SYLLABUS - DIPLOMA IN MECHANICAL ENGINEERING

I. Basics of Mechanical Engineering

Engineering Mechanics: Basics of mechanics - Applied mechanics, Statics, and Dynamics. Scalar and vector quantity, Units of measurement - SI units - Fundamental units and derived units. Resolution of a force - Orthogonal components - Composition of forces – Resultant. Moment of a force, Varignon’s Theorem, Torque. Equilibrium and Equilibrant, Free body diagram. Lami’s Theorem.

Types of Beams, supports, and simple Loads acting on a beam. Truss: The magnitude and type of forces in various members of the truss, methods of joints. Friction and its relevance, Centroid, centre of gravity and moment of inertia. Shear Force & Bending Moment. Theory of Simple Bending and Deflection of Beams. Rigid, elastic and plastic bodies, Types of stress, strain, Hook’s law. Elasticity, Elastic limit, Modulus of elasticity. Percentage elongation. Mechanical properties of materials, Longitudinal and lateral strain, Modulus of Rigidity, Poisson’s ratio, volumetric strain, change in volume, Bulk modulus. Relation between modulus of elasticity, modulus of rigidity.Thermal stresses in bodies of uniform section and composite sections.

Strength of Materials and Metrology: Columns and struts Introduction: Euler's equations, Rankine's formulae for columns – buckling load - slenderness ratio - equivalent length on different end conditions. Torsion in Shafts and Springs: Function of shaft - Polar M.I for solid and hollow shafts. Design of shaft, comparison of strength and weight of solid and hollow shafts. Classification of springs - Deflection formula for closed coil helical spring - stiffness of spring. Crystal structures: Unit cell and space lattice - Iron-Carbon binary diagram - effect of slow cooling for various compositions - Alloy Steels - effects of alloying elements - composition, properties and uses. Failure & Testing of Materials: Metal failure; Fracture, Destructive testing, Hardness testing, Non-destructive testing. Heat treatment processes, Non-ferrous metals, and their Alloys. Measurements: Static and Dynamic Measurements - Methods of measurements, Precision and Accuracy, Errors in Measurements, Measurement of force. Measuring Gauges and Comparators, Surface Texture, Linear and Angular Measurement.

II. Thermal & Automobile Engineering

Thermodynamic system, intrinsic and extrinsic properties. Boyle’s law, Charle’s law, Joule’s law, Avogadro’s law - characteristic gas equation, Mayors relation-heat and work Thermodynamic equilibrium - Quasistatic processes. Change in internal energy, heat transferred and enthalpy change in each process. Statement of Zeroth law, first law, and second law of thermodynamics (Kelvin Plank and Clausius statements) - concept of entropy – reversible and irreversible process. Air standard cycles - assumptions- air standard efficiency - P-V, T-S diagram. Carnot cycle, Otto cycle, Diesel cycle. Working and comparison of petrol and diesel engines - Compare SI, CI engines. Valve timing diagram for diesel and petrol engines -two and four stroke. IC Engines. Steam and its properties - Steam generators - Functions and use of steam boilers - Steam turbines - working principle - Classification. Heat exchangers – Classification - Air compressors- uses of compressed air - Working principle. **Automobile Engineering:** Classification and basic structure of an automobile, Basic engine components, Engine valves - valve operating mechanism - overhead and side valve engines - Flywheel and Governor. The necessity and types of cooling system, necessity and types of lubrication system, Fuel system - Working of A.C mechanical pump - Fuel Injector - Single point and multi point fuel injection systems - Fuel filters, Ignition system - Elements of charging system - Elements of starting system; Governing system - Types of governing system. Transmission systems in automobile – requirements and classification of clutch - Gear box - functions-working- types - Suspension systems -Types and components. Wheels & tyres - types of wheels, Brakes.

III. Fluid Mechanics & Hydraulic Machinery

Properties of fluid, Fluid Pressure & Pressure Measurement- Types of fluid flow, Path line and Stream line, Continuity equation for steady incompressible flow, Euler equation, Bernoulli's theorem, Applications of Bernoulli's theorem Venturi meter, Orifice meter and Pitot tube - coefficient of discharge - Types of Notches and Orifices. Flow Through Pipes - Laminar and turbulent flows - Hagen-Poiseuille equation, Darcy's equation, and Chezy's equation for frictional losses - Hydraulic gradient and total gradient line. Impact of jets - Work done and efficiency. Hydraulic Turbines - Classification and Selection of hydraulic turbines. Features of hydroelectric power plant . Centrifugal Pumps: Principle of working and applications, Priming and its methods, Cavitation, Manometric head, Work done, efficiency, Reciprocating Pumps: Construction, working principle and applications, Cavitation and separation. Hydraulic ram, air lift pump, jet pump-propeller pumps - turbine pumps.

