

## Plan of Written Examination

All the aspirants are informed as under with respect to the written test to be conducted for the recruitment of **Junior Draftsman Civil, Junior Draftsman (Mechanical/Electrical)** :-

- (i) The Exam will be conducted in MCQ (Multiple Choice Questions) format. OMR sheets will be used for answering the questions.
- (ii) There will be negative marking. Each question carries 1 mark. **For every wrong answer, 1/4<sup>th</sup> mark would be deducted. The question(s) not attempted will receive no credit or discredit.**
- (iii) The test would be of 2 hours duration.
- iv) Pattern of the written competitive examination is as follows:-

Sr. No.	Topic	No. of Questions	Marks (Each Question carries 1 mark)	Type of Questions
1.	Questions from the Subject (Part A of Syllabus)	90	90	MCQs (Multiple Choice Questions)
2.	Questions from General Knowledge, English, Punjabi, Logical Reasoning and Mental ability (Part B of Syllabus)	30	30	
<b>Total</b>		<b>120</b>	<b>120</b>	

- v) For the post of Junior Draftsman (Electrical/Mechanical) part A contains questions from the subjects namely Mechanical and Electrical. Candidate can attempt any one of the above mentioned subjects.
- vi) Tentative syllabus for the written examination for the recruitment of **Junior Draftsman** is annexed at Annexure-1 and 2.

## Annexure-I

### Part A Syllabus

#### Post-Junior Draftsman, Civil

1. **Introduction:** Importance of safety and general precautions observed in the in the industry/shop floor. Familiarization & information about rules and regulations of the Trade.
  - List of the Instruments, equipment's and materials
2. **Importance of B.I.S.**
  - Introduction of Code for practice of Architectural and Building Drawings (IS: 962- 1989, SP-46:2003).
  - Layout of drawing. Lines, Lettering, Dimensioning.
  - Knowledge of different types of scale. Principle of R.F.
  - Different types of projection views: Orthographic, Isometric, Oblique and Perspective.
3. **Characteristic, types and uses of Materials:-**
  - Stones, Bricks, Lime, Pozzolanic, Cement, *Sand*, Clay Products (types, earthenware, stoneware, porcelain, terracotta, glazing), Mortar & Concrete (Types, uses, preparation, proportion, admixtures and applications),
  - Timber (Types, Structure, disease & defects, characteristic, seasoning, preservation and utility) Alternative material to Timber (Plywood, Block board, Particle board, Fireproof reinforced plastic (FRP), Medium density fibreboard (MDF) etc.), Tar, bitumen, asphalt
  - Protective materials:- *Paints*, Varnishes, Metal and Plastics
4. **Building Construction:-**
  - Sequence of construction of a building, different parts of building, Stonemasonry (Terms, use and classification), Principle of construction, composite masonry, Strength of walls, Strength of masonry, Brick masonry – principles of construction of bonds, Tools and equipment's used.
  - Foundation:- Purpose of foundation, Causes of failure of foundation, Bearing capacity of soils, Dead and live loads, Examination of ground, Types of foundation, Drawing of footing foundation setting out of building on ground excavation, Simple machine foundation
  - Types of shoring, scaffolding, Underpinning and Timbering
  - Carpentry joints, Doors, *Windows*, *Ventilators*
  - Floors, Flooring, Stairs, lift and Escalator
  - Roofs & Roof coverings, *Truss*, *Shell*, *Dome*, *Roof & coverings*
  - House drainage of building:- Introduction, Terms used in PHE, Systems of sanitation, System of house drainage, plumbing, sanitary fittings, etc, Types of sewer appurtenance, Systems of plumbing, Manholes & Septic

tank, Water treatment plant, Sewerage treatment plant

### **5. Treatments of building structures:-**

- DPC Sources and effects of dampness, Method of prevention of dampness in building, Damp proofing materials, Anti-termite treatment, Weathering course, Fire proofing, Arches, *Lintel* (types, wooden, brick, stone, steel &RCC), Chajjahs, Centering & Shuttering

