# Haryana Engineering College, Jagadhri

Lesson Plan of Mechanical Engineering Deptt. 4th Semester

**Subject :** Materials Engineering (ES-204A)

**Objective of Course :**

1. To understand the Crystal structures and deformation mechanism in various materials.
2. To study various types of phase diagrams, TTT curve and Iron carbon diagram. To learn about different heat treatment processes.
3. To learn about the failure mechanisms like Creep and Fatigue and designation of materials.
4. To study Basics of Metallography and Basic Principle involved in the working of various types of Material characterization techniques.

| Day | Topic / Chapter Covered | Academic Activity | Test/Assignment |
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| Day 1 | Crystallography: Review of Crystal Structure | Lecture | |
| Day 2 | Space Lattice, Co-ordination Number | Lecture | |
| Day 3 | Number of Atomsper Unit Cell, Atomic Packing Factor | Lecture | |
| Day 4 | Numerical Problems Related to Crystallography | Lecture | |
| Day 5 | Imperfection in Metal Crystals: Crystal Imperfections and their Classifications | Lecture | |
| Day 6 | Point Defects, Line Defects, Edge & Screw Dislocations | Lecture | |
| Day 7 | Surface Defects, Volume Defects | Lecture | |
| Day 8 | Introduction to Engineering materials and Standard Materials Designation: Introduction to Engineering materials | Lecture | Assignment 1 |
| Day 9 | Steel Terminology, Standard Designation System for Steels | Lecture | |
| Day10 | Indian Standard specifications for steels as per BIS: Based on Ultimate Tensile Strength and based on Composition | Lecture | |
| Day11 | AISI-SAE standard designation for Steels and Aluminium Alloys | Lecture | |
| Day12 | Phase Diagrams: Alloy Systems, Solid solutions | Lecture | |
| Day13 | Hume Rothery's Rules | Lecture | |
| Day14 | Intermediate phases, Phase Diagrams | Lecture | |
| Day15 | Gibbs Phase Rule, Cooling curves | Lecture | |
| Day16 | The Lever Rule, binary phase diagrams | Lecture | |
| Day17 | Applications of Phase Diagrams, Phase Transformation | Lecture | |

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| Day18 | Micro constituents of Fe-C system | Lecture | Assignment 2 |
| Day19 | Allotropic Forms of Iron ,Iron-iron carbide phase diagram | Lecture | |
| Day20 | Modified Iron Carbon Phase Diagrams, Isothermal Transformation, TTT Curve, | Lecture | |
| Day21 | Heat Treatment: Heat treatment of steels | Lecture | |
| Day22 | Annealing, Normalising | Lecture | |
| Day23 | Hardening, Tempering, Case Hardening | Lecture | |
| Day24 | Ageing, Aus tempering and Mar tempering, Surface Hardening, Mass Effect | Lecture | |
| Day25 | Equipments for Heat Treatment | Lecture | |
| Day26 | Major Defects in Metals or Alloys due to faulty Heat treatment. | Lecture | |
| Day27 | Deformation of Metal: Elastic and Plastic Deformation | Lecture | Assignment 3 |
| Day28 | Mechanism of Plastic Deformation, Slip | Lecture | |
| Day29 | Critical Resolved Shear Stress, Twinning | Lecture | |
| Day30 | Conventional and True Stress Strain Curves for Polycrystalline Materials | Lecture | |
| Day31 | Yield Point Phenomena, Bauschinger Effect, Work Hardening | Lecture | |
| Day32 | Failure of Materials: Fatigue, Fatigue fracture, fatigue failure | Lecture | |
| Day33 | Mechanismof Fatigue Failure, Fatigue Life calculations | Lecture | |
| Day34 | Fatigue Tests, Theories of Fatigue | Lecture | |
| Day35 | Creep: Creep Curve | Lecture | Assignment 4 |
| Day36 | Types of Creep, Factors affecting Creep | Lecture | |
| Day37 | Mechanism of Creep, Creep Resistant Material | Lecture | |
| Day38 | Creep Fracture, Cre ep Test | Lecture | |
| Day39 | Stress Rupture test | Lecture | |
| Day40 | Introduction to Metallography: Metallography, Phase analysis | Lecture | |
| Day41 | Dendritic growth, Cracks and other defects Corrosion analysis | Lecture | |
| Day42 | Intergranular attack (IGA), Coating thickness and integrity | Lecture | |
| Day43 | Inclusion size, shape and distribution, Weld and heat-affected zones (HAZ) | Lecture | Assignment 5 |
| Day44 | Distribution and orientation of composite fillers, Graphite nodularity, Intergranular fracturing | Lecture | |

