IC142 Engineering Thermodynamics

Credits: 3-1-0- 4

Prerequisite: Consent of the faculty member

Students intended for: B.Tech

Elective or Core: Core Semester: Even/Odd

Course objective: Thermodynamics is a subject which relates different forms of energies and energy conversions. Thermodynamics gives the possible direction of a process. The power and other energy conversion cycles are basis for the various systems in our daily life. At the end of the course, the students will be able to analyze and evaluate various thermodynamic cycles used for energy production - work and heat, within the natural limits of conversion.

Course content:

- **Introduction:** Applications of Thermodynamics, Brief History [1 Lecture]
- **Fundamental Concepts:** Definitions of system and surrounding, concept of control volume, thermodynamic state, concepts of simple compressible substances, pure substance and phase, thermodynamic processes and thermodynamic equilibrium; Temperature and Zeroth law; Thermodynamic concept of energy [3 Lectures]
- **Energy and energy transfer:** Modes of work and heat transfer, different forms of energy, internal energy. [2 Lectures]
- **Properties of substances:** Thermodynamic properties and use of tables of thermodynamic properties; p-v-T surfaces, idea of a generalized chart and the law of corresponding states [3 Lectures]
- **First Law of Thermodynamics:** The first law referred to cyclic and non-cyclic processes, concept of internal energy of a system, conservation of energy for simple compressible closed systems; Definitions of enthalpy and specific heats; Conservation of energy for an open system or control volume, steady & Transient processes. [8 Lectures]
- **Second Law of Thermodynamics:** The directional constraints on natural processes; Formal statements; Concept of reversibility; Carnot principle; Absolute thermodynamic temperature scale; Clausius Inequality, entropy, change in entropy in various thermodynamic processes, Tds relations, entropy balance for closed and open systems, Principle of increase- in- Entropy, entropy generation [7 Lectures]
- **Exergy:** Concept of reversible work & irreversibility; Second law efficiency; Exergy change of a system, exergy destruction, exergy balance inclosed& open systems. [3 Lectures]
- **Thermodynamic Property Relations:** Maxwell relations; Clausius-Clapeyron equation; Difference in heat capacities; Ratio of heat capacities; general relations for the changes in internal energy, enthalpy, entropy, Joule-Thompson coefficient; [3 Lectures]
- **Vapour Power Cycles:** Carnot cycle; Simple Rankine cycle, Reheat and Regenerative cycles with open & closed feedwater heater; actual cycles [3 Lectures]
- **Air Standard Power Cycles:** Carnot, Stirling, Ericssion, Otto, Diesel, and Dual cycles,Brayton cycle, combined cycle power plant [4 Lectures]
- **Refrigeration and air conditioning:** Different refrigeration techniques, Carnot cycle, Vapour compression refrigeration cycle, Absorption refrigeration, combined power and refrigeration systems, Heat pumps, Air-conditioning (Definitions, some air conditioning processes, Psychrometric charts) [4 Lectures]
- **Introduction to Fuel Cells** [1 Lecture]

Textbooks:

Van Wylen, Sonntag, Borgnakke, Fundamentals of thermodynamics, Wiley India, 6th Edition / latest edition.
Cengel and Boles, Thermodynamics, TMH, 6th Edition / latest edition.

References:

Spalding and Cole, Engineering Thermodynamics, 1973.
Moran and Shapiro, Fundamentals of Engineering Thermodynamics, Wiley India, 6th Edition / latest edition.