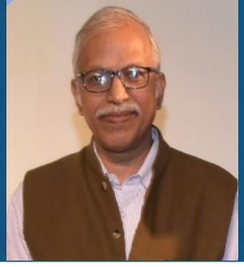

ENGINEERING THERMODYNAMICS

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

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

PRE-REQUISITES: +2 Science

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. Since this is an introductory course, care has been taken to present the materials in a gradual manner to instill confidence in the minds of the students. Attempts have been made to keep the derivation of fundamental equations and principles at an uncomplicated mathematical level. Several examples are provided during lectures for the student to assimilate and reinforce the ideas developed in this subject. Adequate emphasis is given in this course for exposing the students to realistic problems that are likely to be encountered in general engineering practices. Because, the fundamentals of thermodynamics are used extensively while designing all most all engineering systems. The methodical rather than rigid problems solving techniques are enumerated in details to encourage the students to develop a feel for importance of thermodynamics.

ABOUT INSTRUCTOR :

Prof. Debi Prasad Mishra, a professor in the Department of Aerospace Engineering and Design Programme, Indian Institute of Technology Kanpur (IITK) and an adjunct Professor in Centre for Indian Knowledge System, IIT, Guwahati is currently working as the Director of NITTTR Kolkata. Currently he is also working as the chairman, BoG, Govt. College of Engineering, Kalahandi. His areas of interests are Propulsion, Combustion, Computational Fluid Dynamics and Atomization. He had held Indian Oil Golden Jubilee Professional Chair in IIT Kanpur. He has been conferred with several awards and recognitions. He has authored 5 textbooks and 9 edited books in the field of combustion and propulsion. He has published more than 260 research papers in International/National Journals and conferences. He has also five patents to his credit. He has undertaken more than 32 research and consultancy projects from various agencies, research labs and industries. He has developed 6 online courses under Swayam Platform, a national initiative of Govt. of India. Besides this, he has designed and developed a unique MOOC course, “Introduction to Ancient Indian Technology” on Swayam platform of NPTEL. Over last 10 years, he has delivered several invited lectures on ancient Indian science & technology and culture & tradition to more than 1.5 lakh people across India to revive and re-establish ancient scientific and technological culture of India. He has also delivered several invited lectures on ancient Indian spiritual knowledge system by several organizations across India. He has written several articles to popularize science and technology among common people and delivered several lectures and discussion on TV and radio related to Ancient Science and Technology and other different topics. He has penchant for designing and developing eco-friendly sustainable products and technologies. He does dabble in Odiya literature and has two books in Odiya language to his credit. He is well known as a motivational speaker and is very popular among youth circles.

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 Processes-Charging & discharging of tanks.

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

Week 7: II Law Application to Chemically Reacting Systems: Fuels & Combustion, Theoretical Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, Adiabatic flame temperature.

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.