IV. Manufacturing Technology – Conventional and Modern

Manufacturing Technology and Machine Tools: Introduction to Manufacturing Process: Properties of materials - Foundry -Types of patterns, Advantages &

Disadvantages of Pattern materials. Castings – Types and Defects in casting, Cold working, and Hot Working-. Powder metallurgy. Welding: Classification and techniques, Types of welding flames. Electrode coatings – functions of Electrode coating. Welding defects, Welding positions. Forging: Forging tools. Press working: Types of Presses and Specifications, Press working operations. Metal cutting: chip formation, tool signature/ nomenclature of the single point cutting tool - properties of various cutting tool materials- tool life problems- machinability. Speeds - feeds and depths of cut of different operations for different materials. **Lathe machine and operations:** Types of lathe and specifications. **Drilling:** Classification; Basic parts and their functions. **Shaping Machines** – parts and their functions. Hydraulic method- automatic feed mechanism. Planning machines- parts, specification, comparison with shaper Slotting Machines. **Milling:** Types of milling machines and parts, Milling operations and cutters – types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter. **Grinding and finishing processes:** Types, Principles of metal removal by Grinding. **Cutting Fluids & Lubricants:** Types and selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants.

Modern Production Processes & Material Handling: Importance of Jigs & fixtures in mass production, Powder metallurgy, and surface modification techniques - applications of P/M- Procedure of P/M- pros and cons - Metal spraying organic coatings. Basic concepts of NC and CNC machines- construction details, classification, Programming CNC machines, Rapid Prototyping (RP) in product design- 3D printing- applications. Material handling equipment : Classification & applications - Mechanisms used in Material Handling Equipment. Conveying Machinery - Construction - Working of Traction type conveyors - Pneumatic & Hydraulic conveyors - Surface Transportation Equipment- Function and, applications of Trackless equipment. Hoisting Machinery & Equipment - Construction, Working & Maintenance of different types of hoists - Safety principles in material handling.

Computer Integrated Manufacturing: Concept of Computer Integrated Manufacturing (CIM) - Opportunities for Automation and Computerization in a Production System - Programmable Automation, Flexible and Fixed Automation; Reasons for Automation. Automation & Robotics, Robotic System & Anatomy Classification, Future Prospects. Robotic Application in Manufacturing, Programming for Robots. **Product Development** - Sequential and Concurrent Engineering - Comparison. Computer-Aided Design (CAD) - Definition, Advantages, CAD hardware and software - Engineering Analysis – Types.

Computer Aided Manufacturing (CAM) – Computer Aided Process Planning (CAPP) – Group Technology - Master Production Schedule (MPS) - Material Requirements Planning (MRP) - Capacity Requirement Planning (CRP) - Inventory Control with the aid of Computer.

V. Industrial Engineering, Management & Safety

Industrial Engineering: Production Planning and Control (PPC) - Functions of PPC - Concept of production and productivity - Methods for improving productivity - Types of Production - Plant maintenance - Measure of central tendency and dispersion. **Work Study**: Objectives - conduct of Method study - Therbligs – Symbols, SIMO chart. Work Measurement – Definition - Time study; Employees rating factor - application of time allowances. - Principal Constituents of project estimate Costing. **Industrial management and safety:** Functions of Manager - Manpower planning - Job evaluation - Performance appraisal - Training - Labor turnover – Wages. Characteristics of Quality - Concept and role of ISO - Quality Audit – objectives – TQM - Inventory management - EOQ and ABC. Stores management. Modern Management Techniques Just in Time - Quality circle - Zero defect concept - 5S Concept - Management Information Systems. Network analysis – PERT and CPM - Linear programming – Transportation problem. **Safety:** Importance of safety in the workplace - safety performance index - accident proneness - 4Es of accident prevention technique - the role of management, safety officers and safety council - precautions to be observed in hazardous situations like toxic, flammable, electrical shock and material handling.

VI. Refrigeration and Air-Conditioning

Introduction of Refrigeration, Air refrigeration-open and closed air refrigeration cycles. Refrigeration systems: - Comparison of Vapour absorption and Vapour compression system. Refrigeration Equipments: Compressors, Condensers, Evaporators, Capillary tube, Automatic Expansion valve; Thermostatic expansion valve. Air conditioning: Factors affecting human comfort, Design and Load estimation of Air conditioning systems, concept of HVAC

VII. Machine Design

Design of Machine Elements: General Considerations in Machine Design - types of constrained motions - types of fasteners - welded joints - Riveted joints - threaded joints. **Shafts:** Shaft materials - Standard Sizes - Design of Shafts - power transmitted by shaft. **Cams and Followers**: Concept - Definition and application of Cams and Followers. **Flywheel**: Concept, function, and application of flywheel. **Governors**: Types, Concept, function and applications, Comparison between Flywheel and Governor.

Couplings and bearings: – functions and classification. **Power Transmission**: Types of Drives, Condition for maximum power transmission - slip, velocity ratio, length of open belt, and crossed belt.

Product Design: Product Definition - Types and Levels of product. New product development (NPD) process: Product life cycle - Customer need identification - Challenges - Product analysis - Economic considerations - Production and Marketing aspects. Product design, Factors affecting product design - Standards of performance and environmental factors - Decision making and iteration - Morphology of design - Role of aesthetics - Design optimization - Economic factors in design - Design for safety and reliability. Role of computers in design - Modelling and Simulation - Mathematical Modelling - Similitude and scale models - Concurrent design - Six sigma and design. Design for manufacturing - Rapid Prototyping (RP) - Application of RP in product design - Product Development versus Design.