### **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.

### **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.

### **Thermal Engineering**

**Properties of Pure Substances**: P-V & P-T diagrams of pure substance like H<sub>2</sub>O, 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).

1<sup>st</sup> 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.

**2<sup>nd</sup> 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.

**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. 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. Air Compressors & their cycles; Refrigeration cycles; Principle of a Refrigeration Plant; Nozzles & Steam Turbines

#### Fluid Mechanics and Hydraulic Machinery

**Properties & Classification of Fluid**: Ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids. **Fluid Statics**: Pressure at a point. **Measurement of Fluid Pressure**: Manometers, U-tube, Inclined tube. **Fluid Kinematics**: Stream line, laminar & turbulent flow, external & internal flow, continuity equation. **Dynamics of ideal fluids**: Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equitation. **Measurement of Flow rate Basic Principles** 

Venturimeter, Pilot tube, Orifice meter. **Hydraulic Turbines**: Classifications, Principles. **Centrifugal Pumps**: Classifications, Principles, Performance.

### **Production Engineering**

**Classification of Steels**: Mild steal & 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, 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.

### **Workshop Practice and Industrial Basics**

Engineering Drawing Interpretation: Symbols, GD&T NDT Techniques: DP, MPI, UT, Radiography Qualifications Transformers, Wiring, Earthing, Industrial Safety, Single Phase and Three Phase AC Circuits

# Syllabus for Technical Supervisor (Diploma) Electronics and Communication

### **Basic Electronics**

Introduction to electronic components: Resistors, capacitors, inductors, diodes, transistors, and their characteristics. Concepts of rectifiers, Clippers & Clampers, voltage regulators, and biasing of transistors. Introduction to semiconductors, PN junction diodes, Zener diodes, LED, photodiodes, optoelectronic devices.

# **Electronic Devices and Circuits**

Analog electronics circuits: BJT configurations (CE, CB, CC), amplifier circuits, feedback amplifiers, oscillators, power amplifiers, multivibrators, and differential amplifiers. Working principles and characteristics of FET, MOSFET, and UJT.

### **Digital Electronics**

Number systems, logic gates, Boolean algebra, simplification techniques, combinational logic circuits (adders, subtractors, multiplexers, demultiplexers, encoders, decoders), sequential circuits (flip-flops, counters, shift registers), and introduction to memories and logic families.

#### **Network Filters and Transmission Lines**

Basic concepts of electrical networks, passive components, network theorems, AC and DC circuit analysis. Filters and their applications, transmission line theory, characteristics impedance, reflection coefficient, and standing wave ratio (SWR).

#### **Electronic Instruments and Measurement**

Study of measuring instruments including analog and digital multimeters, cathode ray oscilloscopes (CRO), signal generators, frequency counters, and LCR meters. Concepts of transducers, sensors, accuracy, precision, and calibration.

#### Microprocessors

Architecture, instruction set, addressing modes, and programming of 8085/8086 microprocessors. Interfacing with memory and peripheral devices. Basics of programmable peripheral interface (8255), ADC/DAC, and practical assembly language programming.

#### **Microcontrollers and Embedded Systems**

Study of microcontroller architecture (8051), programming, timers/counters, serial communication, and interrupt handling. Introduction to embedded systems, real-time applications, interfacing with sensors and actuators, and embedded C programming.

#### **Industrial Electronics and Transducers**

Working principles and applications of SCR, TRIAC, DIAC, and other power electronic devices. Introduction to converters, inverters, choppers, and their control techniques. Types of transducers and their applications in measurement and control systems.

### Wireless and Mobile Communication

Introduction to wireless communication systems, cellular concepts, GSM, CDMA, mobile radio propagation, antennas, frequency reuse, and handoff techniques. Evolution of mobile generations (2G to 5G).