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| Day45 | Materials Characterization Techniques: Characterization techniques suchas X-Ray Diffraction (XRD) | Lecture | |
| Day46 | Scanning Electron Microscopy, transmission electron microscopy | Lecture | |
| Day47 | Atomic force microscopy, scanning tunneling microscopy | Lecture | |
| Day48 | Atomic absorption spectroscopy | Lecture | |

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# Haryana Engineering College, Jagadhri

Lesson Plan of Mechanical Engineering Deptt. 4th Semester

**Subject :** Applied Thermodynamics (MEC-202A)

**Objective of Course :**

1. Understand the working of boilers, types of boilers, accessories and mountings used on boilers.
2. Learn about simple and modified Rankine cycles.
3. Understand the design and analysis of steam flow through steam nozzles. To learn about the working of different types of condensers.
4. Analyze the working and design of the steam turbine and apply the knowledge in solving the engineering problems of turbines.

| Day | Topic / Chapter Covered | Academic Activity | Test/Assignment |
|---|---|---|---|
| Day 1 | Steam Generators: Introduction; classification of boilers | Lecture | |
| Day 2 | Comparison of fire tube and water tube boiler; their advantages | Lecture | |
| Day 3 | Description of boiler; Lancashire | Lecture | |
| Day 4 | Locomotive; Babcock; Wilcox etc. | Lecture | Assignment 1 |
| Day 5 | Boiler mountings; stop valve; safety valve | Lecture | |
| Day 6 | Blow off valve; feed check etc. | Lecture | |
| Day 7 | Water level indicator; fusible plug | Lecture | |
| Day 8 | Pressure gauge | Lecture | Assignment 2 |
| Day 9 | Boiler accessories; feed pump | Lecture | |
| Day10 | Feed water heater; preheater | Lecture | |
| Day11 | Super heater; economizer; natural draught chimney design | Lecture | |
| Day12 | Artificial draught; stream jet draught | Lecture | |
| Day13 | Mechanical draught | Lecture | Assignment 3 |
| Day14 | Calculation of boiler efficiency and equivalent evaporation. | Lecture | |
| Day15 | Vapour Power Cycles: Simple and modified Rankine cycle | Lecture | |
| Day16 | Effect of operating parameters on Rankine cycle performance | Lecture | |
| Day17 | Effect of superheating; effect of maximum pressure | Lecture | |
| Day18 | Effect of exhaust pressure; reheating and regenerative Rankine cycle | Lecture | Assignment 4 |
| Day19 | Types of feed water heater; reheat factor; binary vapour cycle | Lecture | |
| Day20 | Simple steam engine, compound engine; function of various components. | Lecture | |
| Day21 | Steam Nozzle: Function of steam nozzle | Lecture | |

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| Day22 | Shape of nozzle for subsonic and supersonics flow of stream | Lecture | |
| Day23 | Variation of velocity; area of specific volume | Lecture | Assignment 5 |
| Day24 | Steady state energy equation; continuity equation | Lecture | |
| Day25 | Nozzle efficiency; critical pressure ratio for maximum discharge | Lecture | |
| Day26 | Physical explanation of critical pressure; super saturated flow of steam | Lecture | |
| Day27 | Design of steam nozzle | Lecture | Assignment 6 |
| Day28 | Advantage of steam condensation; component of steam condensing plant | Lecture | |
| Day29 | Types of condensers; air leakage in condensers | Lecture | Assignment 7 |
| Day30 | Dalton's law of partial pressure; vacuum efficiency | Lecture | |
| Day31 | Calculation of cooling water requirement; air expansion pump. | Lecture | |
| Day32 | Steam Turbines: Introduction; classification of steam turbine | Lecture | |
| Day33 | Impulse turbine; working principle; compounding of impulse turbine; velocity diagram | Lecture | |
| Day34 | Calculation of power output and efficiency | Lecture | |
| Day35 | Maximum efficiency of a single stage impulse turbine | Lecture | Assignment 8 |
| Day36 | Design of impulse turbine blade section; impulse | Lecture | |
| Day37 | Reaction turbine; working principle | Lecture | |
| Day38 | Degree of reaction; parsons turbine; velocity diagram | Lecture | |
| Day39 | Calculation of power output; efficiency of blade height | Lecture | |
| Day40 | Condition of maximum efficiency | Lecture | |
| Day41 | Internal losses in steam turbine | Lecture | |
| Day42 | Governing of steam turbine | Lecture | |

