# Mechanical Engineering

(Ref – https://ssc.nic.in/Downloads/portal/english/Syllabus-JE%20Eamination.pdf)

## 1. Theory of Machines and Machine Design

- Concept of simple machine, Four bar linkage and link motion, Flywheels and fluctuation of energy, Power transmission by belts – V-belts and Flat belts, Clutches – Plate and Conical clutch, Gears – Type of gears, gear profile and gear ratio calculation, Governors – Principles and classification, Riveted joint, Cams, Bearings, Friction in collars and pivots

## 2. Engineering Mechanics and Strength of Materials

- Equilibrium of Forces, Law of motion, Friction, Concepts of stress and strain, Elastic limit and elastic constants
- Bending moments and shear force diagram, Stress in composite bars, Torsion of circular shafts
- Bucking of columns – Euler's and Rankin's theories, Thin walled pressure vessels

## 3. Thermal Engineering

**(a) Properties of Pure Substances -** p-v & P-T diagrams of pure substance like $H_2O$, Introduction of steam table with respect to steam generation process, Definition of saturation, wet & superheated status, Definition of dryness fraction of steam, degree of superheat of steam, H-s chart of steam (Mollier's Chart)

**(b) 1st Law of Thermodynamics -** Definition of stored energy & internal energy, 1st Law of Thermodynamics of cyclic process, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow, Steady State Steady Flow Energy Equation

**(c) 2nd Law of Thermodynamics -** Definition of Sink, Source, Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator, Thermal Efficiency of Heat Engines & Co-efficient of Performance of Refrigerators, Kelvin–Planck & Clausius Statements of 2nd Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius Integral, Entropy, Entropy change calculation of ideal gas processes, Carnot Cycle & Carnot Efficiency, PMM–2; definition & its impossibility

**(d) Air Standard Cycles for IC Engines -** Otto cycle; plot on P–V, T–S planes; Thermal Efficiency, Diesel Cycle; Plot on P–V, T–S planes; Thermal efficiency, IC Engine Performance, IC Engine Combustion, IC Engine Cooling & Lubrication

**(e) Rankine Cycle of Steam -** Simple Rankine cycle plot on P–V, T–S, h–s planes, Rankine cycle efficiency with & without pump work, Boilers; Classification; Specification; Fittings & Accessories : Fire Tube & Water Tube Boilers

**(f) Other Topics -** Air Compressors & their cycles, Refrigeration cycles, Principle of a Refrigeration Plant, Nozzles & Steam Turbines

## 4. Fluid Mechanics & Machinery

- Ideal & real fluids, Newton's law of viscosity Newtonian and Non-Newtonian fluids, Compressible and incompressible fluids
- Pressure at a point
- Manometers, U-tube, Inclined tube
- Stream line, laminar & turbulent flow, External & internal flow, Continuity equation
- Bernoulli's equation, Total head, Velocity head, Pressure head, Application of Bernoulli's equation
- Basic Principles : Venturimeter, Pilot tube, Orifice meter
- Hydraulic Turbines : Classifications, Principles, Centrifugal Pumps : Classifications, Principles, Performance

## 5. Production Engineering

- Classification of Steels : mild steel & alloy steel, Heat treatment of steel
- Welding – Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques i.e. TIG, MIG, etc. (Brazing & Soldering), Welding Defects & Testing; NDT
- Foundry & Casting – methods, defects, different casting processes, Forging, Extrusion, etc., Metal cutting principles, cutting tools
    - Basic Principles of machining with (i) Lathe(ii) Milling (iii) Drilling (iv) Shaping (v) Grinding
- Machines, tools & manufacturing processes

## 6. Engineer drawing and mechanical drafting

- Projections and multiview representation, Sectional views.
- Dimensioning, tolerance, machining and welding symbols.
- Production drawing, Introduction to Auto CAD, Application of Auto CAD, Presentation.
- Pipe Drafting, Gear Drawing, Graph and charts

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## Trade Test Tasks

1. Identify and explain components of a four-bar linkage mechanism.
2. Calculate gear ratio and sketch a simple gear train.
3. Demonstrate alignment and tensioning of a V-belt or flat-belt drive.
4. Assemble and explain the working of a single-plate clutch model.
5. Compute stress, strain, and modulus of elasticity from a load–elongation dataset.
6. Draw shear force and bending moment diagrams for a simply supported beam.
7. Solve a torsion problem for a circular shaft to find shear stress or angle of twist.
8. Calculate critical buckling load using Euler or Rankine formula from given data.
9. Identify steam states (wet/saturated/superheated) using pressure–temperature values.
10. Sketch a Rankine cycle on T–S or h–s diagram and describe stages.
11. Calculate thermal efficiency of Otto or Diesel cycle from compression/cut-off ratios.

12. Demonstrate pressure measurement using U-tube or inclined manometers.
13. Apply Bernoulli's equation to compute discharge using venturimeter/orifice meter readings.
14. Identify type and components of a hydraulic turbine from models or diagrams.
15. Inspect welded samples and identify welding defects (porosity, cracks, undercut etc.).
16. Demonstrate tool setting and facing operation on a lathe (or explain steps).
17. Prepare a part drawing with correct dimensions, tolerances, and machining symbols.
18. Interpret a given production drawing and identify fits, tolerances, and surface finish.
19. Create a simple 2D AutoCAD drawing of a mechanical component.
20. Prepare a freehand sectional view of a pipe joint or bearing housing.
21. Convert an isometric view of a mechanical object into orthographic (front, top, side) projections.
22. Read a sectional drawing and identify hidden/internal features accurately.
23. Draw and label different types of welding symbols and apply them on a given drawing.
24. Prepare a detailed pipe drafting layout with correct representation of elbows, tees, flanges, and valves.

# Electronics & Communication/ Instrumentation Engineering

(Ref - https://viet.edu.in/img/courses-tab/diploma/diploma-ece/curriculam/C23-DECE-curriculum.pdf)

I. Electronic Components and Materials

- Conductors, semiconductors, and insulators.

- Passive components: resistors, capacitors, inductors, and their testing.

- Electromechanical devices: relays, solenoids, switches, contactors.

II. Semiconductor Devices

- Diodes and rectifiers; voltage regulators.

- BJT, FET, MOSFET — operating principle and applications in measurement systems.

- Special-purpose devices: LED, photodiode, UJT, SCR, TRIAC, DIAC.

- Optoelectronic components in instrumentation.

III. Network and Circuits

- DC and AC network analysis using Kirchhoff's laws and theorems.

- Resonance and filter characteristics.

- Time constant and transient analysis of RC and RL circuits.

- Signal conditioning basics.

IV. Electrical & Electronic Measurements

- Measurement fundamentals: accuracy, precision, errors.

- Instruments for electrical measurement: ammeter, voltmeter, wattmeter, energy meter.

- Electronic measuring instruments: DMM, CRO, DSO, signal generators.

- Transducers for industrial parameters:

    o Temperature (RTD, thermistor, thermocouple)

    o Pressure (strain gauge, diaphragm)

    o Flow (turbine, venturi)

    o Displacement (LVDT, capacitive).

- Bridge and calibration techniques.

- Telemetry and data acquisition systems for process monitoring.

V. Analog and Digital Electronics

- Amplifier stages and power amplifiers.

- Oscillators: RC, LC, crystal.

- Operational amplifiers and signal conditioning circuits.

- Logic gates, combinational and sequential circuits.

- Counters, shift registers, ADC/DAC, and memory elements.

## VI. Industrial Instrumentation

- Static and dynamic characteristics of instruments.

- Measurement of process variables: temperature, pressure, flow, level.

- Control valves and actuators.

- Smart transmitters and signal isolation.

- Introduction to hazardous area instrumentation and grounding.

## VII. Control Systems and Automation

- Open-loop and closed-loop systems.

- Block diagram, feedback concepts and stability concepts.

- Controllers: P, PI, PID – working principles and tuning.

