2/4 B.Tech. THIRD SEMESTER

ME3T2 **BASIC THERMODYNAMICS** **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 30marks**
Tutorial: 1 periods/week **Semester end examination: 70 marks**

Objectives:

1. Acquire knowledge on laws of thermodynamics, properties of pure substances.
2. Evaluate psychometric properties and power cycle's efficiency.

Learning outcomes:

At the end of course the student will be able to:

1. Reproduce basic concepts of thermodynamics and to define work and heat.
2. Recall zeroth & first law of thermodynamics applied to both flow and non flow Systems
3. Explain working of various heat engines, heat pumps along with the concepts related to second and third law of thermodynamics.
4. Solve problems by using Mollier charts and Gas tables along with basics from pure substances and perfect gas laws.
5. Define basic concepts of mixtures of perfect gases and Psychometric Properties.
6. Calculate thermal efficiencies of thermodynamic, vapor power and refrigeration cycles.

Pre-Requisite

Engineering Physics, Engineering Mathematics

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, Principles of Thermometry, Reference Points, Constant Volume gas Thermometer, Scales of Temperature, Ideal Gas Scale, PMM I, Joule's Experiments. FIRST LAW OF THERMODYNAMICS: Corollaries, First law applied to a Process, applied to a flow system, Steady Flow Energy Equation.

UNIT - III

LIMITATIONS OF THE FIRST LAW:

Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance. 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, Energy Equation - 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, Mollier Charts, Phase Transformations, Triple point at critical state, properties during change of phase, Dryness Fraction, Clausius Clapeyron Equation , Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT – V

PERFECT GAS LAWS:

Equation of State - specific and Universal Gas constants, various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy, Throttling and Free Expansion Processes, Flow processes, Deviations from perfect Gas Model, Vanderwaals Equation of State , Compressibility charts, Variable specific Heats, Gas Tables.

UNIT –VI

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.Atmospheric air, Psychrometric Properties, Dry bulb Temperature, Wet bulb Temperature, Dew point Temperature, Thermodynamic Wet bulb Temperature, Specific humidity, Relative Humidity, Saturated air, Vapor pressure, Degree of Saturation, Adiabatic Saturation, Carriers Equation, Psychrometric Chart.

UNIT –VII

THERMODYNAMIC CYCLES:

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

UNIT - VIII

VAPOR POWER CYCLES:

Brayton and Rankine Cycles – Comparision and Performance Evaluation, Methods to improve the performance of Rankine Cycle.

REFRIGERATION CYCLES**:** Air refrigeration or Bell colemn cycle, Vapour compression cycle, Vapour absorption cycle – Performance Evaluation.

Learning resource

Text books:

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

Reference books:

1. Thermodynamics by J.P.Holman, McGraw Hill Publications, 2003.
2. Thermodynamics by Cengel & Boles, Tata McGraw Hill Publications, 2009.
3. Thermal Engineering by Rajput, Lakshmi publications, 2003.
4. Engineering Thermodynamics by K Ramakrishna, Anuradha Publishers,2003.