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# Haryana Engineering College, Jagadhri

Lesson Plan of Mechanical Engineering Deptt. 4th Semester

**Subject :** Fluid Mechanics & Fluid Machines (MEC-204A)

**Objective of Course :**

1. Upon completion of this course, students will be able to apply mass and momentum conservation laws to mathematically analyze simple flow situations.
2. The students will be able to obtain solution for boundary layer flows using exact or approximate methods.
3. The students will be able to estimate the major and minor losses through pipes and learn to draw the hydraulic gradient and total energy lines.
4. The students will be able to obtain the velocity and pressure variations in various types of simple flows.
5. They will be able to analyze the flow and evaluate the performance of pumps and turbines.

| Day | Topic / Chapter Covered | Academic Activity | Test/Assignment |
|---|---|---|---|
| Day 1 | Fluid Properties: Definition of fluid | Lecture | |
| Day 2 | Newton's law of viscosity | Lecture | |
| Day 3 | Units and dimensions-Properties of fluids, mass density, weight density | Lecture | |
| Day 4 | Specific volume, specific gravity, viscosity | Lecture | Assignment 1 |
| Day 5 | Compressibility, surface tension and capillarity | Lecture | |
| Day 6 | Fluid Kinematics: Types of fluid flows | Lecture | |
| Day 7 | Stream, streak and path lines; flow rate and continuity equation | Lecture | |
| Day 8 | Differential equation of continuity in cartesian and polar coordinates | Lecture | |
| Day 9 | Rotation and vorticity, circulation | Lecture | |
| Day10 | Stream and potential functions, flow net. Problems. | Lecture | |
| Day11 | Fluid Dynamics: Concept of system and control volume | Lecture | |
| Day12 | Euler's equation, Navier-Stokes equation | Lecture | |
| Day13 | Bernoulli's equation and its practical applications | Lecture | Assignment 2 |
| Day14 | Impulse momentum equation. Problems. | Lecture | |
| Day15 | Viscous Flow: Flow regimes and Reynold's number | Lecture | |
| Day16 | Relationship between shear stress and pressure gradient | Lecture | |
| Day17 | Exact flow solutions, Couette and Poisuielle flow | Lecture | |
| Day18 | Laminar flow through circular conduits. Problems. | Lecture | |

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| Day19 | Turbulent Flow Through Pipes: Darcy Weisbach equation, friction factor | Lecture | |
| Day20 | Moody's diagram, minor losses in pipes | Lecture | |
| Day21 | Hydraulic gradient and total energy lines, series and parallel connection of pipes | Lecture | |
| Day22 | Branched pipes; equivalent pipe, power transmission through pipes. Problems. | Lecture | |
| Day23 | Boundary Layer Flow: Concept of boundary layer, measures of boundary layer thickness | Lecture | Assignment 3 |
| Day24 | Blasius solution, von-Karman momentum integral equation, laminar and turbulent boundary layer flows, | Lecture | |
| Day25 | Separation of boundary layer and its control. Problems. | Lecture | |
| Day26 | Dimensional Analysis: Need for dimensional analysis – methods of dimension analysis | Lecture | |
| Day27 | Dimensionless parameters – application of dimensionless parameters. Problems. | Lecture | |
| Day28 | Hydraulic Pumps: Introduction, theory of Rotodynamic machines | Lecture | |
| Day29 | Classification, various efficiencies | Lecture | |
| Day30 | Velocity components at entry and exit of the rotor, velocity triangles | Lecture | |
| Day31 | Centrifugal pumps, working principle, work done by the impeller, minimum starting speed | Lecture | |
| Day32 | Performance curves, Cavitation in pumps | Lecture | |
| Day33 | Reciprocating pumps, working principle | Lecture | |
| Day34 | Indicator diagram | Lecture | |
| Day35 | Effect of friction and acceleration, air vessels, Problems. | Lecture | Assignment 4 |
| Day36 | Hydraulic Turbines: Introduction | Lecture | |
| Day37 | Classification of water turbines, heads and efficiencies, velocity triangles | Lecture | |
| Day38 | Axial, radial and mixed flow turbines | Lecture | |
| Day39 | Pelton wheel | Lecture | |
| Day40 | Francis turbine and Kaplan turbines, working principles, work done | Lecture | |
| Day41 | Design of turbines, draft tube and types | Lecture | |

