



**FOUR-YEAR UNDER GRADUATE PROGRAMME
(FYUGP)**

BSc CHEMISTRY

Programme	B.Sc Chemistry				
Course Title	LIQUID STATE, GASEOUS STATE AND ELECTROCHEMISTRY				
Type of Course	MINOR				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamentals of Gaseous and Liquid states of matter 2. Basic principles of Electrochemistry 3. Basic knowledge in analytical principles				
Course Summary	1. This course provides the students a thorough knowledge about gaseous and liquid states of matter and the continuity between them. 2. This course aims to impart an idea about electrochemistry 3. This course also aims to develop proficiency in qualitative analysis and to familiarize physical chemistry experiments				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To apply the postulates of kinetic theory of gases.	Ap	F	Instructor-created exams / Quiz /Assignment
CO2	To describe the properties of liquids.	E	C	Instructor-created exams / Quiz /Assignment
CO3	To analyse the behaviour of gases and liquids	An	C	Instructor-created exams / Quiz /Assignment
CO4	To illustrate the basic concepts of electrochemistry and its applications	U	C	Instructor-created exams / Quiz /Assignment
CO5	To perform the cation analysis on a provided mixture containing two cations.	An	P	Lab work

CO6	To enable the students to determine the physical properties (physical constants).	Ap	P	Lab work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (75)	Marks
I	Liquid State		15	34
	1	Introduction – Definition and characteristics of liquids - Vapour pressure, surface tension and viscosity - Explanation of these properties on the basis of intermolecular attraction.	4	
	2	Kinds of solutions –Solubility of gases in liquids – Henry’s law and its applications	2	
	3	Raoult’s law – Ideal and non-ideal solutions – Dilute solutions.	2	
	4	Colligative properties – Qualitative treatment of colligative properties – Relative lowering of vapour pressure – Elevation of boiling point,– Depression in freezing point – Osmotic pressure – Reverse osmosis and its applications	3	
	5	– Application of colligative properties in finding molecular weights (thermodynamic derivation not needed) – Abnormal molecular mass – Van’t Hoff factor	2	
	6	Introduction to liquid crystal phases. Types of liquid crystals: nematic, smectic, cholesteric.	1	
	7	Applications of liquid crystals.	1	
II	Gaseous State - I		10	20
	8	Characteristics of gases	1	
	9	Postulates of kinetic theory of gases	2	
	10	Maxwell’s distribution of molecular velocities – Root mean square, average and most probable velocities.	3	
	11	Collision number – Mean free path – Collision diameter	1	
	12	Viscosity of gases, including their temperature and pressure dependence,	1	

	13	Relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure.	2	
III	Gaseous State - II		10	22
	14	Behaviour of real gases - Deviation from ideal behaviour – Compressibility factor	3	
	15	Causes of deviation from ideal behaviour - van der Waals equation of state (derivation not required) – Expression of van der Waals equation in virial form and calculation of Boyle temperature	4	
	16	PV isotherms of real gases – Continuity of states – Isotherm of van der Waals equation	1	
	17	Critical phenomena (basic idea only) – Critical constants and their determination (derivation not required) – Relationship between critical constants and van der Waals constants.	2	
IV	Electrochemistry		10	22
	18	Specific conductance, equivalent conductance and molar conductance	2	
	19	Variation of conductance with dilution - Kohlrausch's law - Degree of ionization of weak electrolytes	2	
	20	Application of conductance measurements – Conductometric titrations.	1	
	21	Galvanic cells – emf of cell and electrode potentials - IUPAC sign convention – Reference electrodes – Standard Hydrogen electrode – Calomel electrode - Standard electrode potential - Nernst equation	2	
	22	H ₂ -O ₂ fuel cell. Ostwald's dilution law – Buffer solutions – Buffer action [acetic acid/sodium acetate & NH ₄ OH/NH ₄ Cl], applications of buffers.	3	
V	Practical		30	
	A minimum of seven experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher			
	1	a) Inorganic Qualitative Analysis (semi – micro analysis) <ul style="list-style-type: none"> Reactions of Cations: Study of the reactions of the following cations with a view of their identification and 	25	

		confirmation. NH_4^+ , Pb^{2+} , Cu^{2+} , Cd^{2+} , Al^{3+} , Ni^{2+} , Co^{2+} , Mn^{2+} , Zn^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , and Mg^{2+} <ul style="list-style-type: none"> • Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures) 		
	2	b) Open ended experiments– Physical chemistry experiments. (Any one experiment) Suggestions Determination of Physical Constants [Determination of colligative properties, Determination of viscosity of a binary liquid solution (Glycerol-water system) Refractometry experiments etc.]	5	

Reference Books

1. P. W. Atkins, J. de Paula, Atkin's Physical Chemistry, 8th Edn., Oxford University Press, 2006.
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017.
4. G. M. Barrow, Physical Chemistry, 5th Edn., Tata McGraw Hill Education, New Delhi, 2006.
5. S. Glasstone, Introduction to Electrochemistry, East-West Press Pvt. Ltd., New Delhi, 2007.
6. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Textbook of Qualitative Chemical Analysis, 6th Edn., Pearson Education, Noida, 2013.
7. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd Edn., The National Publishing Company, Chennai, 1974.
8. A. Findlay, Findlay's Practical Physical Chemistry, 9th Edn., John Wiley and Sons, New York, 1972.
9. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publications, Meerut, 2008.

Mapping of COs with PSOs and POs

	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1						
CO 2	2				2		1						
CO 3	2				2		1						
CO 4	2				2		1						
CO 5			2		2		1				1		
CO 6			2		2		1				1		

Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓	✓	
CO6	✓	✓	✓	