

Indicative syllabus

Syllabus for Supervisor (TO – Printing) & Supervisor (Technical Control) at S-1 level

1. **Basics of Printing:** Types of printing processes, Offset Printing, Letter press printing, Screen Printing, Flexography, Gravure Printing.
2. **Pre-Press:** Image processing & colour separation, Plate making techniques, Computer to Plate (CTP), conventional plate making, Layout & design basics etc.
3. **Press (Machine Section):** Printing machines & working principles, Machine maintenance basics, Ink-water balance (offset), Registration & colour control etc.
4. **Post-Press:** Cutting, binding, finishing, Numbering, perforation, Packaging basics etc.
5. **Printing Materials:** Types of paper (security paper, coated/uncoated), Inks (security inks, UV inks, etc.), Plates, blankets, chemicals etc.
6. **Quality Control:** Colour measurement (densitometer/spectrophotometer basics), Defects in printing & troubleshooting, ISO standards basics etc.
7. **Industrial Safety & Security:** Industrial safety acts, Security printing concepts (All documents related to security printing i.e. currency, stamps etc.).
8. **Supervisory & Management Skills:** Production planning & control, Manpower handling, Shift management, Inventory control (raw materials & finished goods), Basic industrial laws & discipline.
9. Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).

Syllabus for Supervisor (Ink Factory) at S-1 level:

1. **Physical Chemistry:** Thermodynamics (laws, enthalpy, entropy, free energy, chemical potential, joule-thomson coefficient etc.), Chemical kinetics, Surface chemistry (adsorption, catalysis), chemical & ionic equilibrium, electrochemistry, Ideal & non-ideal solutions, colligative properties, Gas laws & Real gases,
Organic Chemistry: Polymers, resins, binders, Solvents and additives used in inks, Aliphatic and aromatic carbon compounds, General Organic Chemistry (IUPAC nomenclature, Isomerism, Homologues series, various electronic effects, Hyperconjugation, Neighbouring Group participation, Reaction mechanisms of simple reactions – SN1, SN2, SN2', SNi, E1, E2, E1cB; organic named reactions.
Inorganic Chemistry: Pigments (organic & inorganic) Metallic compounds used in security inks, Colloids & dispersion systems, Mole concept, Redox reactions, laws of chemical combination, Equivalence, Volumetric analysis, Periodic classification & properties, Atomic structure & Chemical bonding.
2. **Printing Ink Technology:** Ink formulation principles.
Raw materials: Pigments, dyes, Binders (resins, varnishes), Solvents & additives.
Types of inks: Offset inks, Screen printing inks, UV-curable inks.
Ink properties: Rheology (flow behaviour), Viscosity & tack, Curing mechanisms (oxidation, solvent evaporation, UV curing), Colour science: Colour matching, Shade control, CIE indices etc.
3. **Ink Manufacturing Process:** Batch & continuous manufacturing.
Process flow: Pre-mixing, Grinding & dispersion, Milling (ball mill, bead mill, triple roll mill), Filtration & finishing.
Process parameters: Temperature, pressure, shear rate.
Troubleshooting: Shade variation, Poor dispersion, Drying issues.
4. **Equipment & Engineering Knowledge:**
Machines used in ink plants: High-speed dispersers, Ball mills, Bead mills, Triple roll mills.
Maintenance basics: Preventive maintenance, Breakdown handling.
Basics knowledge of Mechanical systems, Electrical motors & drives, Pumps and valves.
5. **Quality Control & Assurance:**
Testing methods: Viscosity (viscometer), Colour measurement (spectrophotometer), Gloss, drying time, Particle size (Hegman gauge), Tack (Tackometer).
QA systems: ISO standards (ISO 9001 basics), Documentation & SOPs, Statistical Quality Control (SQC) basics.
6. **Security Printing & Special Inks:** UV/IR fluorescent inks, Magnetic inks, Optically variable inks
7. **Industrial Safety & Environmental Management:** Chemical safety & MSDS, Hazardous material handling, Fire & explosion safety.
Pollution control: Air, water, solid waste, PPE and safety audits.
8. **Supervisory & Management Skills:** Production planning & control, Manpower handling, Shift

management, Inventory control (raw materials & finished goods), Basic industrial laws & discipline.

9. Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).

Syllabus for Junior Technician (Printing)/ (Control)/ (Store) at W-1 level

1. Basics of Printing Technology: Introduction to printing processes, Offset printing, Letterpress Printing, Gravure printing, Flexography printing, Screen printing.
2. Printing workflow (Pre-press → Press → Post-press).
 - i) Pre-Press Operations:** Types of artwork and design basics, Image processing and colour correction, Plate making methods (CTP – Computer to Plate), Fonts, layout, imposition, Basics of software like: Adobe Photoshop, Corel DRAW, Adobe Illustrator.
 - ii) Press (Machine) Operations:** Offset printing machine parts and functions, Feeding system, dampening system, inking system, Registration and alignment, Printing defects and trouble-shooting, Preventive maintenance of machines.
 - iii) Post-Press Operations:** Cutting, folding, binding, Lamination, varnishing, embossing, Packaging and finishing techniques.
3. **Ink, Paper & Materials:** Types of printing inks and properties, Paper types (GSM, coatings), Ink–paper compatibility, Drying methods.
4. **Quality Control:** Print quality parameters, Colour matching and density control, Common defects (ghosting, smudging, mis-registration), Inspection tools.
5. **Mechanical & Electrical Basics:** Basic mechanical concepts (gears, bearings), Electrical safety and basics, Machine handling and safety practices.
6. **Industrial Safety:** Workplace safety rules, Fire safety, Use of PPE (Personal Protective Equipment).
7. Basic electrical concepts like current, voltage, resistance, Ohm's law, AC/DC circuits, wiring systems, earthing, electrical safety, and use of measuring instruments like multimeter.
8. Basic Electrician practical includes house wiring, cable joints, testing circuits, fuse and MCB installation, and basic motor connections.
9. Basics of electronics such as components (resistors, capacitors, diodes, transistors), circuit theory, soldering, PCB, and measuring instruments.
10. Basic Electronics practical includes circuit assembly, testing with multimeter, rectifier circuits, amplifier basics and troubleshooting simple electronic devices.
11. Basic Workshop practices like marking, filing, fitting, drilling, welding, grinding, and use of measuring tools such as Vernier calliper and micrometre.