- Programmable Logic Controllers (PLC): architecture, ladder diagrams, timers, counters.

- SCADA systems – architecture and applications.

- Servo and stepper motor control.

## VIII. Microprocessor and Microcontroller Applications

- 8051 architecture and programming.

- Interfacing ADC, DAC, sensors, actuators, and displays.

- Basics of data acquisition systems.

- Arduino-based measurement and control projects.

## IX. Power and Industrial Electronics

- SCR, TRIAC, DIAC – working and triggering circuits.

- Rectifiers, inverters, choppers – applications in control systems.

- Motor drives and solid-state relays.

- SMPS and UPS systems in instrumentation panels.

## X. Data Communication and Industrial Networking

- Basics of data communication: analog and digital signals.

- Communication standards: RS-232, RS-485, MODBUS, HART, Profibus.

- Fieldbus concepts and industrial Ethernet.

- Basics of IoT-based process monitoring.

## XI. Computer Fundamentals

- Number systems and binary arithmetic.

- C/C++ programming and flow control.

- Basic programming in Python.

- Introduction to MATLAB or LabVIEW for measurement simulation.


**Trade test syllabus :**

1. Identify and test common components (resistors, capacitors, diodes, transistors, op-amps) using a digital multimeter.
2. Assemble and test a half-wave and full-wave rectifier circuit; observe output waveform on CRO.
3. Measure voltage, current, and frequency in a given circuit using analog and digital instruments.
4. Use a CRO or DSO to measure amplitude and time period of a waveform from a function generator.
5. Calibrate a given analog voltmeter or ammeter using a digital standard and record the error curve.
6. Demonstrate the effect of zero, span, and linearity adjustments on a pressure gauge or indicating instrument.
7. Construct and test a single-stage BJT amplifier and measure voltage gain.
8. Design a simple op-amp circuit (inverting amplifier / comparator) and verify response.
9. Build and test a logic gate circuit (AND, OR, NOT, NAND) using ICs and verify truth tables.
10. Assemble a 4-bit counter or timer circuit (using 555 or 7493 IC) and display output sequence on LEDs.
11. Identify given transducers: RTD, thermocouple, strain gauge, LVDT, pressure transmitter.
12. Measure temperature using a thermocouple/RTD and record corresponding mV/mA readings.
13. Calibrate a pressure transmitter using a hand pump and current loop meter (4–20 mA output).
14. Demonstrate the operation of a level or flow transmitter and interpret output signal.
15. Interface a sensor (temperature or LDR) with a signal-conditioning amplifier and display its output.
16. Draw and explain an open-loop and closed-loop control system using temperature/speed control setup.
17. Implement a PID control loop on a training panel and observe the effect of P, I, and D actions.
18. Develop and run a simple PLC ladder logic program for ON/OFF control of a motor using start/stop pushbuttons.
19. Program a PLC timer/counter to operate two lamps in sequence.
20. Interface a PLC with an analog input (e.g., pressure/temperature signal) and display on HMI or indicator.
21. Identify ports and pins of an 8051 or Arduino board and explain their functions.
22. Write and execute a microcontroller program to blink LEDs or control a digital output.
23. Acquire and display sensor data (temperature or light intensity) using microcontroller setup.
24. Test and demonstrate operation of SCR or TRIAC using a triggering circuit.

25. Demonstrate DC motor speed control using a PWM or SCR-based control circuit.

# IPR/HR/Finance/R&D/Project Management

- Fundamentals of Intellectual Property Rights

  - WTO & TRIPS Agreement

  - IPR Status in India

  - Basics of Drafting and Filing a Patent

  - Basics of Copyright and Design Registration.

  - PCT and Paris Convention.

- Human Resources (HR) Essentials

  - Role of HR in Organizations, Key Functions: Recruitment, Training, Performance Management

  - Basic HR Policies and Practices , Employee Rights and Responsibilities

  - Importance of Communication in HR

- Outreach and Public Communication

  - Introduction to Outreach Programs, Objectives and Significance in Materials & Processes Types of Outreach Activities (workshops, seminars)

  - Effective Communication Skills, Verbal and Non-Verbal Communication, Public Speaking Techniques

- Basic Technical Skills

  - Computer Literacy o Proficiency in Word Processing, Spreadsheets, and Presentations

  - Introduction to Research Tools, Basic Data Analysis and Research Documentation

- Project Management and Business Development

  - R&D Project Management, Types of R&D Projects and Funding Mechanisms, R&D Project Lifecycle, Auditing R&D Projects, Funding Mechanisms

  - Team Collaboration, Roles in a Team and Effective Teamwork Strategies

  - Business Development, Basics of Technology Transfer, Agreement Drafting, Startup India Policy

**Trade Test Tasks (Practical / Analytical Tasks)**

1. Identify and classify a short case under the correct form of Intellectual Property (Patent, Copyright, Trademark, or Design).
2. Write a brief summary (100 words) of a technical concept suitable for a patent abstract or report.

3. Draft a simple internal communication (memo, office order, or note) using correct format and tone.
4. Prepare a concept note for a small institutional event or outreach activity stating objectives and expected outcomes.
5. Write a one-page meeting or workshop summary highlighting decisions and follow-up actions.
6. Prepare a project initiation note giving title, objectives, budget estimate, and duration.
7. Create a basic project timeline or Gantt chart showing milestones and responsibilities.
8. Draft a budget summary for a sample project indicating expenditure heads and fund allocation.
9. Identify issues in a short project case and suggest corrective steps or risk mitigation measures.
10. Outline a Memorandum of Understanding (MoU) showing essential clauses such as objectives, roles, and confidentiality.
11. Write a short note explaining technology transfer or collaboration process in public R&D organizations.
12. Prepare a training or orientation schedule for staff including topic, duration, and learning outcomes.
13. Summarize a performance appraisal case or prepare a short feedback format based on sample data.
14. Draft a brief grievance handling note showing balanced reasoning and clarity.
15. Prepare a financial statement summary or utilization report using given figures.
16. Demonstrate basic spreadsheet skills by preparing a table of tasks, costs, and completion percentages.
17. Create a simple bar or pie chart representing project expenditure or progress.
18. Format a document in Word with headings, numbering, and table insertion.
19. Prepare a short presentation (3–5 slides) on a given institutional or policy topic.
20. Deliver a two-minute oral briefing summarizing a topic such as "Role of IPR in R&D Management" or "Importance of Communication in Projects."

# Computer Science Engineering / Information Technology

## 1. Hardware, Operating Systems & System Maintenance

- Covers fundamentals of computer architecture, I/O devices, memory hierarchy, buses, and motherboard components.
- Includes OS concepts such as process and memory management, file systems, installation of Linux/Windows, BIOS/POST, and essential Unix commands.
- Emphasis on assembling systems, configuring peripherals, diagnosing faults, data recovery, disk management, and applying security features (authentication, logs, permissions, malware handling).
- Includes basics of electrical/electronics, UPS types, and cloud-based backup and recovery.

## 2. Programming & Software Development

- Focuses on structured programming in C—variables, control structures, arrays, pointers, functions, structures, and unions—along with implementation of key data structures (stacks, queues, linked lists, trees, graphs) and fundamental algorithms for sorting and searching.
- Java covers OOP principles such as classes, inheritance, polymorphism, interfaces, exception handling, and multithreading.
- Python includes data types, loops, functions, and simple OOP implementations.
- Software Engineering introduces SDLC models and basic project development processes. Includes introductory MIS/ERP concepts.

## 3. Database Management Systems

- Includes database characteristics, data models, ER-modelling, relational concepts, keys, and normalization up to BCNF.
- SQL focuses on table creation, constraints, DDL/DML/DCL operations, joins, functions, views, and indexes.
- PL/SQL covers cursors, triggers, procedures, and exception handling.
- Includes fundamentals of database security, web-database connections, and introductory data analysis.

