

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

BSc CHEMISTRY

Programme	B.Sc Chemistry				
Course Title	FUNDAMENTALS OF PHYSICAL CHEMISTRY				
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 Thermodynamics 2. General idea about state of equilibrium 3. Basic idea about order of reaction 4. Basic knowledge in analytical principles and structure of molecules				
Course Summary	1. This course aims to familiarise the students with the concepts of thermodynamics, kinetics and photochemistry. 2. This course also aims to impart an idea about ionic and phase equilibrium 3. This course also aims to develop proficiency in analytical tools and to draw molecular structures using softwares				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the fundamental concepts thermodynamic processes	U	F	Instructor-created exams / Quiz /Assignment
CO2	To evaluate the importance of ionic and phase equilibrium.	E	C	Instructor-created exams / Quiz /Assignment
CO3	To analyse the order of different reactions	An	C	Instructor-created exams / Quiz /Assignment
CO4	To appreciate the importance of photochemistry	U	C	Instructor-created exams /

				Quiz /Assignment
CO5	To create structures of different molecules and calculation of different parameters	C	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
I	Thermodynamics		10	22
	1	Definition of thermodynamic terms – System – Surroundings – Types of systems,	1	
	2	First law of Thermodynamics – Internal energy – Significance of internal energy change –Enthalpy	2	
	3	Second law of Thermodynamics – Entropy and spontaneity – Statement of second law based on entropy.	2	
	4	Entropy change in phase transitions (derivation not required) – Entropy of fusion, vaporization and sublimation.	2	
	5	The concept of Gibbs free energy – Physical significance of free energy –	1	
	6	Conditions for equilibrium and spontaneity based on ΔG values – Effect of temperature on spontaneity of reaction. Third law of Thermodynamics.	2	
II	Ionic and Phase Equilibria		10	22
	7	Introduction to acid base theories – pKa, pKb and pH	1	
	8	Buffer solutions Mechanism of buffer action – Buffer index – Henderson equation – Applications of buffers	2	
	9	Hydrolysis of salts of all types – Degree of hydrolysis – Hydrolysis constant and its relation with Kw	1	
	10	Solubility product and common ion effect.	2	
	11	Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs phase Rule	2	
	12	Phase diagrams of one-component systems – e.g.: water	2	
III	Chemical Kinetics		15	32
	13	The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction.	3	

	14	Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants).	5	
	15	Half-life of a reaction. General methods for determination of order of a reaction.	2	
	16	Concept of activation energy and its calculation from Arrhenius equation (qualitative treatment only)	3	
	17	problems	2	
IV	Photochemistry		10	22
	18	Introduction – Difference between thermal and photochemical processes – Characteristics of electromagnetic radiation - Beer Lambert's law.	3	
	19	Laws of photochemistry: Grothus-Draper law and Stark-Einstein's law of photochemical equivalence.	1	
	20	Quantum yield and its explanation with example – Photophysical processes: Jablonski diagram – Fluorescence – Phosphorescence.	3	
	21	Photosensitization, Role of photochemical reactions in biochemical processes	2	
	22	Photostationary states – Chemiluminescence	1	
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	<ul style="list-style-type: none"> • Absorption (and transmittance) measurements of a colourless and a coloured light absorbing substance in a solution by using a spectrophotometer either experimentally or by simulation. For simulation use https://mas-iiith.vlabs.ac.in/exp/uv-visible-spectroscopy/simulation/expt1/mas_expt1.html • Verify Beer Law using a spectrophotometer either experimentally or by simulation. For simulation use https://mas-iiith.vlabs.ac.in/exp/beer-law/simulation/expt4/mas_expt4.html https://mas-iiith.vlabs.ac.in/exp/lambert-law/simulation/expt3/mas_expt3.html https://mas-iiith.vlabs.ac.in/exp/beer-lambert-law/simulation/expt6/mas_expt6.html • Draw structures of organic molecules using any chemistry structure drawing softwares/websites (any five molecules) Samples: https://molview.org/ https://pubchem.ncbi.nlm.nih.gov/edit3/index.html https://www.chemspider.com/StructureSearch.aspx 	25	

	<p>http://www.kingdraw.cn/en/ https://www.rcsb.org/chemical-sketch</p> <ul style="list-style-type: none"> • Measure the bond length and bond angle of organic molecules using softwares <p>Samples: https://molview.org/</p> <ul style="list-style-type: none"> • Determination of heat of solution (ΔH) of oxalic acid/benzoic acid from solubility measurement. 		
2	<ul style="list-style-type: none"> • Open ended experiments– Physical chemistry experiments. (Any one experiment) <p>Suggestions</p> <p>Determination of velocity constant for acid hydrolysis of methyl acetate.</p> <p>Determination of velocity constant for the saponification of ethyl acetate.</p> <p>Preparation of buffers and determination of pH values of fruitjuices using pH meter.</p> <p>Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide</p> <p>Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.</p>	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. J. Rajaram, J. C. Kuriacose, Chemical Thermodynamics, Pearson Education, New Delhi, 2013.
6. K. Laidler, Chemical Kinetics, 3rd Edn., Pearson Education, New Delhi, 2004.
7. P. L. Soni, O. P. Dharmarha, U. N. Dash, Textbook of Physical Chemistry, 23rd Edn., Sultan Chand & Sons, New Delhi, 2011.
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	✓	✓	✓	