions of riveted joints. Conventional representation. Relation between rivet size and thickness of plates and calculation for arrangement of rivets position. Causes of failure of riveted joint efficiency of riveted joints.
- Limits, fit, tolerance. Tolerance dimensioning, geometrical tolerance. Indications of symbols for machining and surface finishes on drawing (grades and micron values)

3. **Production Engineering and Workshop Technology**
- Description and application of simple measuring tools. Description of vices, hammers, cold chisel, files, drills, etc.-proper method of using them. Method of using precision measuring instrument.
- Maintaining sequence of operation in fitting shop and safety precaution.
- Description of parts of Lathe &its accessories. Description of different job holding devices in lathe operation. Safety precautions for lathes. Methods of using precision measuring

instruments such as inside & outside micrometers, depth gauges, vernier calipers, dial indicators, slip gauges, sine bars, universal bevel protractor.

- Brief Description of milling, shaping, slotting, and planning machines. Quick return mechanism of these machines. Different clamping devices for milling operation. Different clamping devices on shaping operation.
- Brief description of common equipment required for sheet metal work. Different types of joints are used in sheet metal work.
- Introduction to Die casting, gating system design, force calculation, defects and remedies and estimation.
- Brief description of the hand tools used gas & arc welding. Different types of welded joints and necessary preparation required for these.
- Safety precautions, Hand tools used for molding. The description, use and care of hand tools.
- Safety precautions maintained in electrician shop.
- Knowledge of various parts of press tools and their function.
- Knowledge of different moulding processes.
- Lay out of Machine foundations.
- Consideration of ergonomics (human factor) for shop layout.
- Proper measurement practice in workshop. Principles of good measurement result: right measurement, right tools, right sketching, review and right procedures.
- Knowledge of production drawing, name plate and bill of materials, etc.
- Study of production drawing. Procedure of preparing Revision Drawing: putting revision mark, writing remarks in the table as per check list.

4. Computer Aided Drafting

- Introduction to Auto CAD and its working
- Introduction to Solid Works/ AutoCAD Inventor/ 3D Modeling

5. Theory of Machines

- Belt-drive. Materials of belts, slip and creep, Velocity of belt. Arc of contact. Calculation of belt speeds, nos. of belts needed in V-belt drive, velocity, pulley ratio etc. Standard pulleys width of pulley face, velocity ratio chain drive.
- Knowledge of different pipe materials and specifications of Steel, W.I. & PVC pipes.
- Brief description of different types of pipe joints. Pipe threads.
- Pipe fittings (threaded, welded and pressed). Specifications of pipe fittings.
- Different types of valves.
- Gear drive- Different types of gears. Cast gears and machined gears. Knowledge of profile of gears etc.
- Use of Cams in industry. Types of cam, kinds of motion in cam, displacement diagrams. Terms used in cam. Types of follower.
- Knowledge of engine mechanism.
- Transmission of motion from reciprocating to circular through eccentric, crank and connecting rod.

- Couplings, necessity of coupling, classification of couplings. Uses and proportion of different types of couplings. Materials used for couplings.
- Knowledge of bearing to reduce friction, types of bearing, frictional and anti-frictional bearings. Material used for frictional bearings. Properties of frictional bearing (sliding bearing) materials. Parts of anti-frictional bearings (ball, roller, thrust ball, needle & taper roller). Materials and proportion of parts. Difference between frictional and anti-frictional bearings. Advantages of anti-frictional bearings.
- Gears and gear drives- uses, types, nomenclature and tooth profiles.
- Working principle of valves and their description.

7. Fluid Mechanics and Machines

- Brief description of a typical hydraulic system, components, working principle and function of hydraulic jack. Different types of hydraulic actuator. Symbol and working of hydraulic DC valve, non-return valve and throttle valve.
- Knowledge of typical pneumatic system, FRLorair service unit and pneumatic actuator.
- Different types of turbines, their classification, characteristic curves etc
- Different types of pump systems. Characteristics of a pump system: pressure, friction, and flow. Energy and head in pump systems.