Syllabus for Junior Technician (Ink Factory - Attendant Operator) at W-1 level

1. **Basic Chemistry:** Dalton's atomic theory, Bohr atom model (qualitative only without any mathematical treatment), elements, compounds, mixtures, Acids, bases, salts, pH scale, Chemical bonding (Ionic & covalent - qualitative only without any mathematical treatment and restricted to Lewis dot structures only).
General chemistry: Volumetric analysis, Gravimetry, Chemical reactions & equations.
2. **Chemical Plant Operations:** Introduction to chemical plant processes, Batch & continuous process
Unit operations: Mixing, Handling of chemicals, Process control basics.
3. **Equipment & Machinery:** Pumps: Centrifugal pump, Gear pump.
Valves: Gate valve, Globe valve, Check valve, Compressors, blowers, Pipes & fittings, Maintenance basics.
4. **Instrumentation & Measurement:** Pressure measurement, Temperature, Flow measurement (Ford cup), Level measurement.
5. **Industrial Safety:** PPE (helmet, gloves, goggles).
Fire: Types of fire, Fire extinguishers, Hazard & risk, MSDS (Material Safety Data Sheet), First aid, Accident prevention.
6. **Workshop & Fitting Basics:** Hand tools (file, hammer, chisel), Drilling, tapping, reaming
Measuring instruments: Vernier calliper, Micrometre.
7. **Environmental & Utility Systems:** Ambient air quality, manufacturing wastes (chemical) disposal.
8. **Ink manufacturing basics:** Mixing & grinding process, particle size, colour shade etc.

Syllabus for Junior Technician (Ink Factory – Laboratory Assistant) at W-1 level

1. **Basic & Applied Chemistry:** Dalton's atomic theory, Bohr atom model (qualitative only without any mathematical treatment), elements, compounds, mixtures, Acids, bases, salts, pH scale, Chemical bonding (Ionic & covalent - qualitative only without any mathematical treatment and restricted to Lewis dot

structures only).

General chemistry: Volumetric analysis, Gravimetry, Chemical reactions & equations.

- Laboratory Practices** - Use of glassware: Beaker, burette, pipette, flask, Preparation of solutions, Titration (acid-base, redox, complexometric), Sampling techniques.
- Analytical Techniques:** Qualitative inorganic & organic analysis.
Instrumental analysis (basic idea on operational methods only): Conductometer, potentiometer, pH meter, Spectrophotometer, Weighing balance, Muffle furnace, Calibration of instruments, Thermometer, Pressure gauge.
- Ink & Chemical Testing
Ink components: Pigments, dyes, resins, solvents.
Testing of inks: Viscosity, Colour matching, Drying time, Quality control methods.
- Safety in Laboratory:** Lab safety rules, PPE (gloves, goggles, lab coat), Handling hazardous chemicals, MSDS (Material safety Data Sheet), First aid in lab
- Environmental & Utility Systems:** Ambient air quality, manufacturing wastes (chemical) disposal.
- Ink Factory Specific Knowledge:** Ink manufacturing basics, Mixing & dispersion, Security inks

Syllabus for Artist (Graphic Design) at B-4 level

- Fundamentals of Art & Design.**
Elements of design: Line, shape, colour, texture etc.
Principles of design: Balance, contrast, rhythm, hierarchy, Drawing & sketching techniques, Visual composition etc.
- Art & Design History:** History of art & architecture, Evolution of graphic design, Indian & Western art styles, Contemporary design trends etc.
- Typography:** Fonts & typefaces, Layout design, Text composition etc.
- Illustration & Visualization:** Manual illustration, Digital illustration, Character design etc.
- Digital Graphic Design Tools:** Adobe Photoshop, Adobe Illustrator, CorelDRAW.
- Web & Digital Media Design:** Web design basics, UI/UX fundamentals, Interactive design, Multimedia design.
- Animation & Motion Graphics:** Basics of animation, 2D / 3D animation, Visual effects (VFX), Motion graphics.
- Visual Communication & Branding:** Logo design, Brand identity, Advertising design
Packaging design.
- Printing & Publication Design:** Layout design (magazines, books), Printing techniques Colour theory & colour correction, Pre-press & post-press basics.
- Visual Arts (BVA / BA Visual Arts):** Drawing & painting, Sculpture basics, Photography, Digital art etc.
- Supporting Subjects:** Communication skills Environmental studies, Computer basics, Design research & methodology.
- Important Skills Required:** Creativity & visualization, Colour sense, Software skills, Layout & composition understanding.