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| Day42 | Specific speed, unit quantities | Lecture | |
| Day43 | Performance curves for turbines | Lecture | Assignment 5 |
| Day44 | Governing of turbines. Problems | Lecture | |

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# Haryana Engineering College, Jagadhri

Lesson Plan of Mechanical Engineering Deptt. 4th Semester

**Subject :** Mechanics of Solids - II (MEC-206A)

**Objective of Course :**

1. Identify the basics concepts of strain energy and various theories of failures and solve the problems.
2. Differentiate different types of stresses induced in thin pressure vessel and solve the problems. Use of Lame's equation to calculate the stresses induced in thick pressure vessel.
3. Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyze the stresses produced due to loading.
4. Determine the stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings. Analyze the stresses due to unsymmetrical bending and determine the position of shear centre of different section.

| Day | Topic / Chapter Covered | Academic Activity | Test/Assignment |
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| Day 1 | Strain Energy & Impact Loading: Definitions | Lecture | |
| Day 2 | Expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact | Lecture | |
| Day 3 | Strain energy of beams in bending | Lecture | |
| Day 4 | Beam deflections | Lecture | Assignment 1 |
| Day 5 | Strain energy of shafts in twisting | Lecture | |
| Day 6 | Energy methods in determining spring deflection | Lecture | |
| Day 7 | Castigliano's theorem | Lecture | |
| Day 8 | Theories of Elastic Failures: Various theories of elastic failures with derivations | Lecture | Assignment 2 |
| Day 9 | Graphical representations | Lecture | |
| Day10 | Applications to problems of 2-dimensional stress system with Combined direct loading and bending | Lecture | |
| Day11 | Combined torsional | Lecture | |
| Day12 | Direct loading | Lecture | |
| Day13 | Thin Walled Vessels: Hoop & Longitudinal stresses | Lecture | |
| Day14 | Strains in cylindrical | Lecture | |
| Day15 | Spherical vessels & their derivations under internal pressure | Lecture | |
| Day16 | Wire would cylinders | Lecture | |
| Day17 | Thick Cylinders & Spheres: Derivation of Lame's equations | Lecture | |
| Day18 | Radial & hoop stresses and strains in thick | Lecture | Assignment 3 |
| Day19 | Ccompound cylinders | Lecture | |

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| Day20 | Spherical shells subjected to internal fluid pressure only | Lecture | |
| Day21 | Hub shrunk on solid shaft | Lecture | |
| Day22 | Rotating Rims & Discs: Stresses in uniform rotating rings & discs | Lecture | |
| Day23 | Rotating discs of uniform strength | Lecture | |
| Day24 | Stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders | Lecture | |
| Day25 | Hollow cylinders & solids cylinders | Lecture | |
| Day26 | Springs: Stresses in closed coiled helical springs | Lecture | |
| Day27 | Stresses in open coiled helical springs subjected to axial loads and twisting couples | Lecture | Assignment 4 |
| Day28 | Leaf springs | Lecture | |
| Day29 | Flat spiral springs | Lecture | |
| Day30 | Concentric springs | Lecture | |
| Day31 | Bending of Curved Bars : Stresses in bars of initial large radius of curvature | Lecture | |
| Day32 | Bars of initial small radius of curvature | Lecture | |
| Day33 | Stresses in crane hooks | Lecture | |
| Day34 | Rings of circular & trapezoidal sections | Lecture | |
| Day35 | Deflection of curved bars & rings | Lecture | Assignment 5 |
| Day36 | Deflection of rings by Castigliano's theorem | Lecture | |
| Day37 | Stresses in simple chain links | Lecture | |
| Day38 | Deflection of simple chain links | Lecture | |
| Day39 | Unsymmetrical Bending: Introduction to unsymmetrical bending | Lecture | |
| Day40 | Stresses due to unsymmetrical bending | Lecture | |
| Day41 | Deflection of beam due to unsymmetrical bending | Lecture | |
| Day42 | Shear center for angle, channel, and I-sections | Lecture | |

