Department of Mechanical Engineering
Indian Institute of Technology New Delhi
I Semester -- 2026 – 2027

MEL7401: ADVANCED THERMODYNAMICS

(3-0-0)

Syllabus

Module 1	Basic concepts and definitions. Macroscopic and microscopic viewpoints
Module 2	Equilibrium states, zeroth law. First law for open and closed systems
Module 3	Second law for open and closed systems, absolute thermodynamic scale of temperature, maximum entropy principle
Module 4	Equations of state for simple compressible systems, ideal gas equation, van der Waals equation, other variants, generalized compressibility chart
Module 5	Legendre transform, thermodynamic potentials and relationships for simple systems (compressible, elastic, electric, magnetic, etc.), Maxwell's relations
Module 6	Extremum principles for thermodynamic potentials, useful work, availability, exergy
Module 7	Stability conditions for thermodynamic potentials, physical consequences, phase diagram, first and second order phase transitions
Module 8	Multicomponent systems, Euler equation, Gibbs-Duhem relation, conditions of equilibrium (including phase and chemical equilibrium), Gibbs phase rule, chemical potential, stability of multicomponent systems
Module 9	Equation of state of mixtures, entropy of mixing, applications to gas mixtures and ideal solutions, and fugacity
Module 10	Thermodynamics of reactive mixtures, reaction equilibrium, applications to combustion and electrochemical energy conversion
Module 11	Introduction to statistical thermodynamics, microscopic view of entropy, third law

Books:

Callen, H. B : Thermodynamics and an Introduction to Thermostatics, John Wiley & Sons. 1985
Kalyan Annamalai & Ishwar K. Puri, Advanced Thermodynamics Engineering, CRC Press LLC,2002.
Fermi, E. Thermodynamics, Dover Publications 1956
Dhar, P.L. Engineering Thermodynamics - A Generalized Approach, Elsevier 2008
Wark, K. Advanced Thermodynamics for Engineering McGraw-Hill, 1995
Bejan, A Advanced Engineering Thermodynamics, Wiley, 2016