SYLLABUS FOR LAB ASSISTANT

(MECHANICAL ENGINEERING)

Diploma in Mechanical Engineering

1. Engineering Drawing

Basic Elements of Drawing, Concept and applications of Orthographic, Perspective, Isometric and Oblique Projections.

2. Engineering Mechanics

Mechanics, Force and Force system, Resolution of a force, Composition of forces -Law of triangle, Law of parallelogram and law of polygon of forces. Equilibrium and Equilibrant, Lami's Theorem, Laws of friction, Equilibrium of bodies on level surface and inclined plane. Centroid of geometrical plane figures, Centre of Gravity of simple solids, Moment of inertia-theorem of perpendicular axis, theorem of parallel axis. Simple lifting machine, Ideal machine, reversible and non-reversible machines, condition for reversibility, Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Screw jack, Weston's differential pulley block, geared pulley block.

3. Manufacturing Engineering

3.1 Casting Processes-Pattern, types of patterns, pattern materials, pattern allowance, colour code, Moulding sand constituents and its types, properties of moulding sand, Cores: Essential qualities of core materials, core sand preparation, Melting furnace, Blast furnace, Cupola furnace, Crucible furnace, Pit Furnace, Induction Furnace. Gating system, types of gating system, design of riser, Defects in casting: causes and remedies.

3.2 Metal Forming Processes

Hot working, cold working, Rolling, Forging, Extrusion, Drawing. Sheet metal forming processes: Shearing, Blanking-Punching, Embossing-Coining, Piercing, Trimming, Shaving, Nibbling, Notching, Lancing, Deep drawing, Spinning, Bending, Stretch forming.

3.3 Joining Processes

Arc welding, Gas welding, Resistance welding, other welding processes: Thermit welding, Friction welding, Explosion welding, Forged welding, Friction Welding, Brazing, soldering and Adhesive bonding, Weld defects and their causes.

3.4 Machining and Machine Tools

Introduction to metal cutting, Chip formation and types of chips, Mechanics of orthogonal metal cutting , Cutting tool material and geometry, Tool wear and tool life, Cutting fluids, types of cutting fluids, selection of cutting fluid, method of application of cutting fluids. Lathe machine, Milling machine, drilling, reaming, boring, tapping, shaper, planer, slotting machine, jigs and fixtures.

4. **Material Science & Engineering**

Classification of materials: metals, ceramics, polymers and composites. structure of materials: fundamentals of crystallography, symmetry operations, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions. Defects in crystalline materials.

Phase diagrams- Gibbs phase rule, Degrees of Freedom, Unary phase diagram. Introduction to Binary phase diagram- Isomorphous system, Eutectic system, Eutectoid system, Iron-Carbon binary diagram, flow sheet for production of iron and steel, Application of phase diagram.

Non-ferrous metals and its Alloys – Properties and uses.

5. **Strength of Materials**

5.1 Different types of Loads, Mechanical properties of materials, Statically Determinate structures. Direct Stress, Linear Strain, Hook's Law, Stress Strain curve of ferrous and nonferrous materials, Modulus of Elasticity, Yield, Proof, Breaking and Ultimate Stress and Factor of safety. Lateral Strain and Poisson's ratio, Relations between different Moduli. Thermal Stresses and Strain. Shear Stress, Shear Strain and Shear Modulus. Bulk Modulus and Volumetric Strain.

5.2 S.F and B.M Diagram for Cantilever, Simply Supported and Overhang Beams. Relation between Shear Force and Bending Moment. Point of Contra flexure and its importance.

5.3 Slope and Deflection in Cantilever and Simply Supported beams.

5.4 Bending Theory, Flexural equation, Bending stress, Bending strain, Sectional Modulus. Shear stress: Average and Maximum shear stress for rectangular and circular section beams.

5.5 Torsion of Shaft- Torsional Stress and Strain in solid and hollow shafts. Comparison between Solid and Hollow Shafts subjected to pure torsion.

