Engineering Thermodynamics

1.1 Course Number: CH161

1.2 Contact Hours: 3-1-0 Credits: 11

1.3 Semester -Offered: 1st Year- odd

1.4 Prerequisite: Basic physics, Mathematics (Basic multivariable calculus).

1.5 Syllabus Committee Members: Dr. V S Sistla, Dr. A. Ranjan, and Dr. Karan Malik

2. **Objective:**

- understand the laws of thermodynamics and how it is reflected in the systems under equilibrium, and the natural and engineered processes.
- understand the way the laws of thermodynamics govern chemical transformations.
- understand how to calculate the thermodynamic properties of the materials.
- understand the importance of equations of state.
- understand how thermodynamic laws are applied to various cyclic industrial processes.
- understand the statistical interpretation of entropy.

3. **Course Content:**

Unit wise distribution of content and number of lectures

Unit	Topic	Sub-Topics	Lectures
1	Introduction, Basic Concepts and Definitions	Microscopic and Macroscopic energy; Systems and surroundings; Equilibrium and non-equilibrium; Static and quasistatic processes; Thermodynamic properties: Extensive and intensive. Internal energy; Heat and Work; Zeroth law.	5
2	Thermodynamic properties of Fluids and Zeroth Law of Thermodynamics	Equations of states: Ideal Gas, Vander Wall, Beattie-Bridgman, Redich-Kwong, Benedict-Webb-Rubin, Virial, and Compressibility Factor; Steam Table; Mollier Diagram; State Postulate; Temperature scale; Ideal gas Temperature scale.	5
3	First law of thermodynamics and its applications	Heat and Work Interactions; Applications of First Law to Elementary Processes (closed systems) Isobaric, Isochoric, Isothermal, Adiabatic, and Polytropic process.	5

4	Applications of First Law of thermodynamics to flow systems	Control Mass and Control Volume Analysis; Compressor, Turbine, Heat Exchanger, Nozzle, and Diffuser; Throttling process, Refrigeration and Liquefaction of gases; Transient Flow: Charging and Discharging of Cylinders; Chemically Reacting Systems.	6
5	Second Law and Its Applications	Heat Engine and Heat Pump; Clausius and Kelvin-Planck statements; Reversible and Irreversible processes; Carnot cycle, Carnot Theorem, Clausius Inequality; Entropy: Principle of Entropy increase, Entropy change in elementary processes; Control Volume Analysis; Availability.	10
6	Thermodynamic Relations	Maxwell relationship; Thermodynamic Potentials; Jacobian Method; Entropy and other properties relationships; Clapeyron Equation and Kirchoff Equation.	4
7	Thermodynamic cycles of industrial interest.	Classification of cycles; Vapor power cycles: Carnot Cycle, Rankine Cycle, Reheat Cycle, Regenerative cycle; Gas power cycles: Otto cycle, Diesel Cycle, Dual cycle, Brayton Cycle, Stirling and Ericsson Cycle; Refrigeration cycles: Reversed Carnot Cycle, Vapor compression refrigeration cycle.	5
		Total	**40**

4. **Readings**

4.1 Text Books:

1. Rao, Y.V.C., An Introduction to Thermodynamics, Universities Press, Hyderabad, INDIA, 2019.
2. Cengel, Y.A. and Boles, M.A., Thermodynamics: An Engineering Approach, McGrawHill, New York, 1988.

5. **Outcome of the course:**

After the completion of course, the students will be able to:

- apply the first law of thermodynamics to processes of industrial scale.
- calculate the feasibility and thermodynamic limit on efficiency imposed by the second law and thereby analyze the effectiveness of a given process.
- compute thermodynamic properties of the material.
- solve problems related to heat and work exchange which may involve phase change.