## 4. Networking & Security

- Covers data communication basics, OSI/TCP-IP models, network types, topologies, and media (UTP, fiber).
- Includes configuration and role of hubs, switches, routers, modems, and NICs.
- Students learn IP addressing, subnetting, and troubleshooting of cables and devices.
- Security concepts include VLAN, VPN, firewalls, IDS/IPS, proxy servers, and protocol-level vulnerabilities. Introduces IoT communication fundamentals.

## 5. Web, Multimedia & Emerging Technologies

- Client-side development using HTML, CSS, and JavaScript; server-side programming with PHP; basics of XML, DOM/SAX parsing.
- Multimedia skills include image editing (Photoshop) and simple animations (Flash).

- Covers Android fundamentals, cloud service models (SaaS/PaaS/IaaS), and basics of e-commerce and digital marketing.

## 6. Office Productivity Tools

- Hands-on proficiency in OpenOffice Writer, Calc, and Impress for documentation, spreadsheets, presentations, data handling, and professional communication.

## Syllabus for Trade Test (Practical):

1. Identify motherboard components and explain their functions.
2. Assemble a desktop system with RAM, storage, and essential connections.
3. Configure BIOS/UEFI settings and demonstrate CMOS reset.
4. Install Windows or Linux OS with proper partitioning and driver setup.
5. Execute basic Linux shell commands for file and process management.
6. Diagnose and resolve a hardware fault (e.g., no-boot or display issue).
7. Demonstrate OS security features—user management, permissions, logs, and firewall.
8. Create a formatted document in OpenOffice Writer.
9. Prepare a spreadsheet in Calc using formulas and conditional formatting.
10. Develop a short presentation in OpenOffice Impress.
11. Write and execute a C program using loops or conditional statements.
12. Implement a stack/queue/linked list program in C.
13. Write a simple Python program using lists, loops, and functions.
14. Create a SQL table with constraints and insert records.
15. Execute SQL queries with conditions, joins, and aggregate functions.
16. Create and run a PL/SQL stored procedure or trigger.
17. Prepare a UTP straight or cross cable using a crimping tool.
18. Configure a small LAN and assign IP addresses.
19. Perform network troubleshooting using ping and traceroute.
20. Create a simple HTML page with CSS and JavaScript-based validation.

# Civil Engineering

(Ref - https://ssc.nic.in/Downloads/portal/english/Syllabus-JE%20Eamination.pdf)

**Building Materials**

- Physical and Chemical properties

- Classification, standard tests, and uses

- Manufacture/quarrying of materials, e.g.: Building stones, Silicate-based, materials, Cement (Portland), Asbestos products, Timber and wood-based products, Laminates, Bituminous materials, Paints, varnishes

**Estimating, Costing and Valuation**

- Estimate, glossary of technical terms, analysis of rates, methods, and unit of measurement

- Items of work: Earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering

- Calculation Methods: Centre line method, Mid-section formula, Trapezoidal formula, Simpson's rule, Bar bending schedule

- Cost estimate examples: Septic tank, flexible pavements, Tube well, isolated and combined footings, Steel Truss, Piles and pile-caps, Boundary wall, Brick building, Water Tank

- Valuation: Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation

**Surveying**

- Principles of surveying, measurement of distance, chain surveying

- Working of prismatic compass, compass traversing, bearings, local attraction, Plane table surveying

- Theodolite traversing, adjustment of theodolite

- Levelling: Definition of terms, curvature and refraction corrections, temporary and permanent adjustments of dumpy level

- Contouring: Methods of contouring, uses of contour map, Tachometric survey

- Curve setting, Earth work calculation

- Advanced surveying equipment

**Soil Mechanics**

- Fundamentals: Origin of soil, phase diagram, definitions (void ratio, porosity, degree of saturation, water content, specific gravity, unit weights, density index), interrelationship of parameters.

- Classification: Grain size distribution curves, index properties, Atterberg's limits, ISI soil classification and plasticity chart.

- Soil & Water: Permeability, coefficient of permeability, unconfined and confined aquifers, effective stress, quick sand.

- Consolidation: Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement.

- Shear Strength: Shear strength of soils, direct shear test, Vane shear test, Triaxial test.

- Compaction: Soil compaction, laboratory compaction test, maximum dry density, and optimum moisture content.

- Pressure & Bearing Capacity: Earth pressure theories (active and passive), bearing capacity of soils, plate load test, standard penetration test.


**Hydraulics**

- Fluid properties, Hydrostatics, Measurements of flow, Bernoulli's theorem and its application, Flow through pipes, Flow in open channels

- Weirs, flumes, spillways, Pumps and turbines

**Irrigation Engineering**

- Fundamentals: Definition, necessity, benefits, and effects of irrigation; types and methods.

- Hydrology: Measurement of rainfall, run-off coefficient, rain gauge, losses from precipitation (evaporation, infiltration).

- Crop Water Needs: Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies.

- Canal System: Types of canals, canal irrigation, loss of water in canals, canal lining (types and advantages).

- Groundwater: Shallow and deep tube wells, yield from a well.

- Structures & Theories: Weir and barrage, failure of weirs, permeable foundation, Slit and Scour, Kennedy's theory of critical velocity, Lacey's theory of uniform flow.

- Water Management: Flood definition, causes and effects, methods of flood control; Water logging and preventive measures.

- Land Reclamation: Characteristics affecting soil fertility, purposes, methods, and processes.

- Projects: Major irrigation projects in India.

**Transportation Engineering**

- Highway Engineering: Cross-sectional elements, geometric design, types of pavements, pavement materials (aggregates and bitumen) and tests, Design of flexible and rigid pavements (WBM, WMM, Gravel Road, Bituminous construction), rigid pavement joints, pavement maintenance, highway drainage.

- Railway Engineering: Components of permanent way (sleepers, ballast, fixtures and fastening), track geometry, points and crossings, track junction, stations and yards.

- Traffic Engineering: Traffic surveys, speed-flow-density relationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.

**Environmental Engineering**

- Water Supply: Quality of water, source of water supply, purification of water, distribution of water.

- Wastewater Engineering: Need of sanitation, sewerage systems (circular, oval), sewer appurtenances, sewage treatments.

- Drainage: Surface water drainage.

- Solid Waste Management: Types, effects, and engineered management system.

- Pollution Control: Air pollution: Pollutants, causes, effects, control.

- Noise pollution: Cause, health effects, control.

Trade Test Syllabus

1. Identify samples of common building materials.
2. Conduct fineness and consistency test on cement.
3. Determine specific gravity and water absorption of coarse aggregate.
4. Perform compressive strength test on cement mortar cubes.
5. Prepare a quantity estimate for a single-room brick building.
6. Calculate reinforcement steel quantities using a bar bending schedule.
7. Perform rate analysis for a selected construction item.
8. Conduct a chain survey for a closed traverse and plot the plan.
9. Perform differential levelling and prepare an RL table.
10. Determine horizontal and vertical angles using a theodolite.
11. Demonstrate use of auto-level/total station and interpret readings.
12. Determine moisture content of soil by oven-drying.
13. Conduct sieve analysis and prepare grain size distribution curve.
14. Determine Atterberg limits and compute plasticity index.
15. Conduct Proctor compaction test to determine OMC and MDD.
16. Verify Bernoulli's theorem using a hydraulic bench.
17. Determine discharge through a venturimeter or orifice meter.
18. Determine aggregate impact value or bitumen penetration value.
19. Measure pH and turbidity of a water sample or conduct a jar test.
20. Prepare a scaled plan/section of a single-room building and demonstrate correct use of tools and PPE.

