



## Physical Chemistry (1)

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Prerequisites
CHM	241	Physical Chemistry (1)	4	2	3	1	CHM 102

### Objectives:

- To improve the students' knowledge of the laws of classical thermodynamics.
- To recognize the properties of gases, liquids, and solids and their solutions.
- To correlate the kinetic theory to gas laws.

### Syllabus:

Nature of physical chemistry. Classical mechanics and Properties of Gases, The Perfect Gas – States of gases. Gas laws, Individual Gases, Boyle's Law, Charles's and Gay-Lussac's law, Avogadro's Principle, Graham's law, Perfect (Ideal) Gas Equation, Mixtures of Gases. Dalton's Law, Mole Fractions, Real Gases, Virial coefficients, Molecular Interactions, Compression factor Boyle's Temperature, CO<sub>2</sub> Phase Diagram, Condensation. Critical Constants, van der Waals Equations, Principle of Corresponding States, Kinetic Model of Gases.

Introduction to Thermodynamics, Basic Concepts (Work, Heat and Energy), ZERO'th Law. The First Law of Thermodynamics - Conservation of Energy, Systems and Surroundings. Expansion Work, General Expression for Work, Free Expansion, Heat Capacity. Enthalpy, Definition of Enthalpy, Measurement of Enthalpy, Variation of Enthalpy with Temperature, Relation Between Heat Capacities, Adiabatic Change, Work of Adiabatic Change, Heat Capacity and Adiabats. Standard Enthalpy Changes, Enthalpies of Physical Change, Enthalpies of Chemical Change, Hess' Law, Standard Enthalpies of Formation Changes, Reaction Enthalpy & Enthalpy of Formation, Group Contributions, Temperature Dependence of Reaction Enthalpies.

State Functions, Exact and inexact differentials, Changes in internal energy, The Joule experiment, Changes in internal energy at constant p. Temperature Dependence of Enthalpy, Changes in enthalpy at constant volume, Isothermal compressibility, Joule-Thomson effect, CV vs. Cp.

The second law of thermodynamics. Carnot Cycle and entropy: Entropy, Thermodynamic definition, Entropy as a State Function, The Clausius Inequality. Entropy of Phase Transition at the Transition Temperature, Expansion of the Perfect Gas, Variation of Entropy with Temperature, Measurement of Entropy. Third Law of Thermodynamics, Nernst Heat Theorem, Third-Law Entropies, Helmholtz Energy, Maximum Work, Gibbs Energy, Maximum Non-Expansion Work, Standard Molar Gibbs Energies.

Simple Mixtures, Thermodynamic Description of Mixtures, Partial Molar Quantities, Partial Molar Volume, Partial Molar Gibbs Energies, Thermodynamics of Mixing, Gibbs Energy of Mixing, The Properties of Solutions, Liquid Mixtures, Colligative Properties, Boiling point elevation, Freezing point depression, Solubility, osmotic Pressure, Activities, Solvent Activity, Solute Activity, Regular Solutions.

### Textbook:

Physical Chemistry, K. J. Laidler, J. H. Meiser, B. C. Sanctuary, Houghton Mifflin Company, 2003, 4th Ed or later [ISBN: 0618123415]

### References:

Atkins, P., and J. de Paula. Physical Chemistry. 8th ed. New York, NY: W.H. Freeman and Company, 2001 ( ISBN: 9780716735397)

