

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

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>SOLUTIONS AND SURFACE CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>II</b>				
Academic Level	<b>100 - 199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic idea of solutions 2. Colloids – Definition and classification 3. Fundamentals of surface phenomena 4. Basic knowledge in analytical principles				
Course Summary	1. This course provide the students a thorough knowledge about various properties of liquids 2. This course aims to impart an idea about importance of colloids 3. This course aims to develop the concept of adsorption and separation techniques 4. 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 understand the fundamental concepts and the properties of liquids	U	F	Instructor-created exams / Quiz /Assignment
CO2	To evaluate the importance of colligative properties.	E	C	Instructor-created exams / Quiz /Assignment
CO3	To differentiate different types of colloids and explain their properties and applications.	U	C	Instructor-created exams / Quiz /Assignment
CO4	To appreciate the importance of surface phenomena in chemistry	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	Marks
<b>I</b>	<b>Solutions</b>		<b>15</b>	<b>32</b>
	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	
<b>II</b>	<b>Colloids</b>		<b>10</b>	<b>22</b>
	8	True solution, colloidal solution and suspension. Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples.	2	
	9	Purification of colloids by electrodialysis and ultrafiltration	2	
	10	Properties of colloids: Brownian movement – Tyndall effect – Electrophoresis.	2	
	11	Origin of charge and stability of colloids – Coagulation - Hardy Schulze rule – Protective colloids - Gold number. Emulsions.	2	
	12	Applications of colloids: Delta formation, medicines, emulsification, cleaning action of detergents and soaps.	2	
<b>III</b>	<b>Adsorption and Catalysis</b>		<b>10</b>	<b>22</b>
	13	Adsorption, Physical and chemical adsorption, factors affecting adsorption.	2	
	14	Adsorption isotherms: Freundlich and Langmuir isotherms (derivation not required) –	2	
	15	Applications of adsorption.	1	

	16	Catalysis: Homogeneous and heterogenous catalysis – Theories of homogenous and heterogenous catalysis	3	
	17	Enzyme catalysis – Michaelis-Menten equation (derivation not required).	2	
<b>IV</b>	<b>Separation Techniques</b>		<b>10</b>	<b>22</b>
	18	Chromatography- Introduction - Adsorption and partition chromatography - Development of chromatograms: frontal, elution and displacement methods	2	
	19	Qualitative and quantitative aspects of principle and applications of column, thin layer, paper and gas chromatography	2	
	20	Rf value – Relative merits of different techniques	2	
	21	Solvent extraction: Classification, principle and efficiency of the technique.	2	
	22	Extraction of metal ions from aqueous solution,	2	
<b>V</b>	<b>Practical</b>		<b>30</b>	
	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	Inorganic Qualitative Analysis (semi – micro analysis) <ul style="list-style-type: none"> <li>• Reactions of Cations: Study of the reactions of the following cations with a view of their identification and confirmation. <math>\text{NH}_4^+</math>, <math>\text{Pb}^{2+}</math>, <math>\text{Cu}^{2+}</math>, <math>\text{Cd}^{2+}</math>, <math>\text{Al}^{3+}</math>, <math>\text{Ni}^{2+}</math>, <math>\text{Co}^{2+}</math>, <math>\text{Mn}^{2+}</math>, <math>\text{Zn}^{2+}</math>, <math>\text{Ba}^{2+}</math>, <math>\text{Sr}^{2+}</math>, <math>\text{Ca}^{2+}</math>, and <math>\text{Mg}^{2+}</math></li> <li>• Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures)</li> </ul>	25	
	2	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, 5<sup>th</sup> Edn., Tata McGraw Hill Education, New Delhi, 2006.
5. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
6. Christian, G.D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
7. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
8. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
9. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Textbook of Qualitative Chemical Analysis, 6<sup>th</sup> Edn., Pearson Education, Noida, 2013.
10. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3<sup>rd</sup> Edn., The National Publishing Company, Chennai, 1974.
11. A. Findlay, Findlay's Practical Physical Chemistry, 9<sup>th</sup> Edn., John Wiley and Sons, New York, 1972.
12. 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	✓	✓	✓	