Supervisor (Air Conditioning)

- Fundamentals of Refrigeration :**
Definition, need and applications of refrigeration, Units of refrigeration (TR, kW), Methods of refrigeration (natural & artificial), Refrigeration cycles, Carnot Cycle
Bell-Coleman Cycle, Coefficient of Performance (COP), Limitations and practical considerations
- Vapour Compression & Absorption Systems**
Vapour Compression Refrigeration System (VCRS):Components: compressor, condenser, expansion valve, evaporator, Working principle, Wet vs dry compression, Effects of Sub cooling and Superheating, Vapour Absorption System (VAS):Working principle, Comparison with VCRS, Use of P-H diagrams
- Refrigerants and Environmental Aspects**
Definition and classification of refrigerants, Primary vs secondary refrigerants, Properties of ideal refrigerant, Common refrigerants: Ammonia (NH₃), CO₂, Freons (R-12, R-22, R-134a), Environmental impact: ODP (Ozone Depletion Potential), GWP (Global Warming Potential), Safe handling and storage.
- Psychrometry and Air Properties**
Composition of air, Psychrometric terms: Dry bulb temperature, Wet bulb temperature, Dew point, Relative humidity, Specific humidity & enthalpy, Psychrometric chart: Reading and applications, Air conditioning processes: Heating, Cooling, Humidification
- Air Conditioning Systems & Applications**
Definition and objectives of air conditioning, Types of systems: Window AC, Split AC, Packaged AC, Central AC, Components of AC systems, Year-round air conditioning, Applications: Residential, Commercial, Industrial

6. **Heat Load Calculation**
Concept of heat load, Types: Sensible heat, Latent heat, Sources of heat gain: Occupants, Equipment, Solar radiation, Sensible Heat Factor (SHF), Basic cooling load estimation methods
7. **RAC Installation Techniques**
Installation procedures :Window AC and Split AC, Piping layout and insulation, Electrical connections, Charging of refrigerant, Leak detection methods, Commissioning procedures
8. **Maintenance & Troubleshooting of RAC Systems**
Preventive maintenance, Breakdown maintenance, Fault diagnosis: Compressor faults, Refrigerant leakage, Electrical faults, Tools & instruments used, Performance testing
9. **RAC Piping, Materials & Components**
Types of piping materials (copper, steel), Insulation materials, Valves and fittings, Compressors: Reciprocating, Rotary, Condensers and evaporators, Expansion devices
10. **Industrial Management, Safety & Quality**
Basics of industrial management, Total Quality Management (TQM), Work planning & supervision, Safety practices: Electrical safety, Refrigerant handling safety, Emergency procedures, Entrepreneurship basics
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Syllabus for Supervisor (Civil Engineering)

1. **Building Planning & Drawing**
Principles of building planning: orientation, ventilation, sanitation, Types of buildings: residential, public, industrial, Building bye-laws and regulations, Preparation and interpretation of drawings, Floor plans, elevations, and sections, Basics of Computer-Aided Drafting (CAD)
2. **Engineering Mechanics & Strength of Materials**
Force systems and equilibrium, Stress and strain, Elastic constants, Bending moment and shear force, Torsion and buckling of columns
3. **Concrete Technology**
Ingredients of concrete, Properties of fresh and hardened concrete, Mix design basics, Workability and compaction, Curing methods, Admixtures and quality control
4. **Construction Engineering & Management**
Construction planning and scheduling (CPM, PERT), Resource management, Site supervision and organization, Contracts and tendering, Safety management, Quality control
5. **Surveying & Geomatics**
Chain and compass surveying, Levelling and contouring, Theodolite surveying, Total station and GPS basics, Errors and adjustments
6. **Fluid Mechanics & Hydraulics**
Properties of fluids, Fluid statics and dynamics, Bernoulli's theorem, Flow through pipes, Open channel flow, Hydraulic machines basics
7. **Geotechnical Engineering**
Soil properties and classification, Permeability and seepage, Shear strength, Compaction and consolidation, Bearing capacity, Types of foundations
8. **Structural Analysis**
Types of loads, Analysis of determinate structures, Shear force and bending moment diagrams, Deflection of beams, Basic indeterminate structures
9. **Environmental Engineering**
Water supply systems, Water treatment, Sewage and wastewater treatment, Solid waste management, Pollution control
10. **Estimation, Costing & Engineering Economics**
Types of estimates, Quantity take-off, Rate analysis, Preparation of BOQ, Costing and budgeting, Basics of economics
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Supervisor (Electrical and Electronics)

1. **Basic Electrical & Electronics Engineering**
Ohm's Law, Kirchhoff's Laws, AC/DC fundamentals, Basic circuit components (R, L, C, diode, transistor)
2. **Network Analysis**
Nodal & Mesh analysis, Network theorems (Thevenin, Norton), Transient & steady-state analysis
3. **Electrical Measurements & Instruments**
Ammeter, Voltmeter, Wattmeter, DMM, CRO/DSO basics, Measurement errors & calibration
4. **Electrical Machines (Basics)**
Transformer fundamentals, DC machines, Induction motors (basic operation)
5. **Basic Electronics**
Semiconductor basics, Diodes, Transistors, Rectifiers & Amplifiers

6. **Digital Electronics**
Logic gates, Number systems, Flip-flops and basic circuits
7. **Signals & Systems (Basics)**
Types of signals, Fourier & Laplace basics, Sampling concept
8. **Power & Energy Basics**
Electrical power concepts, Energy conversion principles, Basics of batteries & energy systems
9. **Electrical Safety & Protection**
Earthing, Protective devices (MCB, fuse, relay), Safety practices in LT/HT systems
10. **Basic Workshop / Practical Knowledge**
Tools & equipment, Wiring basics, PCB / circuit assembly basics
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Supervisor (Electrical)

1. **Basic Electrical Circuits**
DC circuits: Ohm's Law, Kirchhoff's Laws, Series & parallel circuits analysis, Electrical power and energy concepts, Electromagnetism basics: Faraday's Law, Lenz's Law, Inductance: self & mutual
2. **AC Circuits & Three-Phase Systems**
Sinusoidal waveform, RMS & average values, Phasor representation, R, L, C and RLC circuit analysis, Power: real, reactive, apparent, power factor, Three-phase systems: star & delta connections, Two-wattmeter method
3. **Electrical Machines – I (Transformers)**
Construction & working of transformers, EMF equation, Losses & efficiency, Voltage regulation, Applications in power systems
4. **Electrical Machines – II (DC & AC Machines)**
DC generators & motors: working, EMF, torque, Types of DC motors & characteristics, Induction motors: principle & operation, Synchronous machines basics
5. **Network Analysis**
Circuit laws and theorems (Thevenin, Norton, Superposition), Mesh & nodal analysis, Transient analysis of RL, RC circuits, Laplace transform basics
6. **Analog & Digital Electronics**
Diodes, rectifiers, filters, Transistors and amplifiers, Logic gates, combinational & sequential circuits, Flip-flops and registers
7. **Control Systems**
Open loop vs closed loop systems, Transfer functions, Block diagram reduction, Stability analysis (Routh criterion), Basic controllers (P, PI, PID)
8. **Power Electronics**
Power semiconductor devices (SCR, MOSFET, IGBT), Controlled rectifiers, Inverters and choppers, Applications in motor drives
9. **Power Systems**
Generation, transmission, and distribution, Transmission line parameters, Load flow basics, Power system protection (relays, circuit breakers), Fault analysis basics
10. **Measurements & Electrical Safety**
Measuring instruments (ammeter, voltmeter, wattmeter), Measurement errors and calibration, Earthing and grounding, Electrical hazards and safety standards, Maintenance practices
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Syllabus for Supervisor (Electronics Engineering)

1. **Electronic Devices**
Semiconductor physics: intrinsic & extrinsic materials, PN junction diode: characteristics, rectifiers, Zener diode and voltage regulation, Bipolar Junction Transistor (BJT): configurations, biasing, Field Effect Transistors (FET, MOSFET), Applications in switching and amplification
2. **Digital System Design**
Number systems and binary codes, Boolean algebra and logic simplification, Logic gates and combinational circuits, Multiplexers, decoders, Sequential circuits: flip-flops, registers, counters, Introduction to programmable logic devices
3. **Signals and Systems**
Classification of signals (continuous/discrete), System properties (linearity, time-invariance), Convolution and system response, Fourier series and transforms, Laplace transform and applications, Sampling theorem basics

4. **Network Theory**
Basic circuit laws (KCL, KVL), Network theorems (Thevenin, Norton, Superposition), Transient analysis of RL, RC, RLC circuits, AC circuit analysis using phasors, Resonance in circuits, Two-port network parameters
5. **Probability & Stochastic Processes**
Probability basics and random variables, Probability distributions (Binomial, Poisson, Gaussian), Expectation and variance, Random processes and classification, Stationary processes, Noise analysis in communication systems
6. **Analog Circuits**
Amplifiers: small signal analysis, Frequency response of amplifiers, Feedback in amplifiers, Oscillators (RC, LC, Crystal), Power amplifiers, Operational amplifiers and applications
7. **Microcontrollers**
Architecture of microcontrollers (e.g., 8051/AVR), Instruction set and programming basics, Interfacing with I/O devices, Timers and counters, Interrupts and serial communication, Applications in automation systems
8. **Analog and Digital Communication**
Communication system basics, Amplitude modulation (AM), Frequency modulation (FM), Digital communication basics (PCM, ASK, FSK), Noise and signal-to-noise ratio, Multiplexing techniques, Introduction to wireless communication
9. **Numerical Techniques**
Errors and approximations, Solutions of linear equations, Numerical differentiation & integration, Interpolation methods, Root finding techniques (Newton-Raphson), Applications in circuit analysis
10. **Practical & Project Work (Supervisor-Oriented)**
Electronic devices lab experiments, Digital circuit implementation, Microcontroller programming tasks, Communication system simulations, Fault diagnosis and maintenance, Mini project (e.g., automation system, sensor-based control)
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Syllabus for Supervisor (Instrumentation)

1. **Basics of Electrical & Electronics Engineering**
Electrical quantities: Voltage, Current, Resistance, Power, Ohm's Law, Kirchhoff's Laws (KCL, KVL), AC & DC fundamentals, Basic components: Resistor, Capacitor, Inductor, Introduction to transformers and motors
2. **Electronic Components & Devices**
Semiconductor basics, Diodes (PN junction, Zener, Rectifiers), Transistors (BJT, FET basics), Operational Amplifiers (Op-amps basics), Sensors interface basics
3. **Digital Electronics**
Number systems (Binary, Octal, Hexadecimal), Logic gates and Boolean algebra, Combinational circuits (Adders, Multiplexers), Sequential circuits (Flip-flops, Counters), Memory devices
4. **Engineering Mathematics for Instrumentation**
Matrices & determinants (system solving), Trigonometry (signal representation), Differential calculus (rate of change), Integral calculus (area, system modeling)
5. **Measurement & Instrumentation Fundamentals**
Measurement systems and standards, Static & dynamic characteristics, Errors in measurement, Calibration techniques, Types of instruments (Analog & Digital)
6. **Sensors & Transducers**
Classification of transducers, Temperature sensors (RTD, Thermocouple), Pressure, Flow, Level sensors, Displacement and proximity sensors, Smart sensors
7. **Industrial Instrumentation**
Flow measurement (Orifice, Venturi), Pressure measurement devices, Level measurement techniques, Temperature measurement systems, Signal conditioning
8. **Control Systems**
Open-loop & closed-loop systems, Transfer functions, Block diagram representation, PID controllers, Stability analysis
9. **PLC & Industrial Automation**
Basics of PLC (Programmable Logic Controller), Ladder programming, Input/output modules, SCADA basics, Industrial automation applications
10. **Maintenance & Safety in Instrumentation**
Preventive and predictive maintenance, Troubleshooting techniques, Industrial safety standards, Hazard identification, Documentation & reporting
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Syllabus for Supervisor (IT)