# Fitter trade

## Written Test Syllabus

- Linear measurements - its units, dividers, calipers, hermaphrodite, centre punch, dot punch, prick punch their description and uses of different types of hammers .
- Description, use and care of 'V Blocks, marking off table . Measuring standards (English, Metric Units), angular measurements .
- Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws .
- Files-specifications, description, materials, grades, cuts, file elements, uses . Types of files, care and maintenance of files . Measuring standards (English, Metric Units), angular measurements .
- Marking off and layout tools, dividers, scribing block, description, classification, material, care & maintenance .
- Try square, ordinary depth gauge, protractor - description, uses and cares .
- Uses, care & maintenance of cold chisels materials, types, cutting angles . Marking media, marking blue, Prussian blue, red lead, chalk and their special application, description . Use, care and maintenance of scribing block .
- Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance .
- Physical properties of engineering metal: colour, weight, structure, and conductivity, magnetic, fusibility, specific gravity .
- Mechanical properties: ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity .
- Micrometer- outside and inside principle, constructional features, parts graduation, reading, use and care .
- Micrometer depth gauge, parts, graduation, reading, use and care . Digital micrometer .
- Vernier calipers, principle, construction, graduations, reading, use and care .
- Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Caliper . Digital Vernier caliper .
- Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance .
- Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine .
- Determination of tap drill size .
- Safety precautions to be observed in a sheet metal workshop, sheet and sizes, Commercial sizes and various types of metal sheets, coated sheets and their uses as per BIS specifications .
- Shearing machine-description, parts and uses .
- Stakes-bench types, parts, their uses . Various types of metal joints, their selection and application, tolerance for various joints, their selection& application .
- Wired edges .
- Solder and soldering: Introduction-types of solder and flux . Composition of various types of solders and their heating media of soldering iron .

- Method of soldering, selection and application-joints . Hard solder, types and method of brazing .
- Various rivets shape and form of heads, importance of correct head size .
- Rivets-Tin man's rivets types, sizes, and selection for various works . Riveting tools, dolly snaps description and uses .
- Method of riveting, spacing of rivets . Flash riveting, use of correct tools, compare hot and cold riveting .
- Safety-importance of safety and general precautions observed in a welding shop . Precautions in electric and gas welding (Before, during, after) .
- Introduction to safety equipment and their uses . Machines and accessories, welding transformer, welding generators .
- Welding hand tools: Hammers, welding description, types and uses, description, principle, method of operating, carbon dioxide welding . H.P. welding equipment: description, principle, method of operating . L.P. welding equipment: description, principle, method of operating .
- Types of Joints-Butt and fillet as per BIS SP: 46-1988 specifications .
- Gases and gas cylinder description, kinds, main difference and uses .
- Drill- material, types, (Taper shank, straight shank) parts and sizes . Drill angle-cutting angle for different materials, cutting speed feed .
- R.P.M. for different materials . Drill holding devices- material, construction and their uses .
- Counter sink, counter bore and spot facing-tools and nomenclature . Reamer material, types (Hand and machine reamer), kinds, parts and their uses, determining hole size (or reaming), Reaming procedure .
- Screw threads: terminology, parts, types and their uses . Screw pitch gauge: material parts and uses .
- Taps British standard (B.S.W., B.S.F., B.A. & B.S.P.) and metric /BIS (coarse and fine) material, parts (shank body, flute, cutting edge) .
- Tap wrench: material, parts, types (solid &adjustable types) and their uses removal of broken tap, studs (tap stud extractor) .
- Dies: British standard, metric and BIS standard, material, parts, types, Method of using dies . Die stock: material, parts and uses .
- Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing . Selection of grinding wheels .
- Bench grinder parts and use .
- Interchange ability: Necessity in Engg. field definition, BIS. Definition, types of limit, terminology of limits and fits, basic size, actual size, deviation, high and low limit, zero line, tolerance zone Different standard systems of fits and limits.
- British standard system, BIS system .
- Lathe cutting tools, Nomenclature of single point & multipoint cutting tools, Tool selection based on different requirements and necessity of correct grinding, solid and tipped, throw away type tools, cutting speed and feed and comparison for H.S.S., carbide tools .
- Use of coolants and lubricants .
- Screw thread definition uses and application, Square, worm, buttress, acme (nonstandard-screw threads), Principle of cutting screw thread in centre lathe principle of chasing the screw thread use of centre gauge, setting tool for cutting internal and external threads, use of screw pitch gauge for checking the screw thread .

- Introduction to Engineering Drawing and Drawing Instruments Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument Lines- Types and applications in drawing Free hand drawing of Geometrical figures and blocks with dimension Transferring measurement from the given object to the freehand sketches .
- Free hand drawing of hand tools and measuring tools . Drawing of Geometrical figures: Angle, Triangle, Circle, Rectangle, Square, Parallelogram .
- Lettering & Numbering - Single Stroke . Dimensioning . Types of arrowhead Leader line with text Position of dimensioning (Unidirectional, Aligned) Symbolic representation Different symbols used in the related trades, Concept and reading of Drawing in . Concept of axes plane and quadrant Concept of Orthographic and Isometric projections Method of first angle and third angle projections .
- Screws: material, designation, specifications, Property classes (eg. 9.8 on screw head), Tools for tightening/ loosening of screw or bolts .
- Torque wrench, screw joint calculation uses, Power tools: its constructional features, uses & maintenance .
- Special files: types (pillar, Dread naught, Barrow, warding) description & their uses .
- Application of slip gauges for measuring, Sine Bar-Principle, application & specification . Procedure to check adherence to specification and quality standards .
- Metallurgical and metal working processes such as Heat treatment, various heat treatment methods chartmalizing, annealing, hardening and tempering purpose of each method, tempering colour .
- The various coatings used to protect metals, protection coat by heat and electrical deposit treatments .
- Treatments to provide a pleasing finish such as chromium silver plating, nickel plating and galvanizing .

## Trade Test Syllabus

- Plan and organize the work to make job as per specification by applying different types of basic fitting operation and Check for dimensional accuracy allowing safety precautions . (Basic fitting operation-marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc) .
- Produce components by different operations and Check accuracy using appropriate measuring instruments . (Different Operations Drilling, Reaming, Taping, Dyeing; Appropriate Measuring Instrument-Vernier, Screw Gauge, Micrometer) .
- Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality .
- Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality . (Different Mating Surfaces- Dovetail fitting, Radius fitting, Combined fitting. Different surface finishing operations - Scraping, Lapping and Honing: Different fastening components - Dowel pins, screws, bolts, keys and cotters. Different fastening tools-hand operated & power tools) .
- Read and apply engineering drawing for different application in the field of work.

# Computer Operator and Programming

Reference https://dgt.gov.in/sites/default/files/2024-12/COPA_CTS2.0_NSQF-3.5.pdf)

<u>Syllabus for Written Test</u>

- **OS & Computer Fundamentals:** Install and setup operating system and related software in a computer following safety precautions.

  **Topics** - Concepts of Hardware and Software; Introduction to Windows and Linux Operating Systems; Main features of Windows OS; Basic DOS (Internal and External) and Linux commands; Booting process; Basic hardware and software issues and their solutions.

- **Office Productivity Tools:** Create, format and edit document using word processing application software, Create, format, edit and develop a workbook by using spreadsheet application software, Create and customize slides for presentation.

  **Topics** - Introduction to Word features, toolbars, and macros; Working with mail merge, templates, and objects in Word; Introduction to Excel features, Data Types, and Cell referencing; Concepts of sorting, filtering, and validating data in Excel; Analyzing data using charts and pivot tables; Introduction to PowerPoint, creating slide shows, and presentation techniques.

- **Networking & Internet:** Install, setup/configure, troubleshoot and secure computer network including Internet.

  **Topics** - Local Networks and Principles of Communications; Introduction to LAN Devices (Hub, Switch) and Internetworking Devices; Internet Concepts: WWW, Web Browsers, search engines; Concepts of Domain Naming Systems and E-mail communication.

- **Database Management (MySQL):** Create and manage database file using MySQL.

  **Topics** - Concept of DBMS and RDBMS; Database Schema and Normalization Rules; DDL, DML, and DCL statements; Enforcing Primary key and Foreign key; Queries: Joins, Sub-queries, and Functions (sum, average, max, min).

