

Mechanical Engineering

1. Workshop Technology and Metrology

- 1.1 Safety Rules, Risk and Hazards in workshop operations.
Basic tools and Basic hand operations
- 1.2 Machine Tools and Operations: Lathe, Shaper, Milling, Grinding, Drilling Machines
- 1.3 Metal Joining Processes: Soldering, Brazing, Gas welding, Arc welding
- 1.4 Types of Fits: Basic System of Limits, Fits and Tolerances
- 1.5 Linear and Angular Measurement: Measuring Tools and Equipments
- 1.6 Errors in measurement

2. Material Science and Metallurgy

- 2.1 Types of Engineering Materials, Material Selection Criteria
- 2.2 Imperfections in Atomic Arrangement: Slip and Twinning, Dislocation, Points and Surface Defects
- 2.3 Mechanical Properties and Testing: Tension, Impact, Fatigue, Hardness Test
- 2.4 Cold working and Hot working
- 2.5 Types of steel
- 2.6 Phase Transformation and Heat Treatment: Iron-carbon Equilibrium diagram, Hardening, Tempering, Annealing, Normalizing

3. Machine Component Design and Drawing

- 3.1 Types of Projection
- 3.2 Production Drawings
- 3.3 Terminologies of Mechanisms, Mobility and Degrees of Freedom
- 3.4 Design Process
- 3.5 Factors Affecting Choice of Materials for Design: Strength, Toughness, Durability, Hardness
- 3.6 Loading: Tensile, Compressive, Shearing, Bending, Bearing and Torsion
- 3.7 Common Types of Failure: Theories of failure, Stress concentration effects, Ductile and brittle materials, Factor of safety

4. Thermodynamics and Heat Engines

- 4.1 Basic Concepts: Thermodynamic System, Thermodynamic Property, Pure Substance, Zeroth Law and its application
- 4.2 First Law of Thermodynamics: Control mass and Control Volume formulation
- 4.3 Second Law of Thermodynamics: Heat engine, Refrigerator and Heat pump, Kelvin Planck and Clausius Statements, Entropy
- 4.4 Refrigeration: Reversed Carnot cycle, Vapor compression cycle, Absorption refrigeration systems, Refrigerants and their properties
- 4.5 Air Conditioning: Psychometric properties and psychometric chart, Heating, cooling, humidification and dehumidification process, Air conditioning systems
- 4.6 Thermodynamic Cycles: Carnot cycle, Otto cycle, Diesel Cycle, Brayton cycle, Rankine cycle
- 4.7 IC engines: Classifications, components, two stroke and four stroke operations, performance of IC engines, Ignition system, Cooling system, Lubrication system
- 4.8 Modes of heat transfer: Conduction, Convection and Radiation

5. Fluid Mechanics

- 5.1 Fluid Properties: Viscosity, Surface tension, Compressibility, Vapor Pressure
- 5.2 Fluid Statics: Pressure variations in static fluid, Pressure head, Manometer, Force on submerged surfaces
- 5.3 Equations of Fluid Flow: Types of flow, Continuity equation, Bernoulli's equation, and Momentum equation
- 5.4 Viscous Effects: Reynolds number, Boundary layer, Frictional resistance to flow in pipes
- 5.5 Flow measurement: Pitot-static tube, Orifice, Venturimeter, Nozzle, and Rotameter

6. Hydraulic and Electric Machines

- 6.1 Water turbines: Pelton, Francis, Kaplan and Cross flow Turbines, Working Principles and Characteristics
- 6.2 Pumps: Centrifugal pump and reciprocating pumps, Working principle and Characteristics, Hydraulic ram
- 6.3 DC Motors: Shunt field, Series field and Compound field motors, Torque- speed characteristics
- 6.4 DC Generators: Shunt, Series and Compound field machines Voltage/speed/load characteristics, Effects of variable load, variable torque
- 6.5 Synchronous and Induction Machines: Basic structure of synchronous machines, Generator on isolated load, Generator on large system, Synchronous motor

7. Industrial Engineering and Management

- 7.1 Role of production/Operation Management and System Concepts
- 7.2 Plant Location and Plant Layout Design
- 7.3 Production Planning and Control: Selection of materials, methods, machines and manpower
- 7.4 Network methods: PERT, CPM
- 7.5 Inventory Control: Inventory costs and Inventory models
- 7.6 Forecasting Techniques: Requirements of forecasting, Time series and Moving average methods, Regression analysis
- 7.7 Quality Management: Importance of quality, Statistical process control
- 7.8 Statistical Analysis: Measurement of central tendency, Deviation, Distribution

8. Engineering Economics

- 8.1 Types of engineering economic decisions
- 8.2 Time Value of Money: Simple interest, Compound interest, Continuous compound interest
- 8.3 Project Evaluation Techniques: Payback period method, NPV method, Future value analysis, IRR method
- 8.4 Benefit and Cost Analysis: Cost benefit ratio, breakeven analysis
- 8.5 Corporate tax system in Nepal
- 8.6 Depreciation and its type

9. Professional Practice

- 9.1 Ethics and Professionalism: Perspective on morals, Codes of ethics and guidelines of professional engineering practice
- 9.2 Legal aspects of Professional Engineering in Nepal: Nepal Engineering Council Act and Regulations, Provision for private practice and employee engineers
- 9.3 Contract law
- 9.4 Tendering law and contract documents
- 9.5 Public Procurement practices for works, goods and services