Course Title	:	**Thermal Sciences**
Course Number	:	**MEA1130**
Credits	:	04
Course Category	:	ESA
Pre-requisites (s)	:	None
Contact Hours	:	3L – 1T – 0P
Type of Course	:	Theory
Course Assessment	:	Course work 15%, Mid-Sem Exam (1 Hours) 25%, End-Sem Exam (2 Hours) 60%

Course Objectives

1. Impart knowledge of basic concepts and laws of thermodynamics and heat transfer.
2. Develop capability to evaluate the performance of thermal engineering systems.
3. Develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.

Course Outcomes

After taking this course, the student will be able to:

1. **Apply** the basic thermodynamic concepts and **analyze** systems using intuitive problem-solving techniques.
2. **Apply** the First Law of Thermodynamics to a system of thermodynamic components to **estimate** required balances of heat, work and energy flow.
3. **Evaluate** system properties and **apply** energy balance with the help of property data.
4. **Explain** the importance of Second Law of Thermodynamics and **evaluate** the limitations on thermal-mechanical energy conversion in practical systems.
5. **Formulate** the models necessary to study, **analyze** and **design** engineering systems through the application of basic principles of heat transfer.

Syllabus:

Unit 1: Applications of Thermodynamics, **Basic Concepts and Definitions:** Thermodynamic Systems, Properties, States, Processes, Cycles,Thermodynamic Equilibrium, Quasi-Static Process, Pressure and its Measurement, Zeroth **Law of Thermodynamics**, Temperature and its Measurement. Thermodynamic Concepts of Heat and Work; Types of Work Interactions, **First Law of thermodynamics** for control mass and control volume, Energy as a Property, Internal Energy, Enthalpy, Specific heats.

Unit 2: Steady-State, Steady-Flow Process (SSSF) and Uniform-State, Uniform-Flow Process (USUF) processes. **Pure Substance:** Different Phases of Pure Substance, Property Diagrams, Tables and Charts, Phase Boundaries, Dryness Fraction, Phase-Change Processes of Pure Substances, Property Diagrams for Phase-Change Processes, concept of ideal gas and real gas.

Unit 3: Second Law of Thermodynamics and its Applications: Limitations of First Law, Statements and Corollaries of Second Law, Reversible and Irreversible Processes, Internal and External Irreversibility, Direct and Reversed Heat Engines (Efficiency and COP), Carnot Cycle, Thermodynamic Temperature Scale, Clausius inequality, Entropy – a property of a system, Second law analysis of control volume. Analysis of Power and Refrigeration cycles

Unit 4: Concepts of Heat Transfer and its Engineering Applications: Fourier's law of steady state heat **conduction**, Composite wall and the electrical analogy, Heat flow through a hollow cylinders and spheres, **Convective** heat transfer, Newton's law of cooling, Combined heat transfer, electrical analogy, overall heat transfer coefficient, Black body **radiation**, grey body, emissive power, emissivity, Kirchhoff's law, Stefan-Boltzmann law, Radiation properties. **Applications** of heat transfer in electrical, electronics and computer systems.

Books:

1. Thermodynamics, An Engineering Approach by Yunus A. Cengel and Michael A Boles, McGraw-Hill Education.
2. Moran, M.J. and Shapiro, H.N., Fundamentals of Engineering Thermodynamics, John Wiley.
3. Engineering Thermodynamics by D.B. Spalding and E. H. Cole, English Language Book Society, London.
4. Engineering Thermodynamics by P. K. Nag, Tata McGraw-Hill Education.

Mapping of COs, POs & PSOs

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