MEBT203	Basic Thermodynamics	L-T-P-Cr-CH: 3-1-0-4-4	Prerequisites: N/A

The "Basic Thermodynamics" course is offered with the following objectives:

i. To introduce the students to the thermodynamic laws (1st law, 2nd law, 3rd law).
ii. To familiarize the students with the concept of heat, work, cyclic heat engine, heat pump, refrigerator etc.
iii. To introduce the students to the change of state, properties, processes and cycles.
iv. To make the students enable in using Steam tables for estimating the thermodynamic properties of substances in gas and liquid states.
v. To be able to apply ideal cycle analysis.

Contents:

Introduction and basic concepts: Basic definitions, thermodynamic systems and control volumes, properties, states, thermodynamic equilibrium, change of state, processes and cycles **(3 lectures+ 1 tutorial)**

Temperature: Zeroth law, temperature measurements, international temperature scale **(1 lectures+ 1 tutorial)**

Properties of pure substance: Definition, p-v, T-s and h-s diagram of pure substance (water), properties of steam, use of steam tables and charts (Mollier diagram) **(4 lectures+ 3 tutorial)**

Properties of gas mixtures: Gases-Equation of state of an Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy change of Ideal Gases. Equation of state of Real Gases, Principle of corresponding state, Compressibility Factor **(2 lectures+ 1 tutorial)**

Energy transfer: Work transfer, pdV and other types of work transfer, heat transfer, specific heat at constant pressure and volume, latent heat, comparison of heat and work **(3 lectures+ 3 tutorial)**

First law of thermodynamics: First law for a closed system undergoing a cycle and change of state , internal energy, enthalpy, PMM-I, limitations of first law, non-flow and flow processes; steady state, steady flow and transient flow processes; application of first law to steady flow process, steady flow energy equation(SFEE) **(4 lectures+ 3 tutorial)**

Second law of thermodynamics: Kelvin Plank statement, Claussius statement, Irreversibility, Carnot Cycle, Corollaries of Carnot's theorem, Applications of Second Law to closed and open systems, heat engine, heat pump and refrigerator, PMM-II, entropy, Claussius theorem, Claussius inequality, T-ds Relations, entropy principle and its application, entropy generation in closed and open system, absolute entropy and third law of thermodynamics **(5 lectures+ 3 tutorial)**

Exergy: Definition, quality concept of energy, Reversible work and irreversibility, Exergy balance in closed and open system, Second law efficiency, Guoy Stodola theorem **(3 lectures+ 3 tutorial)**

Thermodynamic property relations: Maxwell relations, T-ds equations, Clausius Clapeyron equation, General relations for change in internal energy, enthalpy, entropy, Cp, Cv etc., Gibbs phase rule. **(2 lectures+ 1 tutorial)**

Thermodynamic Cycles: Rankine cycle, Otto, Diesel, Dual etc. **(2 lectures+ 1 tutorial)**

(Total: 30 lectures+ 20 tutorials = 50 classes)

Course Outcomes- After completing the course the students will be able to:

CO1: State the various thermodynamic laws and apply those in various thermal system.
CO2: Define thermodynamic properties, processes and determine energy transfer in various processes.
CO3: Apply the steady-flow energy equation to various steady flow devices such as pumps, turbines, compressors etc.
CO4: Draw P-v and T-s diagrams of thermodynamic cycles and evaluate their efficiency, entropy, exergy etc.
CO5: Use steam tables for determining temperature of steam and water at various states.
CO6: Understand the interrelationship between different thermodynamics cycles.

Textbooks:

1. Y.A. Cengel, M.A. Boles, Thermodynamics, An Engineering Approach, McGraw Hill Education, 8th Ed., 2017.
2. P.K. Nag, Engineering Thermodynamics, McGraw Hill, 6th Ed., 2017.

Reference Books:

1. C. Borgnakke, R.E. Sonntag, *Fundamentals of Thermodynamics*, John Wiley & Sons, 8th edition,2014.
2. M.J.Moran, H.N. Shapiro, D.D. Boettner & M.B. Bailey, *Principles of Engineering Thermodynamics*, S.I. version, John Wiley & Sons, 8th edition,2011.

Mapping of COs with the Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	0	0	0	0	1	0	0	0	1	3	2	0	1
2	3	2	0	0	0	0	1	0	0	0	1	3	2	0	1
3	3	2	0	0	0	0	1	0	0	0	1	3	2	0	1
4	3	2	0	0	0	0	1	0	0	0	1	3	2	0	1
5	3	2	0	0	0	0	1	0	0	0	1	3	2	0	1
6	3	2	0	0	0	0	1	0	0	1	1	3	2	0	1