- **Web Design & Cyber Security:** Develop web pages using HTML, CSS, and JavaScript. Secure information from Internet by using cyber security concept.

  **Topics** - Concepts of Static and Dynamic Web pages; Introduction to HTML and various tags; Concepts of CSS and applying CSS to HTML; Overview of Information Security, threats, and risk management; Introduction to IT Act and penalties for cybercrimes.

- **Advanced Skills:** Using cloud storage for file sharing and writing a simple program in Python or Java.

**Syllabus for Trade Test (Practical)**

1. Assembling components of a desktop computer.
2. Install Windows and Ubuntu Linux operating systems.
3. Format hard disk and create partitions.
4. Install drivers for printer, scanner, webcam.
5. Use basic DOS commands for file/directory management.
6. Use basic Linux commands for file/directory management.
7. Create a document with tables, headers/footers, and page borders.
8. Create an invitation letter using mail merge.
9. Create a mark sheet using a spreadsheet with functions and formulae.
10. Prepare a pivot table from a given data set.
11. Create a simple presentation with audio/video elements and transitions.
12. Create straight and cross-over network cables.
13. Practice IP Addressing (IPv4) and use the ping command to test networks.
14. Set up and configure a wired LAN with at least three computers.
15. Share files, folders, and printers in a network.
16. Configure Hub and Switch.
17. Installation of MySQL, Creation and use of databases and tables.
18. Using DDL, DCL, and DML statements (Create, Insert, Update, Select).
19. Applying data integrity rules and constraints.
20. Writing simple select queries with joins and functions.
21. Design simple web pages with text, paragraphs, tables, and lists using HTML.
22. Use hyperlinks and insert pictures in a web page.
23. Design web pages with forms and form controls.
24. Create a simple static web page and apply styles using CSS.
25. Provide firewall security for an internet connection.
26. Use Anti-Virus software and perform back-ups of files.

# *Library and Information Science*

(Ref - https://dgt.gov.in/en/cts-details and other labs)

**Written exam syllabus**

- **Introduction to Library & Information Science:** Role of libraries, types (public, academic, special), library functions.

- **Library Organization:** Physical setup, shelving systems, signage, user-friendly layouts.

- **Classification Systems:** Dewey Decimal Classification (DDC), Universal Decimal Classification (UDC); basics and structure.

- **Cataloging Principles:** Anglo-American Cataloguing Rules (AACR2), MARC format, metadata basics.

- **Library Resources:** Books, journals, e-resources, non-book materials; selection and acquisition processes.

- **Safety and Maintenance:** Dust control, book preservation, handling fire hazards, and ergonomics.

- **Basic IT Skills:** MS Office (Word, Excel), internet browsing, digital library concepts.

- **Advanced Cataloging:** Online cataloging, OPAC systems, ISBN/ISSN usage, metadata standards.

- **Information Retrieval:** Search techniques, reference services, user query handling.

- **Library Automation:** Library management software (e.g., Koha, LibSys), barcode systems, RFID basics.

- **User Services:** Circulation procedures, membership management, interlibrary loans.

- **Digital Libraries:** E-books, databases (JSTOR, PubMed), open-access resources, copyright basics.

- **Entrepreneurship:** Starting a library consultancy, budgeting, marketing library services.

- **Ethics and Laws:** Intellectual property, user privacy, library policies, Right to Information Act.

**Trade test syllabus**

1. Arrange a given set of books in correct order according to Dewey Decimal Classification (DDC) numbers.
2. Prepare accession entries for a set of new books in the accession register.
3. Create and print spine labels and barcode labels for sample books.
4. Paste barcode and spine labels properly on books.
5. Enter bibliographic details of books into library automation software (e.g., Koha/LibSys).
6. Issue and return books using library software and barcode scanner.
7. Create a new user membership record in library software.
8. Prepare an Excel sheet listing books with title, author, and accession number.
9. Search for a specific book or journal in the OPAC system.
10. Conduct stock verification for a small section and mark missing books.
11. Perform shelving and shelf-reading to ensure correct placement of books.
12. Repair a damaged book by pasting torn pages or reattaching the spine.
13. Clean and dust shelves following proper preservation methods.

14. Identify and note ISBN and ISSN numbers from given books and journals.
15. Prepare a catalog card manually for a given book.
16. Download and save a research article from an open-access source.
17. Prepare a short monthly transaction report using sample issue-return data.
18. Draft or fill an interlibrary loan request form/email.
19. Create a library section signage (e.g., "Reference Section") using MS Word.
20. Back up library data files from computer to an external device (pen drive).
21. Conduct an online reference search for a given topic using Google Scholar or JSTOR.
22. Demonstrate correct handling of fire safety equipment in the library.
23. Prepare a subject-wise list of books from the accession register.
24. Identify and rectify misplaced books from a given shelf section.
25. Demonstrate professional and courteous interaction with a library user seeking assistance.

# **Electrician/ Electric trade**

(Ref- https://dgt.gov.in/en/cts-details)

**Written Test syllabus**

 **Electrical Basics**

- Atomic structure, conductors, insulators, semiconductors
- Ohm's Law, Kirchhoff's Laws
- Electrical power, energy, efficiency, and units
- Series and parallel circuits
- Laws of magnetism, magnetic effects of electric current
- Electromagnetic induction and Faraday's laws
- Self and mutual induction, inductance, eddy currents
- Renewable and non-renewable sources

## **B. Electrical Machines**

- DC Machines (Generators and Motors) — construction, working, applications
- AC Fundamentals — single-phase and three-phase systems
- Transformers — working principle, EMF equation, losses, efficiency
- Alternators and synchronous motors — construction, working
- Induction motors — single-phase and three-phase types
- Starting methods and speed control

## **C. Electrical Measurements and Instruments**

- Types of instruments: ammeter, voltmeter, wattmeter, energy meter
- Use of megger, tong tester, multi meter, and CRO
- Calibration and measurement of resistance, voltage, current, power, and energy

## **D. Wiring and Installation**

- Types of wiring systems: conduit, casing-capping, cleat, etc.
- Earthing — purpose, methods, materials
- Domestic, commercial, and industrial wiring
- Estimation and costing of wiring installations
- Electrical safety rules (IE Rules), fuses, circuit breakers (MCB, MCCB, RCCB)
- Overhead wiring

## **E. Electrical Accessories and Control Devices**

- Switches, relays, contactors, timers, push buttons
- Control panels and motor starters (DOL, star-delta, etc.)
- Lighting systems — fluorescent, LED, sodium vapour, etc.

## **F. Basic Electronics**

- Semiconductor theory, diodes, transistors, SCR, TRIAC, DIAC
- Rectifiers, amplifiers, and oscillators

- Digital electronics basics: logic gates, ICs, microcontrollers (basic idea)

## G. Power Transmission and Distribution

- Generation of electrical power (thermal, hydro, nuclear, renewable)
- Transmission lines, voltage levels, substation equipment
- Distribution systems and load management
- Power factor improvement and reactive power

## Trade Practical (Skill Test)

- Jointing and soldering of conductors
- Wiring a simple domestic circuit (light, fan, socket)
- Testing of continuity and insulation resistance
- Measurement using multimeter, megger, tong tester
- Connection and testing of a DC shunt motor
- Connection and testing of single-phase transformer
- Reversing direction of rotation of a motor
- Connecting and testing of star-delta starter
- Repair of electrical appliances (iron, heater, fan, mixer, etc.)
- Earthing of an installation
- Fault detection and rectification in wiring circuits
- Assembling and testing of control panels.
- Carry out overhead wiring installation.
- Perform internal power wiring for a room, including layout marking

# INSTRUMENT MECHANIC

## Fundamentals of Measurement and Electrical Basics

Introduction to precision measuring instruments including gauge blocks, sine bars, micrometers, vernier calipers, dial indicators, bevel protractors, and thickness gauges. Screw thread elements, types used in instruments, and drill size calculation for tapping. Tubing and fittings: tube types, tube cutting, flaring, swedging, bending, and threading tools. Electrical components such as conductors, semiconductors, insulators, and SWG. Basics of electricity—static electricity, current, voltage, potential difference, EMF, resistance, DC/AC circuits, and grounding. Measurement using multimeters and resistor color codes. Soldering tools, materials, and techniques. Application of Ohm's and Kirchhoff's laws, series and parallel circuits. Primary and secondary cells, switches, relays, magnetism, and electromagnetism.