1. **Programming for Problem Solving**
Introduction to Programming Concepts, Algorithms and Flowcharts, Basics of C/Python Programming, Data Types, Variables, Operators, Control Structures (if, loop, switch), Functions and Recursion, Arrays and Strings, File Handling, Debugging and Error Handling
2. **Data Structures and Algorithms**
Introduction to Data Structures, Arrays, Linked Lists, Stacks and Queues, Trees (Binary Tree, BST), Graphs (Basics, Traversal), Searching Techniques (Linear, Binary), Sorting Algorithms (Bubble, Merge, Quick), Algorithm Complexity (Time & Space Analysis)
3. **Discrete Mathematics**
Logic and Propositional Calculus, Sets, Relations, Functions, Boolean Algebra, Combinatorics, Graph Theory, Recurrence Relations
4. **Computer Organization & Architecture**
Basic Computer Organization, CPU Architecture, Instruction Set & Execution Cycle, Memory Hierarchy (Cache, RAM), Input/Output Organization, Number Systems & Arithmetic
5. **Operating Systems**
Introduction to Operating Systems, Process Management & Scheduling, Threads and Concurrency, Deadlocks, Memory Management (Paging, Segmentation), File Systems, Security & Protection
6. **Database Management Systems**
Introduction to DBMS, Data Models and ER Diagrams, Relational Model, SQL Queries (DDL, DML), Normalization, Transactions & Concurrency Control, Database Security
7. **Computer Networks**
Network Basics and Models (OSI, TCP/IP), Transmission Media, Data Link Layer, Network Layer (Routing, IP Addressing), Transport Layer (TCP/UDP), Application Layer Protocols (HTTP, FTP, DNS), Network Security Basics
8. **Design and Analysis of Algorithms**
Algorithm Design Techniques, Divide and Conquer, Greedy Algorithms, Dynamic Programming, Backtracking, Complexity Analysis (Big-O, Ω , Θ), NP-Completeness (Basics)
9. **Machine Learning (Basic Level)**
Introduction to Machine Learning, Types of Learning (Supervised, Unsupervised), Regression Techniques, Classification Algorithms, Clustering (K-means), Model Evaluation, Applications of ML
10. **Cyber Security**
Introduction to Cyber Security, Types of Cyber Threats, Cryptography Basics, Network Security, Authentication & Authorization, Malware & Attacks, Security Policies & Practices

Syllabus for Supervisor (Mechanical and Air Condition)

1. **Engineering Mathematics & Basic Science**
Basic algebra, equations, statistics, Basic physics (heat, energy, electricity basics)
2. **Engineering Drawing & Basics**
Reading drawings, Symbols, dimensions, Basic machine drawings
3. **Workshop & Manufacturing Technology**
Carpentry, fitting, welding, Sheet metal, machining basics, Fabrication processes
4. **Thermodynamics**
Heat, work, energy, Laws of thermodynamics, Basic cycles (Carnot, refrigeration cycle)
5. **Heat Transfer**
Conduction, convection, radiation, Heat exchangers (basic idea)
6. **Fluid Mechanics**
Pressure, flow, viscosity, Reynolds number, friction loss, Pipe flow basics
7. **Refrigeration & Air Conditioning Basics**
Vapour compression system, Vapour absorption system, Psychrometry & comfort conditions
8. **Mechanical Components & Systems**
Compressors, pumps, Valves, pipes, fittings, Basic machine elements
9. **Installation, Maintenance & Troubleshooting**
RAC installation basics, Fault finding (electrical + mechanical), Leak detection, servicing
10. **Industrial Safety & Process Planning**
Safety standards & PPE, Electrical & mechanical safety, Basics of costing & planning
11. **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Syllabus for Supervisor (Mechanical)

- 1: **Engineering Materials & Applications**
Classification of engineering materials (metals, polymers, ceramics, composites), Crystal structure and defects, Mechanical properties (strength, hardness, toughness, ductility), Heat treatment processes (annealing, quenching, tempering), Corrosion and prevention methods, Material selection for industrial components
- 2: **Mechanics of Deformable Solids**
Stress and strain concepts, Hooke's law and elastic constants, Axial loading and deformation, Torsion of shafts, Bending stresses in beams, Shear force and bending moment diagrams, Failure theories (basic concept)
- 3: **Fluid Mechanics & Hydraulic Machines**
Fluid properties and statics, Pressure measurement devices, Fluid kinematics and dynamics, Bernoulli's equation and applications, Flow through pipes and losses, Pumps (centrifugal, reciprocating), Hydraulic turbines
- 4: **Heat Transfer & Thermal Machines**
Modes of heat transfer (conduction, convection, radiation), Heat exchangers (types and applications), Steam generation and boilers, Rankine cycle basics, IC engines (working principles), Performance parameters
- 5: **Kinematics & Dynamics of Machines**
Mechanisms and kinematic pairs, Velocity and acceleration analysis, Gear mechanisms and gear trains, Flywheel and governors, Balancing of rotating masses, Vibrations (basic concept)
- 6: **Manufacturing Processes**
Casting processes and defects, Metal forming (rolling, forging, extrusion), Machining processes (lathe, drilling, milling), Welding and joining processes, Non-traditional machining (EDM, laser), Surface finishing
- 7: **Machine Elements & System Design**
Design principles and factor of safety, Design of shafts, keys, and couplings, Bearings (types and selection), Springs design, Gears and belt drives, Failure analysis basics
- 8: **Measurements & Metrology**
Measurement systems and errors, Linear and angular measurement, Vernier, micrometer, gauges, Surface roughness measurement, Limits, fits, and tolerances, Calibration and standards
- 9: **Mechatronics, Robotics & Control**
Basics of sensors and actuators, PLC fundamentals, Control systems (open and closed loop), Robotics basics (types, applications), Industrial automation concepts
- 10: **Production & Operation Management**
Production planning and control, Inventory management, Quality control techniques, Work study and time study, Maintenance management, Lean manufacturing basics
- 11: **Basic knowledge of computer and its application i.e. MS office (Word, Excel, PPT etc.).**

Junior Technician (Mechanic & Air conditioning)

