



# ARSD College, University of Delhi

## Lesson Plan

Course Name : B.Sc. (Hons) Chemistry						
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
I	Chemistry - C II: Physical Chemistry - I	States of Matter & Ionic Equilibrium	2	0	0	2
Teacher/Instructor(s)		Dr. Anjali Verma				
Session		2022-23				

### Course Objective:

- To develop basic and advance concepts regarding the three states of matter.
- To derive the expressions for determining the physical properties of gases, liquids and solids.
- To study the concept of ionization in aqueous solution, pH, buffers and various applications of ionization

### Course Learning Outcomes:

- Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance.
- Explain the crystal structure and calculate related properties of cubic systems.
- Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.
- Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses and ever day life.

### Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Ionic equilibria	1-2	Strong, moderate and weak electrolytes
		3-4	degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water.
		5-6	Ionization of weak acids and bases, pH scale,
		7-8	dissociation constants of mono and diprotic acids.
		9-10	Salt hydrolysis-calculation of hydrolysis constant

		11-12	common ion effect, degree of hydrolysis and pH for different salts.
		13-14	Buffer solutions; derivation of Henderson equation and its applications.
		15-16	Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.
		17-18	Qualitative treatment of acid – base titration curves (calculation of pH at various stages).
		19-20	Theory of acid–base indicators; selection of indicators and their limitations.
2.	Solid state	21-22	Nature of the solid state
		23-24	law of constancy of interfacial angles, law of rational indices, Miller indices
		25-26	Elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups
		27-28	seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law
		29-30	rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

#### Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	Contents	Contact Hours
1	Gaseous state: Kinetic molecular model of a gas; postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of $\sigma$ from $\eta$ ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure and temperature for different gases. Causes of deviation from	22

	ideal behaviour. Equation of states for real gases; van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.	
II	Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.	06
III	Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.	12
IV	Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.	20
	<b>Total</b>	<b>60</b>
<b>Suggested Books:</b>		
<b>Sl. No.</b>	<b>Name of Authors/Books/Publishers</b>	<b>Year of Publication/Reprint</b>
1.	Atkins, P.W.; Paula, J.de. Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.	2014
2.	Ball, D. W., Physical Chemistry, 2nd Edition, Cengage Learning, India.	2017
3.	Castellan, G. W., Physical Chemistry, 4th Edition, Narosa	2004

4.	Kapoor, K.L., A Textbook of Physical Chemistry, Vol 1, 6th Edition, McGraw Hill Education.	2015
<b>Mode of Evaluation:</b>	Internal Assessment / End Semester Exam	