## Electrical Principles and Machines

Principles of alternating and direct current, waveform parameters (RMS, average, peak, time period, frequency). Inductance, capacitance, energy storage, series/parallel circuits, reactance, impedance, and resonance. DC and AC generators: working principles, EMF equation, Faraday's and Lenz's laws, Fleming's rules. DC motor operation and speed control; AC motors including induction, synchronous, and stepper types.

## Transformers and Measuring Instruments

Transformer types, transformation ratio, regulation, open- and short-circuit tests, autotransformers. Measuring instruments: absolute and secondary types, PMMC, moving coil meters, full-scale deflection, sensitivity, and range extension. Conversion of galvanometer to voltmeter/ammeter. Ohmmeters, Megger, insulation tester, earth tester. AC instruments: MI, electrodynamometer, energy, watt-hour, ampere-hour, and power-factor meters. Special instruments: voltage tester, continuity tester, rotation and phase sequence testers, synchroscope, frequency meter, thermocouple ammeter.

## Electronics and Power Supplies

Semiconductors, PN junction diode characteristics, Zener, tunnel, and photo diodes. Transistor types (NPN/PNP), configurations (CB, CC, CE), gains, and biasing. Basics of FET and MOSFET. Rectifiers (half/full wave), voltage multipliers, filters (capacitive, inductive, RC, LC), voltage regulators (Zener, shunt, series, IC, variable). Power supply units: UPS, SMPS, inverters, converters. Amplifier characteristics, PCB construction, oscillators, operational amplifiers, and 555 timer applications.

## Digital Electronics and Microprocessors

Number systems and conversions, Boolean algebra, logic operations and codes, logic gates and DeMorgan's theorem, adders, subtractors, flip-flops, counters, registers, multiplexers, demultiplexers. Display systems (LED, LCD, CRT, etc.), A/D and D/A converters, and interface standards (IEEE-488, RS-232). CRO operation, CPU basics, ROM/RAM, peripherals, data interfaces, ADC/DAC, introduction to 8085 architecture, instruction set, and programming.

**Measurement, Pressure, Flow, Level, Temperature, Control Systems, Networking, SCADA, and Analytical Instruments**

Measurement systems, calibration standards, SI units, instrument characteristics and errors. Strain gauges, LVDT, RVDT, vibrometers, tachometers, pressure and vacuum measuring devices, and transducers. Flow measurement using head-type, variable area, turbine, magnetic, Coriolis, and ultrasonic meters; level measurement methods. Temperature measurement using bimetallic sensors, filled systems, RTDs, thermistors, thermocouples, and pyrometers; humidity instruments and recorders. Actuators and control valves with characteristics and positioners. Process control principles, control modes (P/I/D), tuning, PLCs, smart devices, HART. Networking fundamentals, communication basics, SCADA/DCS architecture, and analytical instruments such as pH, conductivity, and dissolved oxygen meters.

**Trade test syllabus**

1. Use Basic Engineering Metrology measurement with Vernier Caliper, Micrometer etc to measure given components within ±0.1 mm tolerance and record readings accurately.
2. Calculate drill size for tapping and demonstrate tapping of a threaded hole. Assemble a ferrule-type tube fitting ensuring leak-free joint.
3. Perform correct tube cutting, flaring, and bending using flaring tool and bender as per standard radius.
4. Assemble a simple DC circuit with variable resistance, measure current and voltage, and verify Ohm's law graphically.
5. Identify live, neutral, and earth in a single-phase supply using a tester and ensure safe earthing connection.
6. Identify resistors, capacitors, diodes, and transistors and test each using a digital multimeter/LCR meter.
7. Solder a small circuit neatly on a PCB and demonstrate its operation using a DC supply.
8. Check and calibrate a PMMC voltmeter or ammeter against a standard reference instrument. Note deviation and correction.
9. Connect a single-phase transformer and measure transformation ratio; run a small DC or induction motor and demonstrate direction reversal.
10. Display a sine-wave signal on CRO/DSO and measure its amplitude and frequency using time-base and voltage controls.
11. Construct and verify the truth table of AND, OR, and NOT gates using a digital trainer or discrete components.
12. Connect a Bourdon tube pressure gauge to a dead-weight tester, perform calibration, and plot error curve.
13. Set the cut-in and cut-out pressures of an adjustable pressure switch and verify operation on test bench.
14. Assemble and calibrate a Rotameter using a standard flow setup; note flow rate at different float positions.
15. Connect a differential pressure type level transmitter to a simulator and demonstrate signal variation with liquid level.
16. Measure temperature using RTD and thermocouple sensors with a digital indicator; compare readings and comment on accuracy.
17. Calibrate a temperature transmitter using a temperature source and milliamp calibrator; record zero and span adjustment.
18. Identify valve parts, connect a pneumatic supply, and demonstrate full-stroke operation with a positioner.

19. Assemble a basic ON–OFF control loop (temperature/pressure simulator) and demonstrate control action through a controller.
20. Wire a simple PLC start–stop circuit or demonstrate communication with a HART transmitter using communicator or simulator.

# Draughtsman Civil

**Written Test Syllabus**

- Importance of safety and general precautions observed in the in the industry/shop floor.
- All necessary guidance to be provided to the new comers to become familiar with the 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 55 concept& its application. Response to emergencies e.g.; power failure, fire alarm, etc.
- Importance of B.1.S, Introduction of Code for practice of Architectural and Building Drawings, Layout of drawing. Lines, Lettering, Dimensioning.
- Knowledge of different types of scale. Principle of R.F Materials: Stones: characteristics, types & uses. Bricks-. Manufacturing, characteristics of good bricks, types, uses and hollow bricks. Lime-characteristics, types, manufacturing &its uses. Pozzolanic: characteristics, types & uses.
- Cement: - Manufacturing, characteristics, types, uses and test of good cement.
- Different types of projection views: Orthographic, Isometric, Oblique and Perspective, Building: Principle of planning, Objectives & importance, Function& responsibility, Orientation, Local building Bye-Laws as per ISI code, lay out plan & key plan, submitted in composition of drawing, Provisions for safety, Requirement of green belt and land.
- Computer aided drafting: Operating system, Hardware & software., Introduction of CAD, Its Graphical User Interface, Method of Installation, Basic commands of CAD, Knowledge of Tool icons and set of Toolbars, Knowledge of shortcut keyboard commands.
- Building Planning: Economy & orientation, Provision for lighting and ventilation, Provision for drainage and sanitation, Types of building, Planning & designing of residential, public and commercial building.
- Prefabricated Structure: Preparation, Method of construction, assembling, Advantages & disadvantages.
- 3D modeling concept in CAD: 3D coordinate systems to aid in the construction of 3D objects, Knowledge of shortcut keyboard commands.
- Concepts of design of earthquake resisting buildings- requirements resistance, safety, flexible building elements, special requirements, base isolation techniques.
- Reinforced cement concrete structure: Introduction to RCC uses, Materials proportions, Form work, Bar bending details as per IS Code, Reinforced brick work.
- Materials used for RCC: Construction, Selection of materials coarse aggregate, fine aggregate, cement water and reinforcement., Method of mixing concrete machine mixing and hand mixing, Slump test.

