

BT 304 THERMODYNAMICS FOR BIOTECHNOLOGISTS

Course Description & Objectives:

Develop familiarity with thermal energy concept..To estimate properties of chemical compounds and biomass.Develop familiarity with heat of reactions.Develop familiarity with phase and chemical equilibria.

Course Outcomes

1. Understand the terminology associated with engineering thermodynamics.
2. Reiterate the first and second laws of thermodynamics, and understand the practical implications of these laws in engineering design.
3. Understand the concepts of heat, work and energy conversion, and can calculate heat and work quantities for industrial processes.
4. Calculate the properties of ideal and real mixtures based on thermodynamic principles.
5. Explain the underlying principles of phase equilibrium in two-component and multi-component systems.
6. Apply mass, energy and entropy balances to flow processes.

UNIT - I : The first law and other basic concepts:

The scope of thermodynamics. The first law of thermodynamics, thermodynamic state and state functions, enthalpy, steady-state steady flow process, equilibrium, phase rule, reversible process, constant - V and constant - P processes, heat capacity. Calculation of Work, energy and property changes in reversible processes.

UNIT - II : Behavior of Fluids :

The PVT behavior of pure substances, virial equations, ideal gas, applications of the virial equations, second virial coefficients from potential functions. Thermodynamics of flow processes; principles of conservation of mass and energy for flow systems.

UNIT - III : Second Law of Thermodynamics :

Statements of the second law, thermodynamic temperature scales Entropy, Entropy changes of an ideal gas, third law of thermodynamics, entropy from the microscopic view point.

UNIT - IV : Thermodynamic Properties of Fluids & Solution Thermodynamics :

Estimation of thermodynamic properties using equations of state; Maxwell relationships and their applications; Calculation of flow processes based on actual property changes, Partial molar properties, concepts of chemical potential and fugacity, Ideal non ideal solutions, Gibbs Duhem equation; Excess properties of mixtures; Activity Coefficient.

UNIT - V : Phase Equilibria & Chemical Reaction Equilibria :

Criteria for phase equilibrium; Vapor-liquid equilibrium calculations for binary mixtures, Liquid – Liquid equilibrium and Solid-liquid equilibrium, Equilibrium criteria for homogeneous chemical reactions; Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant; Calculation of equilibrium conversions and yields for single and multiple chemical reactions.

TEXT BOOKS:

1. J.M. Smith, H.C. Van Ness and M.M. Abbott. "Introduction to Chemical Engineering Thermodynamics", 5th ed., McGraw Hill, 2005.
2. Y.V. C. Rao, "Chemical Engineering Thermodynamics", 1st ed., University Press, 2004.

REFERENCE BOOKS:

1. K. V. Narayanan, "A Text Book of Chemical Engineering Thermodynamics", 1st ed., PHI Publications, 2001.
2. Y.V.C. Rao, "Engineering Thermodynamics", 1st ed., University Publications, 2004.
3. M.D. Koretsky, "Engineering and Chemical Thermodynamics", 1st ed., John Wiley and sons, 2004.

