## Fundamentals of Thermodynamics and Heat transfer

BEG...ME

Year: I

Semester: II

| Teaching Hours/week | | | | Examination Scheme | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Internal | | Final | | | | |
| | | | | Theory | Practical | Theory | | Practical | | |
| Cr | L | T | P | | | Duration (in hrs) | Marks | Duration | Marks | |
| 2 | 2 | 1 | 2/2 | 20 | 25 | 1.5 | 30 | | | 75 |

### Course Objectives:

To provide the students with a basic understanding and aplims of Thermodynamics and Heat Transfer



### Course Content:

1. Basic Concepts (3 hours)
   - 1.1. Definition and Application areas of Thermodynamics
   - 1.2. Concepts and Definitions
     - 1.2.1. System, Surroundings, Boundary and Universe
     - 1.2.2. Thermodynamic Properties: Intensive, Extensive and Specific Properties
     - 1.2.3. Thermodynamic State and equilibrium and quasi-static process
     - 1.2.4. Thermodynamic Processes and Cycles: Isobaric, isothermal and isochoric processes CyclicProcess, Quasi-equilibrium Process, Reversible and Irreversible Process
   - 1.3. Common Properties: Pressure, Specific Volume, Temperature
   - 1.4. Zeroth Law of Thermodynamics, Equality of Temperature
   - 1.5. Value of energy to society

2. Energy and Energy Transfer (4 hours)
   - 2.1. Energy and its Meaning
   - 2.2. Stored Energy and Transient Energy; Total Energy
   - 2.3. Energy Transfer as heat and work
   - 2.4. Expressions for displacement work transfer (*Isobaric work, Isochoric Work, Isothermal and Polytropic work)*
   - 2.5. Power

3. **Properties of Common Substances (4 hours)**
   - 3.1. Ideal Gas (*Boyles Law, Charles Law) and Combined Gas Equation*
   - 3.2. Saturation curves For Two- Phase Mixture (T-v and P-v) Diagrams
   - 3.3. Two Phase (Liquid and Vapor) Systems: Phase Change; Subcooled Liquid, Saturated Liquid, Wet Mixture, Critical Point, Quality, Moisture Content, Saturated Vapor and Superheated Vapor
   - 3.4. Other Thermodynamic Properties: Internal Energy, Enthalpy, *Specific heat Capacities*
   - 3.5. *Numerical related to Steam Table (Specific Properties related to quality)*

4. **First Law of Thermodynamics (6 hours)**
   - 4.1. Introduction and law of conservation of energy
   - 4.2. First Law of Thermodynamics for closed systems; First Law of Thermodynamics for closed system Undergoing Cyclic Process
   - 4.3. Application of the First law of Thermodynamics to Closed systems undergoing some common process: Constant Volume, Adiabatic, Constant Pressure, Constant Internal Energy.
   - 4.4. First Law of Thermodynamics for open systems (Control Volume)
     - 4.4.1. Conservation of mass, expression of mass flow rate, flow work and general energy equations
     - 4.4.2. Steady State Analysis and applications
   - 4.5. Other Statements of the First Law
   - 4.6. Perpetual Motion Machine of the kind PMM I

5. **Second Law of Thermodynamics (7 hours)**
   - 5.1. Necessity of Formulation of Second Law
   - 5.2. Kelvin-Planck and Clausius Statements of the Second Law of Thermodynamics
   - 5.3. Heat Engine and Thermal Efficiency, Heat Pump, Refrigerator and coefficient of Performance (COP) (*Theory and Numerical*)
   - 5.4. Entropy and entropy change *( introduction and definition*)
   - 5.5. Reversible and Irreversible Process
   - 5.6. Entropy and Process Relation for an Ideal Gases
   - 5.7. Isentropic Process for an Ideal Gas
   - 5.8. Air Standard Otto Cycle and Diesel Cycle (*Theory and Numerical*)

6. **Introduction to Engineering Heat Transfer:(6 hours)**
   - 6.1. Basic concepts and modes of heat transfer
   - 6.2. One Dimensional Steady State Heat Conduction through a Plane Wall/Flat Plate
   - 6.3. Radial Steady State Heat Conduction through a Hollow Cylinder
   - 6.4. Heat Flow through Composite Structures
     - a. One Dimensional Steady State Heat Conduction through a Composite Wall
     - b. Radial Steady State Heat Conduction through a Multilayer Tube
   - 6.5. *Overall heat transfer for Plane composite wall*
   - 6.6. Electrical Analogy for Thermal Resistance

**Laboratories:**

- Temperature measurement
- Experiment related to heat pump or refrigerator
- Experiment related to heat transfer conduction, radiation and Convection

**Tutorials:**

a) Three assignments in each before first and second assessments.

b) Quiz before first and second assessments.

**Final Examination Scheme:**

| Chapters | Marks* | Remarks |
|---|---|---|
| 1 | 2 | |
| 2 | 4 | |
| 3 and 4 | 7 | |
| 5 | 9 | |
| 6 | 8 | |
| Total | 30 | |

*There may be minor deviation in marks distribution.

**References: (in APA style)**


1. C.P., G., & R., P. (1991). *Engineering Thermodynamics.* Roorkee: Nemchand & Broj.
2. Cengel, Y. A., Boles, M. A., & Kanoglu, M. (2019). *Thermodynamics: An Engineering Approach.* McGraw-Hill Education.
3. Howell, J. R., & Buckius, R. O. (1987). *Fundamental of Engineering Thermodynamics.* Mc Graw Hill Publishers.
4. P.K., N. (n.d.). *Engineering Thermodynamics.* New Delhi: Tata Mc Graw Hill.