



TEACHING PLAN: CH-306

SCHOOL: SOBAS		ACADEMIC SESSION: 2023- 2024		FOR STUDENTS' BATCH: VI SEMESTER	
1	Course code	CH-306			
2	Course Title	PHYSICAL CHEMISTRY			
3	Credits				
4	Learning Hours	Contact Hours		54	
		Practical Teaching		27	
		Project, Tutorial and Assessment		09	
		Total hours		90	
5	Course Objective	<p>The purpose of this course is to provide:</p> <ol style="list-style-type: none"> 1. Broad and balance knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories. 2. To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems. 3. To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship. 			
6	Course Outcomes	<ol style="list-style-type: none"> 1. Systematic and coherent understanding of the fundamental concepts in Physical chemistry. 2. Students will be able to understand the basic principle of electronic spectroscopy and the energy related to every colour imparted by chemicals. They will also gain the clear physical interpretation of chemical bonding and molecular structure. 3. The course curriculum is expected to develop an inquisitive feature among the students through suitable questions and experimental investigation. 4. Students will be having clear knowledge of how light is important to chemical reactions and how the amount of molecules in a solution affects the nature of a solution which is beneficial for the applied field. 5. Students will gain the knowledge of different phases of materials and their co-existence. 			
7	Outline syllabus:				
7.01	Paper Code	Unit	Introduction	Reference number	Teaching methods
7.02	CH-306 UNIT-I SPECTROSCO PY-III	(a)	Energy curves	Banwell and McCash	Lecture, Blackboard, PPT, Discussion, AV
		(b)	Selection Rules	Banwell and McCash	Lecture, Blackboard, PPT, Discussion, AV
		(c)	Electronic Transitions	Banwell and McCash	Lecture, Blackboard, PPT, Discussion, AV
7.03	CH-306 UNIT-II	(a)	Photochemical Process	Puri, Sharma & Pathania	Lecture, Blackboard, PPT, Discussion,

	PHOTOCHEMISTRY		P.C. Rakshit	AV	
		(b)	Jablonski Diagram	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
		(c)	Photosensitized Reaction	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
7.04	CH-306 UNIT-III SOLUTIONS: DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES	(a)	Ideal and non-ideal solutions	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
		(b)	Expressing Concentrations	Puri, Sharma & Pathania	Lecture, Blackboard, PPT, Discussion, AV
		(c)	Colligative Properties	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
7.05	CH-106 UNIT-IV PHASE EQUILLIBRIUM	(a)	Components of a system	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
		(b)	Gibbs phase rule	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
		(c)	Phase Equilibria	Puri, Sharma & Pathania P.C. Rakshit	Lecture, Blackboard, PPT, Discussion, AV
8	Course Evaluation				
8.10	CA: 20%				
8.1	Attendance	5%			
8.12	Homework	-			
8.13	Quizzes	4 Quizzes, 5%			
8.14	Projects	1 Project, 5%			
8.15	Presentation	1 Presentation, 5%			
8.16	Any other	--			
8.2	MTE(IA)	20%			
8.3	End-term examination: 60%				
9	Text Books & References				
9.1	Text books	<ol style="list-style-type: none"> 1. <i>Physical Chemistry- P.C. Rakshit</i> 2. <i>Principles of Physical Chemistry- Puri, Sharma & Pathania</i> 3. <i>Fundamentals of Molecular Spectroscopy- Banwell and McCash</i> 			
9.2	References	Physical Chemistry- Peter Atkins [OXFORD]			
9.3	Video References	https://www.youtube.com/watch?v=CM4qsSltQOY https://www.youtube.com/watch?v=WP6JpnHZJIQ https://www.youtube.com/watch?v=NqXIfsxy9yU			

