



CHEMISTRY & BIOCHEMISTRY

Chemical and Biological Thermodynamics: Principles to Applications

Type of Course	: New
Course Snapshot	: Core / UG, PG
Pre-requisites	: Not required
Course Duration	: 30 hours / 12 weeks
Industry Support	: Chemical and Pharmaceutical Industries

COURSE OUTLINE:

The course is designed to benefit students of chemistry, chemical engineering, biotechnology, and pharmaceutical sciences to learn from basic concepts of chemical thermodynamics to applications in chemical and pharmaceutical industries including protein folding and stability.

INSTRUCTOR:

Prof. Nand Kishore
Department of Chemistry
IIT Bombay



ABOUT INSTRUCTOR:

Prof. Nand Kishore is currently Professor at the Department of Chemistry, Indian Institute of Technology Bombay, Mumbai. He was head of the Department from December 2008 to December 2011. After completing his PhD (Chemistry) from Indian Institute of Technology Delhi in 1989, he received postdoctoral training at Yale University, U.S.A. (1989-1991) and at the National Institute of Standards and Technology, U.S.A. (1991-1992). He joined as faculty at IIT Bombay in 1992. His areas of research are Bio-thermodynamics and Bio-physical Chemistry.

COURSE PLAN:

- Week 1 : Concepts of system, surroundings, state function, path function, and descriptions with suitable examples. Work, heat, energy. Tutorial with problem solving.
- Week 2 : First Law of Thermodynamics. applications of First law of Thermodynamics. Second Law of Thermodynamics. Heat Capacity and its applications. Technological applications of Second Law. Tutorial with problem solving.
- Week 3 : Third law of Thermodynamics and its technological applications. Tutorial with problem solving.
- Week 4 : Gibbs free energy (G), Helmholtz free energy (A), Applications of G and A and connection with work. Tutorial with problem solving.
- Week 5 : Second law machinery and Maxwell relations. Chemical potential and its applications to chemical systems. Tutorial with problem solving.
- Week 6 : Ideal and non-ideal solutions. Examples and applications of concepts. Activity, fugacity, activity coefficient, ideal systems.
- Week 7 : Non-ideality and intermolecular interactions, Excess functions. Tutorials with problems solving.
- Week 8 : Concept of equilibrium, thermodynamic criterion of equilibrium, endergonic and exergonic reactions, direction of equilibrium. Equilibrium constant and its optimisation.
- Week 9 : Effect of external factors on equilibrium constant. Tutorial (Equilibrium constant and its applications).
- Week 10 : Partial molar quantities, thermodynamics of mixing. Applications of partial molar quantities in understanding intermolecular interactions. Tutorial with problem solving
- Week 11 : Type of systems and technology development, Differential scanning calorimetry. Isothermal titration calorimetry. Applications of Isothermal titration calorimetry and Differential scanning calorimetry. Tutorial with problem solving
- Week 12 : Calorimetry in rational drug design, protein-ligand interactions, protein folding, protein stability and other related areas with examples. Tutorial. with problem solving.