- Structure columns, beams, slabs one-way slab & two-way slab, Innovative construction, Safety against earthquake, Grade of cement, steel-behavior and test, Bar-bending schedule, Retaining wall, R.C.C.
- Framed structure
- Steel structures: Conmen forms of steel sections, Structural fasteners, Joints, Tension & compression member, Classification, fabrication, Construction details.
- 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
- Roads: History of highway development, 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.
- Estimating and Costing: 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 items and their specifications, Labour and materials., Govt. Schedule of rate, estimating of irregular boundaries by trapezoidal and Simpsons formula.
- Total Station: Components parts, accessories used, characteristics, features, advantages and disadvantages, principle of EMD, Working and need, Setting and measurement, Electronic, display Data reading, Rectangular and polar co-ordinate system, Terminology of open and closed traverse.
- GPS (Global Positioning System): - Introduction of GPS system, Co- ordinate and time system, Satellite and conversional geodetic system, GPS. Signal, code, and biases, Role of TRANSIT in GPS development, GPS survey methods. Basic geodetic co-ordinate, Ground support equipment, signals, Tracking devises& system, Time measurement and GPS timing.

## Trade Test Syllabus

- Draw freehand sketches of hand tools used in civil work following safety precautions.
- Draw plane figures applying drawing instruments with proper layout and the method of folding drawing sheets.
- Draw orthographic projections of different objects with proper lines, lettering and dimensioning.
- Draw Isometric/Oblique/Perspective views of different solid/hollow/cut sections with proper lines, lettering and dimensioning.
- Draw component parts of a single storied residential building with suitable symbols and scales.
- Draw different types of stone and brick masonry.

- Draw different types of shallow and deep foundation.
- Draw different types of shoring, scaffolding, underpinning, framework and timbering.
- Draw different types of Damp proofing in different position.
- Draw different types of doors and windows according to manner of construction, Arrangement of component, and working operation.
- Perform site survey with chain / tape and prepare site plan.
- Prepare the detailed drawing of electrical wiring system.
- Draw types of ground and upper floors.
- Draw different types of vertical movement according to shape, location, materials in stair, lift, ramp and escalator.
- Draw different types of roofs, truss according to shape, construction, purpose and span.
- Create objects on CAD workspace using Toolbars, Commands, Menus, formatting layer and style.
- Draw a sanction plan of double storied flat roof residential building by using CAD.
- Create objects on 3D modeling concept in CAD.
- Prepare a drawing of public building detailing with roof and columns by frame structures using CAD.
- Prepare detailed drawing of RCC structures using CAD and prepare bar bending schedule.
- Draw the details of a framed structure and portal frame of a residential building using CAD.
- Draw the different types of steel sections, rivets and bolts using CAD.
- Draw the details of girders, roof trusses and steel stanchions using CAD.

# Operator Advanced Machine Tools

## Safety

Safety and general precautions in industry and shop floor. Personal Protective Equipment (PPE). First Aid procedures. Operation of electrical mains and electrical safety. Occupational safety and health principles. Safety signs, response to emergencies. Importance of housekeeping, 5S concepts. Material handling techniques — lifting, moving, and handling heavy loads and equipment.

## Basic Fittings and Maintenance

Purpose, types, and description of: Vice, Divider, Scriber, Marking Block, Micrometer, Vernier Caliper, Vernier Height Gauge, Surface Plate, Angle Plate, Combination Set, Vernier Bevel Protractor. Use of Bench Grinder, Hacksaw and blades, Hammers, Drills, and Drilling Machine operations. Taps and tapping, screwdrivers, spanners, socket and tubular tools, hook spanners, wrenches, T-sockets, ratchets, pipe wrenches. Sheet metal types and uses, snip and stake, lap and butt joints using dolly and snap. Pipe cutting, bending (hot and cold) using fixtures, riveting (types, precautions). Use of drift, pullers, and extractors.

## Turning

Types, constructional features, working principles, and functions of lathe machine. Accessories and attachments of lathe. Driving mechanisms — cone pulley, all-geared headstock, quick-change gearbox, apron mechanism. Lathe cutting tools — materials, angles, and geometry. Lathe operations — facing, turning, taper turning, boring (step and taper boring), eccentric turning, threading (internal/external). Determination of cutting speed, feed, coolant application, lubrication systems.

## Grinding

Types, construction, and working principle of grinding machines. Surface and cylindrical grinding operations. Grinding wheels — types, specifications, balancing, truing. Methods of holding work and wheels. Speed, feed, coolant selection. Fault identification, rectification, and preventive maintenance. Study of hydraulic systems.

## Milling

Types, accessories, attachments, and work holding devices. Types of milling cutters. Milling operations — plain, step, angular, slot, and groove cutting. Gear terminology and cutting — spur, helical, bevel gears, racks, worm and worm wheels. Gear cutting calculations and indexing procedure.

## Interchangeable System and Gauges

Basis size, limits, tolerance, and allowances. System of limits, fits, and tolerances — hole basis and shaft basis. Gauges and templates — types, purpose, limit gauges worker's, inspection, master). Sine bar and sine center — principle, construction, and application. Slip gauges — types and use. Toolmaker's microscope and profile projector. Common machining defects and remedies in turning, milling, and grinding — taper, chattering, poor surface finish, parallelism issues. Surface roughness symbols (BIS).

## CNC Fundamentals

Introduction to CNC machines — workstations, input/output devices, CPU, memory. Communication between CNC and computer. Comparison of conventional and CNC machines — advantages and disadvantages. Axis designation, coordinate systems and applications. G-codes and M-codes — types and functions. Interpolation types and applications. Tool compensation — cutter radius, tool wear, tool nose radius. Tool nomenclature, tool change command, work and tool offsets. Part programming for turning and milling (G & M codes, feed, speed, depth of cut).

## CNC Turning Centre

Modes of operation — JOG, MPG, REF, MDI/MDA. Program execution — Auto SBL and Auto Cont. modes. Knowledge of CNC cutting tools — geometry, materials, cutting speed, feed, depth of cut. Tool offsetting and setting procedures. Programming for contour profiles, grooving, threading, undercut, canned/fixed cycles. Tool nose radius compensation (TNRC) using G41/G42.

## CNC Vertical Machining Centre

Modes of operation — JOG, MPG, REF, MDI/MDA. Program execution — Auto SBL and Auto Cont. modes. CNC cutting tools — geometry, materials, speed, feed, depth of cut. Tool offsetting and setting techniques. Programming for face, edge, and slot milling (radial and circumferential). Tool type chart, cutter radius compensation (G41/G42). Pocket milling (square and circular), canned/fixed cycles for hole machining. Technical English terms, process charts, job cards, estimation of cycle time, and productivity reports. Contour programming for different profiles.

## Preventive, Predictive, and Total Productive Maintenance (TPM)

Difference between breakdown and preventive maintenance. Routine and periodic maintenance — checking lubrication, hydraulic oil levels, system pressure, and adjustments. Maintenance procedures on shop floor. Importance of centralized lubrication systems. Hydraulics and pneumatics — cleaning, pressure regulation, and lubrication of pneumatic filters and regulators.

### Trade test syllabus

1. Mark a given job using divider, scriber, surface plate, and marking block as per drawing.
2. Measure linear and angular dimensions using Vernier caliper, micrometer, and bevel protractor.
3. Cut an external thread on a lathe using single-point tool and check with thread gauge.
4. Perform surface grinding of a mild-steel job maintaining parallelism and surface finish.
5. Perform plain and slot milling on a workpiece using milling machine.
6. Demonstrate gear cutting setup and perform indexing calculation for spur gear cutting.
7. Check a machined job using slip gauges, sine bar, and surface plate for accuracy.
8. Prepare a sample limit gauge (GO/NO-GO) and explain system of limits, fits, and tolerances.
9. Demonstrate CNC machine startup sequence and home reference procedure (JOG, MPG, REF).

10. Create and input a simple CNC turning program using G & M codes for facing and turning.
11. Set tool offset and perform automatic cycle on CNC turning center to complete a contour profile.
12. Create and run a simple CNC milling program for pocket or slot machining using cutter compensation.
13. Demonstrate tool nose radius compensation (G41/G42) in CNC turning or milling.
14. Perform routine maintenance checks on CNC machine – lubrication, hydraulic oil, and pressure systems.
15. Identify hydraulic and pneumatic components and demonstrate safe pressure regulation and filter cleaning.