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# Haryana Engineering College, Jagadhri

Lesson Plan of Mechanical Engineering Deptt. 4th Semester

**Subject :** Instrumentation & Control (MEC-208A)

**Objective of Course :**

1. Students will have basic knowledge about measurement systems and their components.
2. Students will learn about various sensors used for measurement of mechanical quantities.
3. Students will have basic knowledge of process monitoring and control.

| Day | Topic / Chapter Covered | Academic Activity | Test/Assignment |
|---|---|---|---|
| Day 1 | Introduction, typical applications of instrument systems, functional elements of a measurement system. | Lecture | |
| Day 2 | Classification of instruments, standards and calibration. | Lecture | |
| Day 3 | Static and dynamic characteristics of measurement systems. | Lecture | |
| Day 4 | Static and dynamic characteristics of measurement systems. | Lecture | Assignment 1 |
| Day 5 | Statistical analysis of data and measurement of uncertainty | Lecture | |
| Day 6 | Statistical analysis of data and measurement of uncertainty | Lecture | |
| Day 7 | Statistical analysis of data and measurement of uncertainty | Lecture | |
| Day 8 | Statistical analysis of data and measurement of uncertainty | Lecture | Assignment 2 |
| Day 9 | Introduction and classification, transducer selection and specifications, | Lecture | |
| Day10 | Primary sensing elements, resistance transducers, | Lecture | |
| Day11 | Variable inductance type transducers, capacitive transducers | Lecture | |
| Day12 | Piezo-electric transducers, strain gauges. | Lecture | |
| Day13 | Smart Sensors: Introduction, architecture of smart sensor, bio sensor and physical sensor. | Lecture | Assignment 3 |
| Day14 | Piezo-resistive pressure sensor, microelectronic sensor. | Lecture | |
| Day15 | Force and weight measurement system, | Lecture | |
| Day16 | Measurement of torque, shaft power | Lecture | |
| Day17 | Speed and velocity: electrical and contactless tachometers. | Lecture | |
| Day18 | Acceleration: vibrometers, seismic | Lecture | Assignment 4 |

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| | and piezo-electric accelerometer. | | |
| Day19 | Basic terms, Pressure: Liquid column manometers | Lecture | |
| Day20 | Elastic type pressure gauges, electrical types for pressure and vacuum. | Lecture | |
| Day21 | Temperature measuring instruments: RTD sensors, NTC | Lecture | |
| Day22 | thermistor, thermocouples | Lecture | |
| Day23 | Semiconductor based sensors. | Lecture | Assignment 5 |
| Day24 | Flow Measurement: drag force flow meter, turbine flow meter, electronic flow meter, electromagnetic flow meter, hot-wire anemometer. | Lecture | |
| Day25 | Flow Measurement: drag force flow meter, turbine flow meter, | Lecture | |
| Day26 | electronic flow meter, electromagnetic flow meter, hot-wire anemometer. | Lecture | |
| Day27 | Humidity definitions, Humidity measuring devices. | Lecture | Assignment 6 |
| Day28 | Density and Specific Gravity, Basic terms | Lecture | |
| Day29 | Density measuring devices, Density application considerations, Viscosity. | Lecture | Assignment 7 |
| Day30 | Viscosity measuring instruments. | Lecture | |
| Day31 | Basic terms used in pH, pH measuring devices, pH application considerations. Problems. | Lecture | |
| Day32 | Introduction, basic components of control system. | Lecture | |
| Day33 | Classification : closed loop and open loop control system, transfer function, block diagram representation of closed loop system | Lecture | |
| Day34 | Reduction techniques, mathematical modelling of various mechanical systems and their analogy with electrical systems, signal flow graph and its representation. | Lecture | |
| Day35 | Mathematical modelling of various mechanical systems and their analogy with electrical systems, signal flow graph and its representation. | Lecture | Assignment 8 |
| Day36 | Mathematical modelling of various mechanical systems | Lecture | |
| Day37 | Their analogy with electrical systems, signal flow graph and its representation. | Lecture | |

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| Day38 | Basics of actuatorspneumatic controller, hydraulic controller and their comparison | Lecture | |
| Day39 | Actuators pneumatic controller | Lecture | |
| Day40 | Hydraulic controller and their comparison | Lecture | |

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