### **6. Surveying:-**

- Introduction, History and principles of chain survey, Instruments Classification, accuracy, types, Main divisions (plane & geodetic), Chaining, Mouza Map, Compass survey, Plane table survey.
- *Levelling*:-Auto level, dumpy Level, Tilting Level, Principle of levelling Types, component / part and function, Datum Focussing & parallax, Deduction of levels / Reduced Level, Types of leveling, Application to chain and Levelling Instrument to Building construction.
- *Contouring*:-Definition, Characteristics, Methods, Interpolation of Contour, Contour gradient, Uses of Contour plan and Map.
- Introduction to Theodolite survey

### **7. Electrical Wiring: -**

- Safety precaution and elementary first aid, Artificial respiration and treatment of electrical shock, Elementary electricity, General ideas of supply system, Wireman's tools kit, Wiring materials, Electrical fittings, System of wirings. Wiring installation for domestic lightings,

### **8. Building:-**

- Principle of planning, Objectives & importance Function & responsibility, Orientation, Local building Bye-Laws as per ISI code, Lay out plan & keyplan, composition of drawing, Provisions for safety, Requirement of green belt and land, Economy & orientation, Provision for lighting, ventilation, drainage and sanitation.
- Types of building, planning & designing of residential, public and commercial building
- *Parks & play ground*-Types of recreation, landscaping etc.
- Prefabricated Structure: Method of construction and assembling
- Concepts of design of earthquake resisting buildings- requirements resistance, safety, flexible building elements, special requirements, base isolation techniques.

**9. Computer aided drafting:-**Operating system, Hardware & software, CAD, 3D modeling concept in CAD, 3D coordinate systems to aid in the construction of 3D objects

**10. Reinforced cement concrete structure:-**Introduction to RCC uses, Materials, Formwork, Bar bending details as per IS Code, Reinforced brickwork, Materials used for RCC Construction, Selection of materials – coarse aggregate, fine aggregate, cement water and reinforcement, Characteristics, Method of mixing concrete, Slump test, Structure –

columns, beams, slabs - one-way slab & two-way slab, Innovative construction, Safety against earthquake, Grade of cement, steel-behaviour and test, Bar-bending schedule, Retaining wall, R.C.C. Framed structure.

- Steel structures:-Structural fasteners , Joints, Tension & compression member, Classification,fabrication, Construction details.

**11. Roads:-** Introduction, General principles of alignment, Classification and construction of different types of roads, Component parts, Road curves, gradient, Curves-types, designation of curves, Setting out simple curve by successive bisection from long chords, simple curve by offsets from long chords, Road drainage system,

- Basics of Bridges & Culvert.

### **12. Irrigation Engineering:-**

- Basic terms used in irrigation, Hydrology like duty, delta, base period, intensity of irrigation, Hydrograph, peak flow, run off, catchment area, CCA, corps like, rabi, kharif etc.,
- Storage, diversion head, work -characteristics and types.
- Reservoir –types of reservoirs, i.e., single purpose and multi- purpose, area, capacity and curves of reservoir.
- Dams, weir & barrages- types purposes.
- Hydro electric project like Forebay ,Penstock, Turbines, Power house, etc.
- Canals- classification and distribution system, canal structures.
- Types of cross drainage works like Aqueduct, Super passage, Syphon, Level crossing, inlet and outlet, etc.

### **13. Estimating and Costing:-**

- Introduction, Purpose and common techniques, Drawing of construction, Measurement techniques.
- Estimate-necessity, importance, types- approximate and detailed estimate-main and sub estimates ,revised, supplementary, maintenance/repair estimate-taking off quantities-method Rate analysis of typical item sand their specifications, Labor and materials, Govt. Schedule of rate, Estimating of irregular boundaries by trapezoidal and Simpsons formula.

## Part A Syllabus

### Post- Junior Draftsman (Electrical/Mechanical)

#### I. 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-L and R-C circuit.

##### 3. 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, 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, 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.

#### **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 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.

## **10. Estimation and Costing**

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

## **11. The Utilisation 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 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.

## II Mechanical:

### 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 engineering drawing as per Sp-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 plane 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.

### **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 and 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. Toleranced dimensioning, geometrical tolerance. Indications of symbols for machining and surface finishes on drawing (grades and micron values)
- Knowledge of design, manufacture, and operation of pressure vessels.

