COURSE MODULE

Faculty Name/s: **Mr. Ravikumar S**			Academic Year:**2023 - 2024**				
Department: **Mechanical Engineering**							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
BME304	**Basic Thermodynamics**	**PCC**	**Engg. Physics, EME,**	**3**	**-**	**-**	**40**
Course Objectives	• Learn about thermodynamic system and its equilibrium, basic law of zeroth law of thermodynamics. • Understand various forms of energy - heat transfer and work, Study the first law of thermodynamics. • Study the second law of thermodynamics. • Interpret the behaviour of pure substances and its application in practical problems. Study of Ideal and real gases and evaluation of thermodynamic properties.						

Topics Covered as per Syllabus

Module 1

Introduction and Review of fundamental concepts: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. 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 *(The topics are Only for Self-study and not to be asked in SEE. However, may be asked for CIE)*

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, thermocouples, electrical resistance thermometer. Numerical.

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**.** **8 Hours**

Module 2

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, Problems.

Extension of the First law to control volume; steady flow energy equation (SFEE), Problems.

8 Hours

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. 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. Problems **8 Hours**

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. Problems

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. Problems.

8 Hours

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 (*Processes are not to be asked for SEE*).

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.

Thermodynamic relations: Maxwell's equations, TdS equation. Ratio of Heat capacities and Energy equation, Joule-Kelvin effect, Clausius-Clapeyron equation. **8 Hours**

List of Textbooks

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.
4. Thermodynamics- An Engineering Approach YunusA.Cenegal and Michael A.Boles Tata McGraw Hill publications 2002Fundamentals of Automobile Engineering, K.K.Ramalingam, Scitech Publications (India) Pvt. Ltd. 4.
5. Automobile Engineering, R. B. Gupta, SatyaPrakashan,(4th Edition) 1984.

List of URL:

- https://www.youtube.com/watch?v=9GMBpZZtjXM•&list=PLD8E646BAB3366BC8
- https://www.youtube.com/watch?v=jkdMtmXo664•&list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne
- https://www.youtube.com/watch?v=1lk7XLOxtzs•&list=PLkn3QISf55zy2Nlqr5F09oO2qcIwNNfrZ&index=3

https://www.youtube.com/watch?v=Dy2UeVCSRYs•&list=PL2_EyjPqHc10CTN7cHiM5xB2qD7BHUry7

	Course outcomes On completion of the course, the students will be able to	RBT
CO1	**Explain** fundamentals of thermodynamics and **evaluate** energy interactions across the boundary of thermodynamic systems.	L3
CO2	**Apply** 1st law of thermodynamics to closed and open systems and **determine** quantity of energy transfers.	L3
CO3	**Evaluate** the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics	L5
CO4	**Apply** the knowledge of entropy, reversibility and irreversibility to **solve** numerical problems and **interpret** the behaviour of pure substances and its application in practical problems	L3
CO5	**Recognize** differences between ideal and real gases and **evaluate** thermodynamic properties of ideal and real gas mixtures using various relations	L3

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Organise Industrial visits to Thermal power plants and submission of report
- Case study report and power point presentation on steam power plant

.List of thermal energy devices at homes, hostels and college premises and applicable laws

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

List of Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	-	-	-	-	-	-	-	-	-	2
CO-2	3	3	-	-	-	-	-	-	-	-	-	2
CO-3	3	3	-	-	-	-	-	-	-	-	-	2
CO-4	3	3	-	-	-	-	-	-	-	-	-	2
CO-5	3	3	-	-	-	-	-	-	-	-	-	2

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

List of Course Outcomes	Program Specific Outcomes	
	PSO1	PSO2
CO-1	2	-
CO-2	2	-
CO-3	2	-
CO-4	2	-

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution