II YEAR-I Semester

ME3T2 BASIC THERMODYNAMICS Credits: 3

Lecture: 3 periods/week Internal assessment: 30marks
Tutorial: 1 period/week Semester end examination: 70 marks

Course Objectives

- Acquire knowledge on laws of thermodynamics, properties of pure substance
- Evaluate power cycle efficiencies

Course Outcomes:

Upon completion of this course the student will be able to:

1. Recall basic concepts of thermodynamics and calculate work and heat
2. Analyse zeroth and first law of thermodynamics and working of various heat engines
3. Assess quality and quantity of energy and degree of disorderness
4. Analyse cycles using pure substances, perfect gas laws and mixtures of gases
5. Compare efficiencies of various thermodynamic cycles

UNIT – I

INTRODUCTION:

Basic Concepts - System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle, Reversibility, Quasi static Process, Irreversible Process, Causes of Irreversibility, Energy in State and in Transition, Types, Work and Heat, Point and Path function.

UNIT – II

ZEROTH LAW OF THERMODYNAMICS:

Concept of Temperature, Measurement of temperature, Scales of Temperature, Ideal Gas Scale, PMM I, Joule's Experiments.

FIRST LAW OF THERMODYNAMICS:

First law applied to a Process, applied to a flow system, Steady Flow Energy Equation. LIMITATIONS OF THE FIRST LAW: Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

UNIT - III

SECOND LAW OF THERMODYNAMICS:

Kelvin-Planck ,Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle - Carnot cycle and its specialties, Thermodynamic

scale of Temperature, Clausius Inequality, Entropy - Principle of Entropy Increase, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – IV

PURE SUBSTANCES :

p-V-T- surfaces, T-S and h-s diagrams, properties during change of phase, Dryness Fraction, Clausius Clapeyron Equation , Property tables.

PERFECT GAS LAWS:

Equation of State - specific and Universal Gas constants, Throttling and Free Expansion Processes, Flow processes, Deviations from perfect Gas Model, Vanderwaals Equation of State , Compressibility charts, Variable specific Heats, Gas Tables.

MIXTURES OF PERFECT GASES:

Mole Fraction, Mass fraction ,Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Avogadro's Laws of additive volumes, Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT –V

THERMODYNAMIC CYCLES:

Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Brayton Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Learning Resources

Text Books:

1. P.K.NAG, Engineering Thermodynamics, Tata McGraw Hill Publications - 1995.
2. Mahesh M Rathore, Thermal Engineering, McGraw Hill Publications - 2012.

Reference Books:

1. J.P.Holman, Thermodynamics, McGraw Hill Publications -2003.
2. Cengel & Boles, Thermodynamics, Tata McGraw Hill Publications - 2009.
3. V.P. Vasandani and D.S. Kumar "Treatise on Heat Engineering" Metropolitan book Co Pvt Ltd , 2000
4. K Ramakrishna, Engineering Thermodynamics, Anuradha Publishers – 2003

Data books to be allowed in examinations:

1. S.C. Jain, Steam Tables, Birla Publications Pvt. Ltd – 2011
2. R.S. Khurmi & N. Khurmi, Steam Tables, S.Chand Publications – 2014