

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

1. **Subject Code:** MIC-102 **Course Title:** Engineering Thermodynamics
2. **Contact Hours:** L: 3 T: 1 P: 2/2
3. **Examination Duration(Hrs.):** Theory: 3 Practical: 0
4. **Relative Weightage:** CWS: 15-30 PRS: 20 MTE: 15-25 ETE: 30-40 PRE: 0
5. **Credits:** 4 6. Semester: Spring 7. Subject Area: PCC
8. **Pre-requisite:** Nil
9. **Objective:** To familiarize the students with basic concepts of macroscopic thermodynamics.

10. Details of the Course:

S.No.	Contents	Contact Hours
1.	Introduction: Introduction to thermodynamic system, surrounding, state, process, properties, equilibrium, heat and work, zeroth law of thermodynamics	3
2.	Properties of pure substance: PvT surface, Pv, Tv, TP diagrams. Equation of state for ideal and real gases. Virial equation of state, vander Waal equation, use of steam tables and Mollier diagram	6
3.	First law of thermodynamics: First law application to non-flow processes such as isochoric, isobaric, isothermal, adiabatic and polytropic processes. Steady flow energy equation, flow work. Application to various practical systems viz. nozzles, diffuser, turbines, heat exchangers etc. Application of energy equation to transient problems	7
4.	Second law of Thermodynamics: Second law, reversible and irreversible processes, Clausius and Kelvin Planck statements, Carnot cycle, corollaries of second law: thermodynamic temperature scale, Clausius inequality, entropy as a property, principle of increase of entropy, calculation of entropy change	7
5.	Entropy and Exergy: Entropy and its generation, entropy balance for closed system and for control volume, basic concepts of exergy and irreversibility, exergy for closed system and control volume, exergetic efficiency.	6
6.	Properties of ideal gas mixtures, Gas-vapour mixtures and Air-conditioning: Properties of gas-vapour mixtures, adiabatic-saturation and wet-bulb temperatures, psychrometric chart, human comfort and air conditioning, various air conditioning processes.	4
7.	Gas and Vapour Power Cycles: Otto, diesel, dual, Stirling, Joule-Brayton cycle, Thermal efficiency and mean effective pressure, Rankine cycle: Simple and reheat.	6
8.	Refrigeration cycles: Reverse Carnot cycle, vapour compression refrigeration cycle.	3
Total		42

List of Experiments:

1. Study of P-V-T surface of H₂O and CO₂.
2. Determine P-T relationship for steam and verify Clausius Clapeyron equation.
3. Determine the calorific value of coal using bomb calorimeter.
4. Analysing exhaust gases using Orsat apparatus. -
5. Study of diesel engine/ Rankine cycle
6. Determine relative humidity and specific humidity of air using sling psychrometer and psychrometric chart.
7. Determine COP of a vapour compression refrigeration unit.
8. Analysing different processes on an air conditioning unit.

11. Suggested Books:

S.No.	Name of Authors/ Books/Publisher	Year of Publication/Reprint
1	Borgnakke, C. and Sonntag, R.E., "Fundamentals of Thermodynamics", Wiley India	2011
2	Cengel, Y.A. and Boles, M.A., "Thermodynamics an Engineering Approach", Tata McGraw-Hill	2008
3	Moran, M.J. and Shapiro, H.M., "Fundamentals of Engineering Thermodynamics", 4 th Ed., John Wiley	2010
4	Nag, P.K., "Engineering Thermodynamics", Tata-McGraw Hill	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-201

Course Title: Mechanical Engineering Drawing

L-T-P: 2-0-4

Credits: 4

Subject Area: PCC

Course Outlines: Basics of 2D Drawings, Orthographic Projections, Dimensioning, Sectioning, 3D modeling, E-Drawings, Temporary Fasteners, Weld joints, Threads, Sheet Metal Printing, Tolerances and fits, Machining and quality Symbols, Assembly Drawings, Detailed Drawings.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-202

Course Title: Theory of Machines

L-T-P: 3-1-2/2

Credits: 4

Subject Area: PCC

Course Outlines: Motion Analysis of Mechanisms, Force Analysis of Mechanisms, Flywheels and Governors, Gears and Cams, Power Transmission using Friction Devices, Mechanical Vibrations, Gyroscope and balancing.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-203

Course Title: Manufacturing Technology

L-T-P: 3-0-2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to Machining: Processes and Tools, Thermal Analysis, Machinability, Economics of Machining, Finishing Processes, Newer Machining Processes, Introduction to casting process, Metrology, Newer Manufacturing Trends.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-204

Course Title: Energy Conversion

L-T-P: 3-1-2/2

Credits: 4

Subject Area: PCC

Course Outlines: Vapor Power Systems, Introduction to Boilers, its mounting and accessories, Nozzles and Diffusers, Introduction to Steam Turbines, Condensers, Gas Turbine Cycles, Basic Principles of Internal Combustion Engine, Clean Energy Devices.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-205

Course Title: Fluid Mechanics

L-T-P: 3-1-2/2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to Fluids, Statics and Kinematics of Fluid, Dynamics of Fluid, Ideal Fluid Flow, Viscous Fluid Flow, Dimensional Analysis, Flow Measurements, Compressible Flow

