K L UNIVERSITY

MECHANICAL ENGINEERING DEPARTMENT

Course Name : **Thermodynamics**
Course Code : **13-ES201**
L – T – P – C : **3 – 0 – 0 – 3**

COMPETENCIES: At the end of the course the student should be able to

Competency Number	Competency
C1	Understand the behavior of a thermodynamic system when it undergoes a change of state or a path or a cycle (5)
C2	Understand thermal equilibrium and apply zeroth law of thermodynamics for temperature measurements (3)
C3	Estimate work transfer and heat transfer in different thermodynamic processes, and understand the similarities and dissimilarities of work and heat (6)
C4	Ability to Apply first law of thermodynamics for a closed system undergoing a cycle and for a change of state ,isolated system and control volume(4)
C5	Ability to Apply steady state steady flow energy equation to nozzle, diffuser, compressor, turbine, pump, boiler, evaporator, condenser and throttling device (4)
C6	Understand thermal reservoirs and the statements of second law of thermodynamics (4)
C7	Understand irreversibility and apply the concept of entropy to verify whether a process or cycle is possible or not (5)
C8	Understand the concept of available and unavailable energy (5)
C9	Understand the mathematical relationship between thermodynamic properties and their relations(4)
C10	Understand and analyze the performance of different ideal Gas , power and refrigerant cycles (5)

SYLLABUS

Fundamental Concepts and Definitions: Thermodynamic system and control volume, Macroscopic and Microscopic points of view. Thermodynamic properties, processes, state, path, cycle. Thermodynamic equilibrium and Quasi-static process. Reversible and Irreversible processes, Zeroth law, concept of temperature.

Work and Heat: Definition of work, units, work done at the moving boundary of system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.

First Law for Non-Flow Systems: First law of thermodynamics for a closed system undergoing a cycle and for a change of state, energy-a property of system, internal energy and enthalpy. Specific heat at constant volume and constant pressure. PMM1 and Converse of PMM1.

First Law for Flow Systems: Control mass and control volume, First law of thermodynamics for a control volume, Steady flow energy equation and applications to engineering equipment.

Second Law of Thermodynamics: Thermal reservoirs, Kelvin-Plank and Clausius statements of second law of thermodynamics, Equivalence of Kelvin-Plank and Clausius statements, Carnot cycle, Reversed heat engine, Carnot's theorem, Corollary of Carnot's theorem, Absolute thermodynamic temperature scale, problems.

Entropy: Definition of entropy, Clausius theorem, entropy change in reversible process Temperature-entropy plot, Inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, Applications of entropy principle, entropy change of an ideal gas, Availability and Irreversibility.

Thermodynamic Relations: Maxwell's equations, *TdS* equations, Difference in heat capacities, Ratio of heat capacities, energy equation, Clausius - Clapeyron equation

Air standard cycles: Otto, Diesel, Dual and Brayton cycles. Performance evaluation and mean effective pressure, Reversed Carnot cycle and Bell Coleman cycle.

RECOMMENDED TEXT BOOKS:

(A) TEXT BOOKS:

1. ***Thermodynamics, An Engineering Approach*** - Younus A Cengel & Michael Boles, (6E) Tata McGraw Hill, New Delhi.
2. ***Engineering Thermodynamics*** - P.K.Nag, (4E) Tata McGraw Hill, New Delhi.

(B) REFERENCE BOOKS:

1. ***Fundamentals of Thermodynamics*** - G.J. Van Wylen., Sonntag (6E), Wiley India publications.
2. ***Engineering Thermodynamics*** Coheand Rogers(5 E)-Pearson education India limited.
3. ***Heat and Thermodynamics*** - Zemansky, Mc Graw Hill (5E),.