Thermodynamics - Video course

COURSE OUTLINE

Module 1: Review

Review of basic concepts – systems, surroundings, processes, properties (extensive/intensive), components (single/multi), phases (G/L/S), ideality, zeroth, first, second laws and their consequences (T, U, S).

Module 2: Additional useful thermodynamic functions

The thermodynamic functions H, A and G, concept of chemical potential, equations for a closed system, Maxwell's relations, thermodynamic analysis of processes – lost work, irreversibility, thoughts on Classical and Statistical Thermodynamics in the context of Biological Processes and Systems.

Module 3: Thermodynamic properties of pure fluids

Review of ideal gas, non-ideal gas, PVT behaviour, virial and cubic equations of state, generalized correlations, residual properties, estimation of thermodynamic properties using equations of state.

Module 4: Thermodynamics of solutions

Partial molar properties, fugacity, ideal and non-ideal solutions, excess properties of mixtures, activity coefficient, Gibbs-Duhem equation

Module 5: Phase Equilibria

Phase rule, criteria for phase equilibria, VLE for pure component, VLE for multi-component system

Module 6: Reaction Equilibria

Equilibrium criteria for homogenous reactions, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, calculation of equilibrium conversion and yields for single and multiple reactions.

COURSE DETAIL

Topic	No. of hours
Module 1: Review Review of basic concepts – systems, surroundings, processes, properties (extensive/intensive), components (single/multi), phases (G/L/S), ideality, zeroth, first, second laws and their consequences (T, U, S).	1
Module 2: Additional useful thermodynamic functions The thermodynamic functions H, A and G, concept of chemical potential, equations for a closed system, Maxwell's relations, thermodynamic analysis of processes – lost work, irreversibility, thoughts on Classical and Statistical Thermodynamics in the context of Biological Processes and Systems.	7
Module 3: Thermodynamic properties of pure fluids	8

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Biotechnology

Pre-requisites:

1. High school Physics.
2. Chemistry.
3. Calculus.

Additional Reading:

1. Callen H. 1985. Thermodynamics and Introduction to Thermistics, 2nd Edition, Wiley.
2. Denbigh K. 1955. The Principles of Chemical Equilibrium with Applications in Chemistry and Chemical Engineering. Cambridge University Press.

Coordinators:

Prof. G.K. Suraishkumar
Department of BiotechnologyIIT Madras

Review of ideal gas, non-ideal gas, PVT behaviour, virial and cubic equations of state, generalized correlations, residual properties, estimation of thermodynamic properties using equations of state.	
Module 4: Thermodynamics of solutions Partial molar properties, fugacity, ideal and non-ideal solutions, excess properties of mixtures, activity coefficient, Gibbs-Duhem equation	**9**
Module 5: Phase Equilibria Phase rule, criteria for phase equilibria, VLE for pure component, VLE for multi-component system	**9**
Module 6: Reaction Equilibria Equilibrium criteria for homogenous reactions, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, calculation of equilibrium conversion and yields for single and multiple reactions.	**6**
Total	**40**

References:

1. Smith JM, Van Ness HC and Abbot MM. 2001. Chemical Engineering Thermodynamics, 6th Edition, McGraw Hill.

2. Sandler SI. 1989.Chemical and Engineering Thermodynamics, John Wiley.