### **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 precaution for lathes. Method of using precision measuring instrument such as inside & outside micrometers, depth gauges, vernier callipers, dial indicators, slip gauges, sine bars, universal bevel protractor, etc.
- Brief Description of milling, shaping, slotting and planing machines. Quick return mechanism of these machines. Different clamping devices on milling operation. Different clamping devices on shaping operation.
- Brief description of common equipment required for sheet metal work. Different types of joints 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, Handtools used for molding. The description, use and care of hand tools.
- Safety precaution 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.

### **Basics of Electrical Engineering**

- A.C & D.C Motors Generators of common types and their uses and brief description of common equipment necessary for sheet metal work.
- Electrical units and quantities.
- Laws of electricity.

### **Computer Aided Drafting**

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

### **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.

### **Thermodynamics**

- Laws Of Thermodynamics
- Knowledge of simple stationary fire tube boiler, boiler mountings. Function and purpose of blow offcock.
- Brief description of internal combustion engines, such as cylinder block piston, carburettor spark plug, camshaft, crank shaft, injector fuel pump etc. Knowledge of fuel injection system in petrol and diesel engine.
- Description of different parts of petrol engine.

### **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, FRL or air 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.

## Annexure-2

### Part B Syllabus

**General Knowledge, English, Punjabi, Logical Reasoning and Mental Ability.**

<b>Sr. No.</b>	<b>Indicative Contents of Syllabus</b>	<b>Weightage (Approx.)</b>
1	<p><b>General Knowledge and Current affairs of National and International importance including:</b></p> <ul style="list-style-type: none"><li>(i) Political issues,</li><li>(ii) Environment issues,</li><li>(iii) Current Affairs,</li><li>(iv) Science and Technology,</li><li>(v) Economic issues,</li><li>(vi) History of Punjab-14<sup>th</sup> century onwards</li><li>(vii) History of India with special reference to Indian freedom struggle movement.</li><li>(viii) Sports,</li><li>(ix) Cinema and Literature.</li></ul>	10
2	<p><b>Logical Reasoning &amp; Mental Ability:</b></p> <p>Verbal reasoning: Coding, Decoding, Analogy, Classification, Series, Direction sense test, relations, mathematical operations, time test, odd man out problems.</p> <p>Non Verbal reasoning: Series, Analogy and Classification.</p> <p>Basic numerical skills, Percentage, Number system, LCM and HCF, Ratio and Proportion, Number series, Average, Problems based on Ages, Profit &amp; Loss, Partnership and Mixture, Simple and Compound Interest, Work and Time, Time and Distance, Mensuration and Data Interpretation.</p>	10
3	<p><b>English:-</b></p> <p>Basic Grammar, Subject and Verb, Adjectives and Adverbs, Synonyms, Antonyms, One Word Substitution, Fill in the Blanks, Correction in Sentences, Idioms and their meanings, Spell Checks, Adjectives, Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice, Correction in Sentences, etc.</p>	5
4	<p><b>ਪੰਜਾਬੀ:-</b></p>	5

	<p>ਸੁੱਧ-ਅਸੁੱਧ, ਸ਼ਬਦ ਜੋੜ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ, ਸਮਾਨਾਰਥਕ/ਵਿਰੋਧੀ ਸ਼ਬਦ, ਨਾਂਵ, ਪੜਨਾਂਵ ਅਤੇ ਕਿਰਿਆ ਦੀਆਂ ਕਿਸਮਾਂ ਤੇ ਸਹੀ ਵਰਤੋਂ, ਲਿੰਗ ਅਤੇ ਵਚਨ, ਪੰਜਾਬੀ ਅਖਾਣ ਤੇ ਮੁਹਾਵਰੇ, ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਅਤੇ ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੀ ਥਾਂ ਇੱਕ ਸ਼ਬਦ ਆਦਿ।</p>	
	<p><b>Maximum Marks</b></p>	<p>30</p>

Note:-a) The distribution of marks/question in each section is indicative. It may vary slightly.

b) The syllabus is broadly classified as above but may vary to some extent.