# Syllabus for Technician (ITI) Mechanical

#### **Fitting and Assembly**

- Use of hand tools
- Types of fits, tolerances, and allowances
- Types of joints: temporary and permanent
- Keys, cotters, pins, dowels
- Limits, fits, and interchangeability
- Surface finish and roughness measurement

# **Machining Operations**

- Lathe machine operations turning, facing, knurling, taper turning, thread cutting
- Drilling machine operations reaming, tapping, counterboring
- Milling operations slab, face, and angular milling
- Grinding operations surface and cylindrical grinding
- Cutting speed, feed, and depth of cut
- Tool materials and cutting fluids

# Welding and Fabrication

- Welding methods: Arc, MIG, TIG, Gas welding
- Soldering and brazing techniques
- Welding defects and inspection
- Types of joints and welding symbols
- Safety in welding and PPE

# Measurement and Metrology

- Vernier caliper, micrometer, height gauge, dial indicators
- Slip gauges, sine bar, bevel protractor
- Limits, fits, and tolerances
- Basic knowledge of coordinate measuring machines (CMM)

# **Engineering Drawing**

- Reading and interpreting mechanical drawings
- Orthographic projections
- Sectional views, assembly drawings
- Symbols for welding, surface finish, tolerances

# Maintenance and Safety

- Preventive and breakdown maintenance
- Lubrication types and schedules
- Bearing maintenance, belt and chain drives
- Safety rules, first aid, PPE, fire extinguishers

• Lockout-tagout (LOTO)

# Hydraulics and Pneumatics (Basics)

- Pascal's law, Bernoulli's principle
- Hydraulic circuits, actuators, control valves
- Pneumatic tools and compressors
- Fluid power systems in industry

# Thermal and Fluid Engineering (Basics)

- Heat transfer methods
- Boilers and steam generation (basics)
- Air compressors types and working
- Properties of fluids and pressure measurement

### **Basic Electronics**

- Passive components: resistors, capacitors, inductors types, functions, color coding
- Semiconductor theory: P-N junction, Zener diode, LED, photodiodes
- Rectifiers: Half wave, full wave, bridge rectifier with filters
- Clipping and clamping circuits
- Voltage regulators Zener-based and IC

### **Transistor Devices and Circuits**

- BJT configurations (CE, CB, CC), transistor biasing, load lines
- Amplifier basics voltage gain, current gain
- Multistage amplifiers and coupling
- Feedback and oscillator circuits (RC, LC, crystal oscillators)

# **Digital Electronics**

- Number systems: Binary, decimal, octal, hexadecimal
- Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR truth tables
- Boolean algebra and simplification
- Combinational circuits: adders, subtractors, encoders, decoders, multiplexers
- Sequential circuits: flip-flops, counters, shift registers
- Memory types: RAM, ROM, EEPROM

#### **Electronic Measurements and Instruments**

- Working and usage of multimeters (analog/digital), CRO, signal generators, LCR meters
- Measurement of voltage, current, resistance, frequency, and capacitance
- Error types and accuracy
- Transducers and sensors LVDT, thermocouple, RTD, strain gauge (basics)

#### **Microcontrollers and Microprocessors (Basics)**

- Architecture of 8085 and instruction set
- Architecture of 8051, instruction set (basic), assembly programming (mov, add, sub, jump)
- I/O interfacing concepts LEDs, switches, motors, displays
- ADC/DAC (basic working)

# **Communication Systems**

- Analog communication AM, FM, PM: principles and comparison
- Block diagram of AM/FM transmitter and receiver
- Noise in communication systems
- Digital communication basics ASK, FSK, PSK

• Modems and multiplexing (TDM, FDM)

# **Power Electronics (Basic)**

- SCR, TRIAC, DIAC working and applications
- Rectifiers and inverters
- SMPS and UPS systems
- Relay working and interfacing

# **Electronic Workshop Practice, Testing & Repair Techniques**

- Soldering and Desoldering Techniques
- Identifying/resolving faults in electronic circuits and equipment
- Identification, Testing, Selection of various electronic components
- Basic Electricity, Tools for an Electrician, AC & DC Basics, Earthing