1. **Workshop Safety & Practices**
PPE, hazard identification, Fire safety, electrical safety, Industrial safety basics
2. **Basic Engineering Drawing**
Reading job drawings, Orthographic & isometric views, Symbols and dimensioning
3. **Workshop Calculation & Science**
Units, measurements, Heat, pressure, work, power, Basic maths (ratio, % , area, volume)
4. **Basic Fitting & Fabrication**
Marking, cutting, drilling, tapping, Filing, grinding, Basic assembly work.
5. **Welding & Joining Processes**
Arc welding basics, Gas welding & cutting, Pipe joints & fittings
6. **Mechanical Systems & Power Transmission**
Bearings, gears, belts, pulleys, Lubrication & cooling systems, Machine components
7. **Hydraulics & Pneumatics**
Basic principles (Pascal law), Components (valves, compressors, actuators), Simple circuits
8. **Basic Electrical & Controls**
Motors (AC/DC), Basic circuits & components, Sensors & simple control systems
9. **Refrigeration & Air Conditioning Basics**
Vapour compression cycle, Refrigerants & properties, Psychrometry & heat load basics
10. **Installation, Maintenance & Troubleshooting**
Preventive maintenance, Fault diagnosis (mechanical + RAC systems), Pumps, compressors, AC systems

Junior Technician (Electrical/Electronics)

- 1. Safety, Tools & Workshop Practice**
PPE, electrical safety, first aid, fire safety, Identification & use of hand tools, Workshop practices (fitting, drilling, wiring basics).
- 2. Basic Electricity**
Current, voltage, resistance, power, AC & DC fundamentals, Series & parallel circuits, Ohm's Law and simple calculations
- 3. Electrical Wiring & Cables**
Types of wires, cables, connectors, Cable joints, termination, crimping, Earthing basics
- 4. Electrical & Electronic Components**
Passive components (R, L, C), Active components (diode, transistor), Identification, testing, applications
- 5. Measuring Instruments**
Use of multimeter, voltmeter, ammeter, Measurement of voltage, current, resistance, Basic calibration
- 6. Basic Electronics**
Diodes, rectifiers, power supplies, Transistors & simple amplifier concepts, Introduction to ICs
- 7. Electrical Machines & Devices (Basic)**
Motors, transformers (basic idea), Relays, circuit breakers, Electrical protection devices
- 8. Engineering Drawing**
Electrical/electronic symbols, Wiring diagrams & circuit diagrams, Reading layouts and schematics
- 9. Workshop Calculation & Science**
Basic math (algebra, percentage, ratio), Units & measurements (SI units), Basic physics (heat, electricity concepts)
- 10. Troubleshooting & Maintenance**
Fault finding in circuits, Testing & repair basics, Preventive maintenance

Junior Technician (Air Conditioning)

- 1. Safety, Tools & Introduction to RAC**
Introduction to Refrigeration & Air Conditioning industry, Scope and job role of technician, General workshop safety, electrical safety, PPE, Fire safety and first aid basics, Classification of tools and equipment used in RAC, Care, maintenance, and handling of tools
- 2. Basic Thermodynamics & Refrigeration Principles**
Concepts of heat, temperature, pressure, work, and energy, Units and measurement systems, Sensible heat, latent heat, superheating, subcooling, Laws of thermodynamics (basic understanding), Refrigeration cycle (Vapour Compression Cycle), Coefficient of Performance (COP) and Ton of Refrigeration, Vapour Absorption Refrigeration System (VARs) – basics
- 3. Electrical Fundamentals for RAC**
Basic electrical quantities: voltage, current, resistance, power, AC and DC supply concepts, Series and parallel circuits, Earthing and insulation, Electrical measuring instruments, Single-phase and three-phase systems (concept only), Basics of motors used in refrigeration
- 4. Electronics Fundamentals**
Introduction to semiconductor devices, Diodes, transistors, capacitors, resistors, Rectifiers (half-wave, full-wave, bridge), Voltage regulation (Zener diode), Basics of integrated circuits (ICs), Applications of electronics in RAC systems
- 5. Refrigeration System Components**
Compressor: types, construction, working (reciprocating, rotary, scroll, inverter), Condenser: air-cooled and water-cooled, Evaporator: types and functions, Expansion devices: capillary tube, thermostatic expansion valve, Refrigerants: types, properties, environmental impact (CFC, HFC alternatives), Lubricants and insulation materials
- 6. Domestic Refrigerators**
Construction and working of direct cool refrigerator, Frost-free refrigerator system, Air circulation and defrosting system, Electrical and mechanical components, Inverter technology refrigerators (concept), Common faults and theory of troubleshooting
- 7. Air Conditioning Systems**
Window air conditioner – construction & working, Split air conditioner – types and working, Inverter AC technology (concept), Package air conditioner basics, Car air conditioning system (basic concept), Comparison of different AC systems
- 8. Commercial Refrigeration Systems**
Water coolers, bottle coolers, deep freezers
Ice plant, cold storage, walk-in coolers
Ice cube machine and ice candy plant
Refrigeration load concept (basic)
Applications in industry and commercial use

9. **HVAC Systems & Advanced Air Conditioning**
Psychrometry: DBT, WBT, RH, air properties, Psychrometric chart (concept and interpretation), Air distribution systems and duct design basics, Fans, blowers, filters, and dampers, Central air conditioning systems, VRF/VRV systems (basic understanding), Chilled water systems (concept)
10. **Workshop Calculation & Science**
Basic arithmetic: fractions, decimals, percentages, Algebra: simple equations, Geometry: area, volume (related to ducts, pipes, tanks), Units and conversions (SI system), Density, pressure, force calculations, Heat calculations (basic heat load concepts), Graphs and basic data interpretation, Applied science in RAC (thermal properties, fluid basics)

Junior Technician (Electrician)

