

Course Code	Course Name	Credits
26CH009	PHYSICAL CHEMISTRY - I	04

Course Objectives

- Understand fundamental principles of thermodynamics, quantum chemistry, solutions, osmosis, and phase equilibria.
- Apply thermodynamic laws, quantum concepts, and colligative properties to analyze chemical systems and solve problems.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Apply thermodynamics and quantum chemistry concepts to solve problems.
- Explain key concepts like thermodynamics, quantum chemistry, dilute solutions, osmosis, and phase rule.
- Evaluate theories, their limitations, and identify research gaps for further study.

Unit 1 - Thermodynamics-I (12 Hrs.)

Thermodynamic terms: System, Boundary, Surroundings; Homogeneous and Heterogeneous systems; Types of thermodynamic systems; Intensive and Extensive properties; State of a system; Equilibrium and non-equilibrium states; Thermodynamic processes; Reversible and Irreversible processes; Nature of heat and work; Internal energy; Units of internal energy; First law of thermodynamics; Enthalpy of a system; Molar heat capacities; Joule-Thomson effect; Adiabatic expansion of an ideal gas; Work done in adiabatic reversible expansion.

Unit 2 – Quantum Chemistry (12 Hrs.)

Black body radiation and quantum theory; Inadequacy of old quantum theory; Atomic spectra; Bohr's model of atoms; Bohr's theory of hydrogen atom and spectral lines; Limitations of Bohr's model; Sommerfeld's extension; Photoelectric effect and Compton effect; de Broglie's equation and its verification; Heisenberg's uncertainty principle; Schrödinger wave equation; Eigenvalues and eigenfunctions; Significance of ψ and ψ^2 ; Radial probability distribution; Orbital energies in multi-electron atoms; Filling of orbitals.

Unit 3 - Theory of dilute solution (12 Hrs.)

Colligative properties; Lowering of vapour pressure; Raoult's law; Derivation of Raoult's law; Measurement of lowering of vapour pressure; Barometric method; Manometric method; Ostwald and Walker's dynamic method; Boiling point elevation; Determination of molecular mass from elevation of boiling point; Measurement of boiling point elevation; Landsberger-Walker method; Cottrell's method; Freezing point depression; Determination of molecular weight from depression of freezing point; Measurement of freezing point depression; Beckmann's method; Rast's camphor method; Colligative properties of electrolytes.

Unit 4 – Osmosis and Osmotic Pressure (12 Hrs.)

Osmosis; Semipermeable membranes; Preparation of cupric ferrocyanide membrane; Osmotic pressure; Pfeffer's method; Berkeley and Hartley's method; Osmometer; Isotonic solutions; Theories of osmosis; Molecular sieve theory; Membrane solution theory; Vapour pressure theory; Membrane bombardment theory; Reverse osmosis; Desalination of sea water; Laws of osmotic pressure; Boyle-van't Hoff law for solutions; Charles'-van't Hoff law for solutions; van't Hoff equation for solutions; Avogadro-van't Hoff law for solutions; van't Hoff theory of dilute solutions; Calculation of osmotic pressure; Determination of molecular weight; Relation between vapour pressure and osmotic pressure; Osmotic pressure of electrolytes.

Unit 5 Phase Rule (12 Hrs.)

Phase; Components; Degrees of freedom; Derivation of phase rule; One-component system; Phase diagrams; Polymorphism; Experimental determination of transition point; Water system; Sulphur system; Two-component systems; Silver-lead system; Zinc-cadmium system; Potassium iodide-water system; Magnesium-zinc system; Ferric chloride-water system; Sodium sulphate-water system.

Reference Books:

- B. R. Puri, L.R. Sharma and M. S. Pathania —Principles of Physical Chemistry, 47th Ed., 2016. Vishal Publishing Co.,
- P. L. Soni and O. P. Dharmaha, —Text book of Physical chemistry, S. Chand and Sons, New Delhi.
- Ira N. Levine, Pearson, —Quantum Chemistry, 7 th Ed., 2014. London, UK,
- B.S Arun Bahl, and G.D. Tuli – Essential of Physical Chemistry (S. Chand Publications)
- Peter Atkins, Julio de Paula, and James Keeler, —Atkins' Physical Chemistry11 th Ed., 2017. Oxford University Press, UK.

Websites and eLearning Sources:

- <https://nptel.ac.in/courses/104103856>
- <https://www.youtube.com/watch?v=1Q4EYFqYgdo>

COs and Bloom's Taxonomy Mapping – 26CH009		
Course Outcomes	On completing U.G. program the students will be able to	BTL
CO1	Understand and recall concepts associated with thermodynamics, quantum chemistry, dilute solutions, osmotic pressure and phases.	K1, K2
CO2	Use the new information to apply, integrate and explain the thermodynamic properties of a system in real life applications.	K3
CO3	Differentiate and calculate vapour pressures and osmotic pressures of liquids using the concepts and theories of dilute solution.	K4
CO4	Justify and evaluate how atoms behave using quantum chemistry	K5
CO5	Categorize and construct one-component and two component system using phase rules.	K6

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

Relationship Matrix – 26CH009													
Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)						Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	2	2	2	1	1	3	2	1	2	1	1	1.75
CO2	2	3	2	2	1	1	3	3	3	3	2	1	2.1
CO3	3	3	2	1	1	1	3	3	2	2	1	1	1.91
CO4	3	2	1	2	1	1	3	3	3	3	1	2	2.08
CO5	3	3	3	1	1	1	3	3	3	3	1	2	2.25
Total													2.01

Mean Score: 3- High, 2- Medium/Moderate, 1-Low