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-206

Course Title: Theory of Production Processes

L-T-P: 3-0-2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to Metal Joining Processes: Welding, Brazing, Soldering, Adhesive Joining, and Solid State Joining, Metal Forming: Fundamentals, Bulk Metal Forming, Sheet Metal Forming, and Advanced Metal Forming, Powder Metallurgy, Non-Destructive Techniques, Additive Manufacturing.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-208

Course Title: Principles of Industrial Engineering

L-T-P: 3-1-0

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to Industrial Engineering, Plant Layout, Material Handling, Production Planning and Control, Project Planning and Control, Quality and Quality Control, Work Study.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-302

Course Title: Machine Design

L-T-P: 3-0-2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to Mechanical Engineering Design, Selection of Engineering Materials, Design Methods Using Failure Theories, Design of Threaded Joints, Design of Helical Springs, Design of Shafts, Design of Spur Gears, Design of Rolling Contact Bearings, Design of Brakes and Clutches.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-303

Course Title: Mechanics of Materials

L-T-P: 3-1-2/2

Credits: 4

Subject Area: PCC

Course Outlines: Mathematical Preliminaries, Kinetics of Deformation, Kinematics of Deformation, Constitutive Relationship, Theories of Failure, Energy Methods in Linear Elasticity, Unsymmetrical Bending, Axisymmetric Problems.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-305

Course Title: Heat and Mass Transfer

L-T-P: 3-1-2/2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to different modes of heat transfer: Conduction (Steady-State and Transient), Convection, and Radiation, Basic Principles of Heat Exchangers, Diffusion Mass Transfer, Transient Diffusion.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/ SCHOOL: Department of Mechanical & Industrial Engineering

Subject Code: MIC-307

Course Title: Operations Management

L-T-P: 3-1-0

Credits: 4

Subject Area: PCC

Course Outlines: Types and Characteristics of Manufacturing Systems, Operations Planning and Scheduling, Gantt Chart, Materials Planning and Control, Inventory Management, Zero Inventory Systems, Capacity Planning, Supply Chain Management, Demand and Supply Management

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**NAME OF DEPARTMENT/ CENTRE/SCHOOL:** Department of Mechanical and Industrial Engineering**Subject Code:** MIL-312**Course Title:** Learning from Engineering Failures**L-T-P:** 2-0-4**Credits:** 4**Subject Area:** PEC

Course Outline: Significance of Learning from Engineering Failures, Fault-Tree Analysis with Illustrative Examples, Introduction to Generic Learning from Failures, Best Industrial Practices in Different Industries, Model of Learning and Unlearning from Failures with Examples, Case Studies of Some of the Famous Engineering Failures in the History.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

Subject Code: MIL-549

Course Title: Aircraft Propulsion

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outline: Introduction to Aircraft Engine Components, Review of Compressible Flow, Engine Thrust and Performance, Gas Turbine Engine Cycle Analysis, Inlet and Nozzles, Combustion Chambers, Axial and Centrifugal Compression, Aerodynamics of Gas Turbines, Component Machining and Designing

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

Subject Code: MIL-507

Course Title: Isogeometric Analysis

L-T-P: 3-0-2

Credits: 4

Subject Area: PEC

Course Outline: Fundamentals of Finite Element Analysis: Strong Form and Weak Form, Introduction to Iso-Geometric Analysis, Introduction to Non-Uniform Rational B-Splines Modeling (NURBS) as a Pre-Analysis Tool and as a Basis for Analysis, NURBS-based implementation in 1D and 2D Linear Elastic Problems

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

Subject Code: MIL-504

Course Title: Mechanics of Soft Materials

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outline: Overview of Soft and Rigid Materials, Mathematical Preliminaries, Kinetics and Kinematics of Deformation in Soft Materials, Conservation and Balance Laws, Isotropic and Anisotropic Hyper-elasticity, Finite Strain Viscoplasticity, Application Examples.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

Subject Code: MIL-505

Course Title: Statistical Machine Learning

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outline: Probability and Statistics, Optimization Methods, Introduction to Statistical Machine Learning, Supervised Machine Learning, Unsupervised Machine Learning, Artificial Neural Networks, Generalization and Regularization

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/ CENTRE/SCHOOL: Department of Mechanical and Industrial Engineering

Subject Code: MIL-506

Course Title: Elastic waves in solids

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outline: Introduction to Elastic Waves, Longitudinal Waves in Thin Bars, Flexural Waves in Beams, Reflection and Transmission of Waves, Waves in Unbounded Media, Plane Harmonic Waves in Half-Space, Plate Waves, Engineering Applications of Waves

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Mechanical and Industrial Engineering

Subject Code: MIC-351

Course Title: Fundamentals of AI/ML

L-T-P: 2-0-0

Credits: 2

Subject Area: PCC

Course Outlines: Introduction to data science; exploratory data analysis; key constituent domains of AI; key classifications and methods in ML, and some mechanical engineering driven case studies.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Mechanical and Industrial Engineering

Subject Code: MIL-316

Course Title: Machine Learning

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outlines: Essential concepts in Probability and Statistics; Search and Optimization; theory and applications of modern methods in Supervised Learning, Unsupervised Learning and Reinforcement learning.