5.6 Stiffness, deflection and maximum stress in helical open and closed coil springs only.

5.7 Thin cylinders and spheres subjected to internal pressure; Hoop stresses, longitudinal stress and change in volume.

5.8 Definition of principal plane and principal stresses. Mohr's circle of Stresses.

6. **Basic Thermodynamics**

6.1 Basic concepts of – State, state point, System, Boundary and Surroundings, Thermodynamic properties, Heat and work, change in internal energy, change in enthalpy and entropy, Specific heats at constant volume and at constant pressure. Thermodynamic processes with representation on P-V and T-S diagram. General gas equation, Characteristics of gas constant, Universal gas constant, specific heats of ideal gases. Thermodynamic equilibrium, Reversibility and irreversibility, Quasi- static process.

6.2 Zeroth, first law of thermodynamics, second law of thermodynamics and third law of thermodynamic. Carnot cycle and its representation on P-V and T-S diagram. Concept of air standard efficiency of Otto, Diesel, and Brayton cycle, representation on P-V & T-S diagram.

6.3 Properties of Steam and Steam Power, Pure Substances, Ideal & Real Gases.

7. **Engineering Metrology**

Linear and Angular Measurements, Limits, Fits, Tolerance, Measurements of Geometric Tolerances and Surface Roughness, Screw Thread and Gear Measurements, Displacement Speed and Temperature Measurements, Transducers, Strain Gauges, Pressure, Flow, Force and Torque Measurements.

8. **Fluid Mechanics & Hydraulic Machinery**

8.1 Properties of Fluid and Fluid Pressure, Pressure measurement- Manometer, U- tube manometer, Incline manometer, Inverted U tube manometer, Piezometer. Concept of Total pressure, Centre of pressure, Pascal's law, Hydrostatic forces on plane and curved surface immersed in liquid and simple problems on it, Metacenter.

8.2 Bernoulli's theorem and its application-Venturi meter, Orifice meter and Pitot tube. Flow Through Pipes- Laminar and turbulent flows. Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line.

8.3 Pelton, Francis and Kaplan turbines, Draft tubes and Concept of cavitation in turbines.

8.4 Centrifugal Pumps, Reciprocating Pumps and Submersible pump.

9. **Theory of Machines**

9.1 Kinematic link, Kinematic Pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, Machine and Structure. Four link planar mechanisms and Inversions.

9.2 Cams and Followers, Belt, Chain, Rope, Gear drives, Flywheel and Governors and Brakes and Clutches.

9.3 Balancing of several masses revolving in same plane.

10. **Applied Thermodynamics**

10.1 Steam condenser, Steam Turbines, Air Compressors, Steam Nozzles.

10.2 Rankine cycle: Construction and Working of Rankine cycle, their P-V & T-S diagram and its application.

10.3 Refrigeration Systems: Definition of Refrigeration; Refrigerating effect, Unit of refrigeration, Coefficient of performance (COP), Air refrigeration (Bell Coleman) cycle, Vapour compression refrigeration cycle, Vapour absorption refrigeration.

10.4 Air Conditioning & Ventilation System-Psychrometry, Psychrometric processes. Working principle of air-conditioning system.

10.5 Heat Transfer-Modes of heat transfer, Fourier law of heat conduction, Newton's law of cooling, Absorptivity, Reflectivity, Transmissivity, black body, White body, gray body, Emissivity; Law of radiation.

11. Advance Manufacturing Engineering

11.1 Non-Traditional Machining Processes-Water jet machining, Ultrasonic machining, Electrochemical machining, Electrical discharge machining, Laser beam machining and Electron beam machining.

11.2 CNC Machining-CNC part programming, G and M codes for turning and milling.

12. Design of Machine Elements

12.1 Creep, Creep strain and Creep Curve, Cyclic loading, Fatigue; S-N curve; Endurance Limit, Factor of Safety, Stress Concentration: Causes & Remedies, Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

12.2 Design of simple machine parts: Cotter Joint, Knuckle Joint. Antifriction Bearings-Life Load relationship.

12.3 Design of Shaft, Key, Coupling & Spur Gear.

12.4 Design of Power Screw, Spring & Leaf Spring.

12.5 Design of Fasteners & Ergonomics.