- 1: **Safety Practices & Workshop Discipline**
Electrical safety rules, PPE, hazards, Fire safety & extinguishers, First aid & electric shock treatment, Workshop discipline and housekeeping, Identification & safe use of tools
- 2: **Engineering Drawing for Electricians**
Drawing instruments and their uses, Types of lines, lettering, dimensioning, Geometrical constructions, Orthographic projection (1st & 3rd angle), Isometric views, Electrical symbols and wiring diagrams, Reading schematic and layout diagrams
- 3: **Workshop Calculation & Science**
Units, measurements, SI system, Basic arithmetic (fractions, ratio, percentage), Algebra basics and simple equations, Mensuration (area, volume, weight), Density, force, work, power, energy, Heat and temperature basics, Basics of electricity (scientific concepts)
- 4: **Electrical Fundamentals & Circuit Laws**
Voltage, current, resistance, Ohm's Law and Kirchhoff's Laws, Series and parallel circuits, Power and energy calculations, AC fundamentals and waveform, Power factor and 3-phase basics
- 5: **Wiring, Cables & Installation**
Types of wires and cables, Wire joints and termination methods, Domestic wiring systems, Conduit wiring installation, Switches, sockets, MCB, ELCB installation, Testing and fault finding
- 6: **Electrical Measurements & Instruments**
Measuring instruments (analog & digital), Ammeter, voltmeter, wattmeter, Multimeter and clamp meter, Energy meter (single & three phase), Measurement errors and calibration
- 7: **Earthing, Protection & Illumination**
Types and methods of earthing, Earth resistance testing, Protective devices (fuse, relay, MCB, RCCB), Types of lamps and lighting systems, Illumination calculation and layout
- 8: **Transformers & Static Machines**
Working principle of transformers, Types and applications, Losses, efficiency and regulation, Transformer testing, Basic winding techniques
- 9: **Electrical Machines (DC & AC)**
DC machines (generator & motor), Induction motors (1-phase & 3-phase), Motor starters (DOL, star-delta), Speed control methods, Alternators and synchronization
- 10: **Electronics, Renewable Energy & Modern Applications**
Basic electronic components (diode, transistor, SCR), Rectifiers and inverters, UPS and stabilizers, Solar energy systems, Electric vehicles and charging systems, Smart grid basics

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Junior Technician (Fitter)

- 1. **Safety, Workshop Practices & 5S System**
Importance of safety in engineering workshops, Personal Protective Equipment (PPE) and its usage, Occupational Safety, Health & Environment (OSHE) guidelines, Fire safety: types of fire extinguishers and applications, First aid and emergency response procedures, Hazard identification and risk prevention, Electrical safety precautions, 5S concept: Sort, Set in order, Shine, Standardize, Sustain, Housekeeping and waste disposal methods
- 2. **Engineering Materials & Metallurgy**
Classification of engineering materials, Properties of metals: Physical (density, conductivity, etc.), Mechanical (strength, hardness, ductility, toughness), Ferrous materials: Pig iron, cast iron, wrought iron, steel, Non-ferrous materials: Copper, aluminium, zinc, tin, alloys, Heat treatment processes: Annealing, hardening, tempering, Corrosion and prevention methods, Surface coating techniques
- 3. **Measuring Instruments & Metrology**
Importance of measurement and accuracy, Linear and angular measurement systems, Measuring instruments: Steel rule, calipers, micrometer, vernier caliper, Vernier height gauge, bevel protractor, Gauges: Plug gauge, snap gauge, feeler gauge, Limits, fits and tolerances, Interchangeability concept, Errors in measurement and calibration, Surface finish and inspection methods
- 4. **Basic Fitting Theory**
Principles of fitting work, Marking and layout techniques, Cutting tools and their theory: Hacksaw, chisel, file, Filing theory: Types of files, grades, cuts, Drilling theory: Types of drills and machines, Threading: Internal and external threads, Fasteners: Bolts, nuts, screws, rivets, Accuracy and tolerance in fitting
- 5. **Sheet Metal & Joining Processes**
Types of sheet metals and their properties, Sheet metal operations: Bending, cutting, forming, Development of simple shapes, Joints in sheet metal: Seam, lap, locked joints, Soldering: Types, fluxes, applications, Brazing process and advantages, Riveting: Types of rivets and joints, Applications in fabrication
- 6. **Welding Technology**
Principles of welding, Types of welding: Arc welding, Gas welding (Oxy-acetylene), Welding equipment and accessories, Welding electrodes and selection, Welding defects and remedies, Safety precautions in welding, Types of joints: Butt, fillet, corner joints, Basic knowledge of modern welding methods
- 7. **Machine Tools & Lathe Theory**
Introduction to machine tools, Lathe machine: Construction and parts, Working principles, Types of lathe operations: Turning, facing, taper turning, threading, Cutting tools: Types and tool geometry, Cutting parameters: Speed, feed, depth of cut, Lubrication and maintenance, Other machines: Drilling, grinding, shaping
- 8. **Fits, Assembly & Surface Finishing**
Types of fits: Clearance, interference, transition, Assembly principles and methods, Surface finishing techniques: Scraping, lapping, honing, Fastening methods: Keys, cotters, pins, Alignment and balancing, Tolerance control in assembly, Inspection of assembled components
- 9. **Power Transmission, Maintenance & Fluid Systems**
Power transmission elements: Belt drives, gears, pulleys, shafts, Types of gears and their applications, Bearings: Types and lubrication, Preventive maintenance concepts, Fault diagnosis and troubleshooting, Basics of pneumatics: Compressors, valves, actuators, Basics of hydraulics: Pumps, circuits, applications, Industrial applications
- 10. **Workshop Calculation & Science**
Units, measurements and conversions (SI system), Basic mathematics: Fractions, decimals, percentages, Geometry: Area, volume, angles, Trigonometry (basic applications in workshop), Algebra (simple equations), Physics concepts: Force, work, power, energy, Friction and motion, Heat and temperature, Pressure and fluid mechanics basics, Material science basics (stress, strain), Application of science in fitting work.

