ENGINEERING THERMODYNAMICS

PROF. D.P.MISHRA
Department of Aerospace Engineering
IIT Kanpur

PRE-REQUISITES : Plus 2 Science

INTENDED AUDIENCE : B.Tech students of Aerospace Engineering, Mechanical Engineering, Chemical Engineering, Metallurgical Engineering and Mining Engineering.

COURSE OUTLINE :
This course is designed for undergraduate engineering students, interested in learning the fundamental aspects of engineering thermodynamics. The main emphasis is placed on precise and logical presentation of the basic concepts and principles, which are essential for the better understanding of engineering thermodynamics

ABOUT INSTRUCTOR :
Prof. D.P. Mishra is working as a professor in the Department of Aerospace Engineering at Indian Institute of Technology (IIT) Kanpur, Kanpur, India where he was instrumental in establishing a combustion laboratory. He is currently holding Indian Oil Golden Jubilee Professional Chair in IIT, Kanpur. He has served as Visiting Professor in 2002 at the Tokyo-Denki University, Japan. His areas of research interest include combustion, computational fluid dynamics, atomization, et.. He is recipient of the Young Scientist Award in 1991 from the Ministry of New and Renewable Energy, Government of India.

COURSE PLAN :

Week 1: SI Unit, Definitions & Concepts: System,Property,Energy, Thermodynamic Equilibrium, Work interaction & various modes of work, Heat,State Postulate; Zeroth Law of Thermodynamics, Temperature Scale.

Week 2: Thermodynamic Properties of Fluids: Pure substance,Phase of substances, Molecular models of matter, Phase change processes in pure substance, Graphical representation of phase change processes,Steam Table

Week 3: Simple compressible substance, Ideal gas Equation of State, van der Walls Equation of State; Law of corresponding states, Compressibility chart, Pressure-volume; Temperature-volume and Phase diagrams; Mollier diagram and Steam tables.

Week 4: First Law of Thermodynamics for Nonflow process: Application of I Law for elementary processes, I Law analysis of Non-flow processes; Use of steam tables & Mollier diagram

Week 5: First Law of Thermodynamics for flow process: Application of I Law of Thermodynamics for Flow Process-Steady state, steady flow processes, Throttling process; Transient Flow ProcessesCharging & discharging of tanks.

Week 6: I Law Application to Chemically Reacting Systems: Fuels & Combustion, TheoreticalAir/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, Adiabatic flame temperature.

Week 7: Limitations of the I Law of Thermodynamics, Heat Engine, Heat Pump Refrigerator. II Law of Thermodynamics Kelvin Planck and Clausius statements their equivalence. Reversible irreversible processes, Criterion of reversibility, Carnot cycle Carnot principles.

Week 8: Applications of II Law of Thermodynamics: Thermodynamic Temperature scale, Clausius inequality,Entropy, Calculations of entropy change, Principle of entropy increase, T-S diagram, II Law analysis of Control volume.

Week 9: Thermodynamic Potentials: Maxwell relations:Available energy,Availability; Second law efficiency. Thermodynamic relations, Jacobian methods, Clapeyron and Kirchoff equations,Phase rule.

Week 10: Power Cycles: Rankine cycle Ideal, Reheat and Regenerative Rankine cycles.

Week 11: Gas Power Cycles: Gas Power Cycles; Otto cycle, Diesel cycle, Dual cycle and Brayton cycle.

Week 12: Refrigeration Cycles: Vapor compression refrigeration,Absorption refrigeration and Gas refrigeration Cycles.