<https://www.youtube.com/watch?v=lrosz8N-9tA>
<https://www.youtube.com/watch?v=Ioi6YiPGV4A>
<https://www.youtube.com/watch?v=i07KnMEGjS8>
<https://www.youtube.com/watch?v=-V2cTv2GsQE>
<https://www.youtube.com/watch?v=MqjNSub1erA>
https://www.youtube.com/watch?v=nn-1UU_1PX8&list=PLF_7kfnwLFCHJ6kUboe60izCndyBUjiaZ
https://www.youtube.com/watch?v=ltirLC4AD2E&list=PLF_7kfnwLFCHJ6kUboe60izCndyBUjiaZ&index=2
https://www.youtube.com/watch?v=Lrn31fEY5uc&list=PLF_7kfnwLFCHJ6kUboe60izCndyBUjiaZ&index=4

Mapping of Outcomes v. Topics

Outcome no. → Syllabus topic↓	1	2	3	4	5
Paper Code. Unit I (a)	Y	Y			
Paper Code. Unit I (b)	Y	Y			
Paper Code. Unit I (c)	Y	Y	Y		
Paper Code. Unit II (a)	Y	Y	Y		
Paper Code. Unit II (b)	Y	Y		Y	
Paper Code. Unit II (c)	Y		Y	Y	
Paper Code. Unit III (a)	Y			Y	Y
Paper Code. Unit III (b)	Y			Y	
Paper Code. Unit III (c)	Y		Y	Y	
Paper Code. Unit IV (a)	Y		Y	Y	Y
Paper Code. Unit IV (b)	Y				Y
Paper Code. Unit IV (c)	Y		Y		Y

QUESTION BANK

Objective type:

UNIT I:

1. Which of the following transitions are of weak intensities and lie in the visible region?

(a) $n \rightarrow n^*$ (b) $\sigma \rightarrow \sigma^*$ (c) $\pi \rightarrow \pi^*$ (d) $n \rightarrow \sigma^*$

2. Arrange the various electronic transitions in the order of increasing energy.

(a) $n \rightarrow \sigma^* < \pi \rightarrow \pi^* < n \rightarrow \pi^* < \sigma \rightarrow \sigma^*$ (b) $n \rightarrow \pi^* < \pi \rightarrow \pi^* < n \rightarrow \sigma^* < \sigma \rightarrow \sigma^*$

(c) $n \rightarrow \sigma^* < n \rightarrow \pi^* < \pi \rightarrow \pi^* < \sigma \rightarrow \sigma^*$ (d) $\sigma \rightarrow \sigma^* < \pi \rightarrow \pi^* < n \rightarrow \pi^* < n \rightarrow \sigma^*$

3. Which of the following organic compound shows transition due to conjugation?

(a) Alkenes (b) Saturated aliphatic ketones (c) **Conjugated dienes** (d) Alkanes

4. Which of the following is an application of electronic spectroscopy?

(a) Detection of impurities (b) Control of purification (c) Study of kinetics of the chemical reaction

(d) **All of the mentioned**

5. Which of the following is the principal chromophore in an azo-dye?

(a) $C \equiv N$ (b) **$N=N$** (c) $C=N$ (d) $N \equiv N$

UNIT II

- Which of the following is an incorrect statement?
(a) First step in photochemistry is excited state (photoexcitation)
(b) Photochemical reactions are caused by absorption of ultraviolet only
(c) When a molecule or atom in the ground state (S_0) absorbs light, one electron is excited to a higher orbital level
(d) It is possible for the excited state S_1 to undergo spin inversion
- Non radiative process from the following is
(a) Fluorescence (b) Phosphorescence **(c) Internal conversion** (d) Absorption
- The quantum efficiency of a photochemical reaction is defined as:
(a) Ratio of molecules decomposed in a given time to the number of quanta absorbed in the same time
(b) Number of molecules decomposed in a given time
(c) Number of quanta absorbed per unit time
(d) Ratio of molecules decomposed in a given time to the number of quanta emitted in the same time
- A substance absorbs 2.0×10^{16} quanta or radiations per second and 0.002 mole of it reacts in 1200 seconds. What is the quantum yield of the reaction ($N = 6.02 \times 10^{23}$)?
(a) 50 (b) 40 (c) 80 (d) 100
- Photochemical activation is highly selective. This statement is...
(a) true (b) false (c) sometimes true (d) none of these

