Approval: 2nd Senate Meeting

ME610 Advanced Thermodynamics

Credit: 3-1-0-4

Prerequisite: Thermodynamics

Students intended for: MS/PhD

Elective or Core: Elective Semester: Odd/Even

Course objective:

This course introduces advance concepts in thermodynamics. It is an extension to the introductory theory of energy analysis with strong emphasis on the concepts of availability and irreversibility with respect to reacting and nonreacting systems.

Course content:

- **Laws of Thermodynamics:** The first law for open and closed system; steady & transient processes; work and heat transfer; second Law of Thermodynamics for open and closed systems; Local Thermodynamic Equilibrium (LTE) Model, entropy maximum and energy minimum principles.
- **Entropy:** Concept of reversibility; change in entropy in various thermodynamic processes, entropy balance for closed and open systems, mechanism of entropy generation
- **Single and Multiphase systems:** Maxwell relations; Clausius-Clapeyron equation; Gibbs-Duhem Relation, phase diagrams, corresponding states; phase transition; types of equilibrium and stability; multi- component and multi-phase systems, equations of state.
- **Chemically Reacting System:** Chemical reactions, irreversible reactions, combustion, chemical energy of fuels.
- **Power Generation:** Irreversibilities in a power plant; advanced steam-turbine power plants; advanced gas-turbine power plants, combined steam turbine and gas turbine plants.
- **Refrigeration:** Joule-Thomson expansion, Liquefaction, refrigerator models with heat transfer irreversibilities.
- **Entropy Generation Minimization:** heat transfer, trade-off between competing irreversibilites, principle of thermodynamic isolation, structure of heat exchanger irreversibility, energy storage systems, sensible and latent heat storage.
- **Kinetic theory of gases-** Introduction, basic assumption, molecular flux, equation of state for an ideal gas, collisions with a moving wall, principle of equipartition of energy, classical theory of specific heat capacity. Transport phenomena-intermolecular forces, The Vander Weals equation of state, collision cross section, mean free path.

Text Books:

Advance Engineering Thermodynamic, Adrian Bejan, Wiley, 2006.

M.J.Moran and H.N.Shapiro, Fundamentals Of Engineering Thermodynamics, John Wiley and Sons,

Reference Books:

F.W. Sears and G.L.Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Narosa Publishing House, New Delhi, 3rd edition, 1998.