# Additive Manufacturing

## Syllabus written examination

## 1. Engineering Drawing and Geometrical Construction

- Nomenclature and care of drawing instruments, drawing sheet layout as per SP-46:2003.
- Types of lines, lettering (single/double stroke), title block, dimensioning systems, and scales.
- Principles of projection: orthographic, first-angle and third-angle, sectional and auxiliary views.
- Construction of geometrical figures — triangle, polygon, ellipse, parabola, hyperbola, involute, cycloid, helix, and spiral.
- Isometric projection and isometric scale; difference between isometric drawing and projection.
- Conversion between isometric and orthographic views.
- Principles of oblique projection and selection of appropriate views.

## 2. Computer-Aided Drafting (2D)

- User interface of 2D CAD software: menu bar, ribbon, command window, layers.
- Drawing commands: line, polyline, polygon, circle, rectangle, ellipse, arc.
- Modify commands: move, copy, trim, offset, rotate, array, fillet, chamfer.
- Concept of layers, text, dimension styles, templates, and plotting procedures.
- Keyboard shortcuts, coordinate systems, zooming and panning, multiple viewports.
- File handling and print preview (.dwg, .pdf formats).

## 3. 3D Modelling, Assembly & GD&T

- Fundamentals of 3D parametric modelling.
- Sketch entities, constraints, and parametric control.
- Feature creation: extrude, revolve, sweep, loft, fillet, chamfer, pattern, shell, rib.
- Assembly creation, mates, and configuration control.
- Concepts of Geometric Dimensioning and Tolerancing (GD&T).
- Annotation, bill of materials, and exploded views.
- Basics of part costing, manufacturability, and data translation formats (STEP, IGES, STL).
- Simulation and optimization overview within CAD.

## 4. Workshop Technology and Fitting Practice

- Workshop safety, PPEs, accident prevention, and 5S principles.
- Basic fitting operations: marking, filing, drilling, tapping, grinding; purpose and procedures.
- Tools and their use: files, chisels, vices, calipers, hacksaw, drills, taps, dies.
- Surface plate, V-block, angle plate, parallel blocks.

- Units of measurement, accuracy, and tolerance (±0.25 mm).
- Difference between conventional (subtractive) and additive manufacturing.

## 5. Metrology and Measurement

- Concept of accuracy, precision, and error.
- Measuring instruments: Vernier caliper, micrometer, height gauge, depth gauge, bevel protractor, dial test indicator, sine bar.
- Measurement of linear, angular, and surface parameters.
- Symbols for surface finish and machining tolerances.
- Limit gauges and interchangeable system.
- Concept of geometrical tolerances: flatness, parallelism, concentricity, cylindricity.
- Reading of inspection reports and preparation of quality documentation.

## 6. Innovation and Design Thinking

- Concept and need for innovation.
- Design Thinking stages: Empathize, Define, Ideate, Prototype, Test.
- Market survey methods — STEEP, Trend analysis, SPICE framework.
- Brainstorming tools: SCAMPER, persona development, stakeholder mapping.
- Feasibility, desirability, and viability in product design.
- Basics of industrial design and perceived quality.

## 7. Fundamentals of Additive Manufacturing (AM)

- Definition, evolution, and scope of Additive Manufacturing.
- Classification of AM processes: Liquid-based (SLA, DLP), Powder-based (SLS, Binder Jetting), Solid-based (FDM/FFF, Sheet Lamination), Metal printing (DMLS, DED).
- Components and working principle of 3D printers: extruder, build platform, slicing process.
- Digital workflow: design → slicing → printing → post-processing.
- Materials used in AM: thermoplastics, photopolymers, composites, metal powders.
- Comparison between FFF, SLA, and SLS in terms of accuracy, surface finish, and application.
- Design for Additive Manufacturing (DFAM) — orientation, supports, layer thickness, infill.
- Limitations and advantages of AM compared to conventional manufacturing.

## 8. Process Algorithm and Slicing Techniques

- Process algorithm of slicing software.
- Layer generation, supports, infill pattern, roof & floor layers, wall thickness, and orientation.
- Honeycomb structures, resolution settings, and turbo printing.
- Exporting sliced files to printer formats.
- Basic troubleshooting in slicing (missing faces, non-manifold geometry).

## 9. Benchmarking, Optimization, and Ergonomics

- Concept and types of benchmarking (functional, performance, process).
- Gap analysis and industrial application of benchmarking.

- Concept of optimization — minimizing cost, weight, or time.
- Customization and personalization in AM products.
- Industrial design aspects — aesthetics, ergonomics, perceived quality, human-factor design.
- Risk and feasibility assessment in design selection.

## 10. Electrical and Sensor Fundamentals

- Basic electrical quantities: voltage, current, resistance, power, Ohm's law.
- Electrical safety, fuses, switches, and circuit breakers.
- Motors, solenoids, transformers — principle and applications.
- Sensors: proximity, ultrasonic, photoelectric — working and use in AM systems.
- Preventive and routine maintenance of electrical parts in 3D printers.

## 11. Maintenance and Post-Processing

- Maintenance concepts: routine, preventive, autonomous, and total productive maintenance (TPM).
- Machine disassembly and assembly procedures; nozzle cleaning, bed-leveling.
- Post-processing operations: cleaning, sanding, deburring, curing, painting, and polishing.
- Quality control and dimensional verification of finished parts.

## 12. 3D Scanning and Reverse Engineering

- Principles of 3D scanning (contact and non-contact).
- Data acquisition methods, point clouds, mesh generation.
- File formats (.STL, .OBJ, .STEP) and conversion to parametric models.
- Scan data alignment, editing, and exporting for AM.
- Applications of reverse engineering.

## 13. Basic Workshop Science and Calculations

- Units, conversions, and mensuration (area, volume, surface area).
- Ratio, proportion, and percentage.
- Basic trigonometry and geometry used in design and fitting.
- Heat, temperature, density, and specific gravity.
- Material science fundamentals: types of plastics, metals, composites; warpage and shrinkage.
- Simple problems using calculator related to manufacturing dimensions.

### Trade test syllabus

1. Prepare a sheet with title block, margin, lettering and draw basic geometrical figures such as triangle, polygon and circle.
2. Generate orthographic and isometric projections of a simple object like a bracket or V-block.
3. Create a 2D CAD drawing of a mechanical part and plot it in .dwg or .pdf format. Convert 2D drawing to 3D drawing.
4. Model a 3D solid part such as a flange or pulley and add tolerance and GD&T annotation.
5. Assemble two or three 3D parts into a single model using mating relations.
6. Perform basic fitting operations—marking, filing, drilling, tapping—on mild steel flat maintaining ±0.25 mm accuracy.
7. Measure a machined part using Vernier caliper and micrometer and record readings.

8. Demonstrate the use of a dial test indicator or bevel protractor to check alignment or angle.
9. Identify components of an FDM 3D printer and explain its working principle.
10. Slice a simple 3D model in slicing software by setting layer height, infill, and supports.
11. Print a small component such as a clamp or gear using an FDM printer.
12. Perform post-processing of the printed part by cleaning, sanding, and polishing.
13. Conduct dimensional inspection of the printed part and compare results with the CAD model.
14. Demonstrate a small design-thinking exercise by identifying a problem and sketching an improved product.
15. Perform a simple optimization exercise to reduce mass or cost of an existing design using CAD tools.
16. Demonstrate electrical measurement using a multimeter and identify relay or transformer connections.
17. Check functioning of a proximity or ultrasonic sensor connected to a controller or indicator.
18. Carry out preventive maintenance of a 3D printer including nozzle cleaning, filament loading, and bed leveling.
19. Scan a small object using a 3D scanner, process the mesh file, and import it to CAD software.
20. Design, print, and finish a simple prototype applying the complete additive manufacturing workflow.