UNIT III

- When two perfect solutions with volume V each are combined, What is the volume of the solution as a result?
(a) V (b) $2V$ (c) Greater than $2V$ (d) Less than $2V$
- 4L of 0.02 M aqueous solution of NaCl was diluted by adding one litre of water. The molality of the resultant solution is
(a) 0.004 (b) 0.008 (c) 0.012 **(d) 0.016**
- Low concentration of oxygen in the blood and tissues of people living at high altitude is due to
(a) low temperature **(b) low atmospheric pressure** (c) high atmospheric pressure
(d) both low temperature and high atmospheric pressure
- Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?
(a) Methanol and acetone (b) Chloroform and acetone (c) Nitric acid and water (d) Phenol and aniline.

5. An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because

- (a) it gains water due to osmosis (b) it loses water due to reverse osmosis.
(c) it gains water due to reverse osmosis (d) it loses water due to osmosis.

UNIT IV

1. What is the formulation for Gibbs Phase Rule?

- (a) $P - F = C + 2$ (b) $P + F = C + 1$ (c) $C - P + F = C + 2$ (d) $P + F = C - 1$

2. In Gibbs phase rule, P stands for?

- (a) P is the minimum number of chemical components required to constitute all the phases in the system
(b) P is the number of degrees of freedom in the system
(c) P is the number of phases in the system
(d) None of the above

3. In which equilibria, in which either P or T can be changed independently?

- (a) Invariant (b) Univariant (c) Divariant (d) All of the above

4. The degree of freedom at a triple point in the unary diagram for water is

- (a) 2 (b) 0 (c) 3 (d) 1

5. For single component system when degree of freedom is 1(one) then number of phases

- (a) 1 (b) 0 (c) 2 (d) 3

Subjective type

UNIT I

1. What is Born-Oppenheimer approximation?
2. Deduce the electronic energy levels of a di-atomic molecule.
3. Describe Frank-Condon Principle.
4. Discuss the dissociation energy in electronic transition diagram.
5. What is selection rule? How is it applicable in electronic spectra of a diatomic molecule?
6. What are forbidden transitions?

UNIT II

1. Explain the terms: (a) Photochemical reaction (b) Lambert-Beer law (c) Stark-Einstein Law (d) Grothus Draper Law (e) Quantum Efficiency
2. Briefly explain Fluorescence and Phosphorescence.
3. Derive the mathematical expression for Lambert-Beer Law.
4. What are the primary and secondary photochemical reactions?
5. State the reason for high and low quantum yield.

6. How do you apply Lambert-Beer Law to determine the concentration of unknown solution?
7. A certain substance in a cell of length l absorbs 10% of incident light. What % of light will be absorbed if the cell length gets increased 5 times?

UNIT III

1. State Raoult's Law.
2. How is the molecular mass of a solute determined from elevation of boiling point?
3. What are the colligative properties?
4. Derive a relationship between the elevation of boiling point of a solution and the mole fraction of the solute.
5. Show that Raoult's law is special case of Henry's law.
6. Explain: Vapour pressure of liquid does not depend on the size of the container.
7. What is vant Hoff Factor? Explain it when solute is associated with the solution.
8. What is osmotic pressure?
9. Explain reverse osmosis? State the applications of this process.

UNIT IV

1. Describe the following terms: (a) Phase (b) Components (c) Degrees of freedom
2. Draw a phase diagram for such components system which contains more than one solid phase.
3. Explain the following terms with help of phase diagram: (a) Triple Point (b) Invariant system (c) Metastable equilibrium.
4. Discuss the phase equilibrium of a system involving two solids and liquids.
5. Distinguish between Eutectic point and Peritectic point.
6. Draw the phase diagram of water system and explain.

PROJECTS (To be given to group of students)

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1. To perform a photochemical reaction.
 2. To calculate the energy of certain electronic transitions.
 3. To calculate boiling of elevation of standard solution.
 4. To calculate the mole fraction of solvent from freezing point depression.