

B. E. MECHANICAL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - III			
BASIC THERMODYNAMICS			
Course Code	18ME33	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> Learn about thermodynamic system and its equilibrium Understand various forms of energy - heat transfer and work Study the basic laws of thermodynamics including, zeroth law, first law and second law. Interpret the behaviour of pure substances and its application in practical problems. Study of Ideal and real gases and evaluation of thermodynamic properties 			
Module-1			
Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer.			
Module-2			
Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems. First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation(SFEE), important			
Module-3			
Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine, schematic representation, importance and superiority of a reversible heat engine and irreversible processes, internal and external reversibility. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles. Problems Entropy: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate.			
Module-4			
Availability, Irreversibility and General Thermodynamic relations. Introduction, Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility. Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.			
Module-5			

Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties.

Real gases – Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases.


Course Outcomes: At the end of the course, the student will be able to:

- CO1: Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
- CO2: Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
- CO3: Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties.
- CO4: Interpret the behavior of pure substances and its application in practical problems.
- CO5: Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Basic and Applied Thermodynamics	P.K.Nag,	Tata McGraw Hill	2nd Ed., 2002
2	Basic Engineering Thermodynamics	A.Venkatesh	Universities Press,	2008
3	Basic Thermodynamics,	B.K Venkanna, Swati B. Wadavadagi	PHI, New Delhi	2010
Reference Books				
3	Thermodynamics- An Engineering Approach	YunusA.Cenegal and Michael A.Boles	Tata McGraw Hill publications	2002
4	An Introduction to Thermodynamcis	Y.V.C.Rao	Wiley Eastern	1993,
5	Engineering Thermodynamics	.B.Jones and G.A.Hawkins	John Wiley and Sons.	


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