Junior Technician (Electronics / Instrumentation)

1. **Safety, Tools & Workshop Practice**
PPE, electrical safety, first aid, Hand tools, soldering, wiring, Basic workshop practices
2. **Basic Electrical Engineering**
AC/DC fundamentals, Voltage, current, resistance, Ohm's law, power, energy, Series & parallel circuits
3. **Electronic Components & Devices**
Passive: Resistor, Capacitor, Inductor, Active: Diode, Transistor, Identification & testing
4. **Analog Electronics**
Rectifiers, power supply, Amplifiers (basic), Op-amp basics
5. **Digital Electronics**
Logic gates, flip-flops, Counters, registers, Basic digital circuits
6. **Measuring Instruments & Electrical Measurement**
Ammeter, voltmeter, wattmeter, Multimeter usage, Measurement techniques
7. **Sensors & Transducers**
Temperature (RTD, Thermocouple), Pressure, level, proximity sensors, Signal conversion basics
8. **Calibration & Troubleshooting**
Instrument calibration basics, Fault finding in circuits, Maintenance practices
9. **Engineering Drawing & Circuit Reading**
Symbols & diagrams, Wiring diagrams, Block diagrams
10. **Basic Control Systems & Applications**
ON/OFF control, Simple automation systems, Industrial applications (level, temp control)

Junior Technician (Mechanic Tool)

1. **Safety, Workshop Practices & Industrial Environment**
Importance of safety in machine tool operations, Personal Protective Equipment (PPE) and safety symbols, Fire safety, first aid, and emergency procedures, Hazard identification and risk prevention, 5S concept and housekeeping practices, Occupational Safety & Health (OSH) standards, Environmental protection and waste disposal.
2. **Engineering Materials, Tools & Measuring Instruments**
Types and properties of engineering materials (ferrous & non-ferrous), Cutting tools: classification and applications, Hand tools: hammers, chisels, files, drills, taps, dies
Measuring instruments: Steel rule, Vernier caliper, micrometer, Dial gauge, feeler gauge, bevel protractor
Limits, fits, and tolerances (basic concept), Surface finish and measurement
3. **Basic Fitting & Assembly Principles**
Principles of fitting operations, Types of fits: Clearance, interference, transition fits, Interchangeability concept, Assembly techniques and sequence, Fasteners: Nuts, bolts, screws, washers, rivets, Keys and keyways, Torque and tightening methods
4. **Machine Tools: Construction & Working Principles**
Classification of machine tools
Construction and working of: Lathe machine, Shaper machine, Milling machine, Drilling machine, Grinding machine
Machine tool specifications and applications
Cutting parameters: Speed, feed, depth of cut
5. **Heat Treatment & Surface Finishing**
Heat treatment processes: Hardening, tempering, annealing, normalizing, Case hardening
Iron-carbon equilibrium concept
Surface finishing methods: Lapping, honing, scraping
Importance of surface finish in machine parts
6. **Mechanical Power Transmission Systems**
Types of power transmission: Belt, chain, gear drives
Gear types and terminology, Gear trains and applications
Couplings and clutches: Types and functions
Bearings: Types (ball, roller, plain), Mounting and lubrication
Brakes and braking mechanisms
7. **Lubrication, Cooling & Maintenance Systems**
Importance of lubrication Types of lubricants (oil & grease)
Lubrication systems: Centralized and manual
Coolants: Types and properties
Cooling systems in machine tools
Maintenance types: Preventive, predictive, breakdown maintenance
Maintenance planning and documentation

8. **Hydraulics & Pneumatics**
Basic principles of hydraulics and pneumatics
Components: Pumps, compressors, valves, actuators
Hydraulic circuits and symbols, Pneumatic circuits and control systems, Advantages and industrial applications, Fluid power system safety
9. **Electrical, Electronics & PLC Basics**
Basic electrical concepts: AC/DC, voltage, current, resistance
Electrical components: Motors, relays, transformers
Electronic components: Diodes, transistors, capacitors, ICs
Sensors: Proximity, ultrasonic
Introduction to PLC: Basic programming concept, Industrial automation overview
10. **Workshop Calculation & Science**
Units and measurements, Fractions, decimals, percentages, Ratio and proportion, Basic algebra
Geometry: Area, volume of common shapes
Trigonometry basics, Cutting speed, feed and machining time calculations
Basic physics: Force, work, power, energy
Heat and temperature, Friction and lubrication principles, Simple machines, Properties of materials, Basic electricity principles

Junior Technician (Mechanic Machine Tool Maintenance /Fitter)

1. **Safety & Industrial Practices**
PPE, first aid, fire safety, Hazard identification, 5S & housekeeping, Electrical safety basics
2. **Basic Fitting Operations**
Marking, measuring, filing, sawing, Drilling, tapping, reaming, Grinding basics, Tolerances & fits
3. **Engineering Drawing**
Reading drawings (2D/3D), Orthographic & isometric views, Dimensioning & symbols, Interpretation of machine drawings
4. **Workshop Calculation & Science**
Units, measurement, SI system, Basic math (ratio, percentage, geometry), Physics basics (force, work, power), Friction, centre of gravity
5. **Machine Tools Fundamentals**
Lathe, drilling, milling, grinding machines, Basic operations on machines, Machine parts & functions
6. **Maintenance of Machines**
Preventive maintenance, Breakdown maintenance, Lubrication systems, Inspection & checklist preparation
7. **Assembly & Fitting Techniques**
Fasteners (nuts, bolts, screws), Assembly & dismantling, Alignment & levelling, Machine erection basics
8. **Hydraulics & Pneumatics**
Basic components (pump, valves, actuators), Circuit basics, Applications in machines
9. **Welding & Fabrication Basics**
Arc welding & gas welding, Types of joints, Safety precautions, Basic cutting operations
10. **Engineering Materials & Heat Treatment**
Ferrous & non-ferrous metals, Properties of materials, Heat treatment processes, Bearings & lubrication basics