PHYSICAL CHEMISTRY

Semester	Subject Code	Category	Lecture hours		Theory Hours		Practical Hours		Credits
			Per week	Per sem.	Per week	Per sem.	Per week	Per sem.	
V	21CCH5C	Core- VII	4	60	4	60	-	-	4

COURSE OBJECTIVES:

The students will be able to

- Gain knowledge about the Principle and Applications of Phase rule, Surface Chemistry, Chemical kinetics, Group theory and Photochemistry.

COURSE OUTCOMES:

On the successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Gain knowledge about the applications of phase rule, reduced phase rule, one component system, two component systems with simple eutectic, two component systems with compound formation and freezing mixtures.	K3
CO2	Know the theory behind adsorption, adsorption isotherms, catalysis, effect of catalyst and kinetics of surface reactions.	K3
CO3	Acquire knowledge about the rate of the reaction, rate constant, order and molecularity of reactions, effect of temperature and catalyst on the rate of the reaction.	K4
CO4	Understand the (i) basics about the kinetics and theories of reaction rates by solving problems (ii) basics of group theory, symmetry elements and point group.	K3
CO5	Acquire knowledge about the laws of photochemistry, kinetics of photochemical reactions and their applications.	K3

*CO – Course Outcomes

Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze.

MAPPING WITH PROGRAMME OUTCOMES:

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S
CO2	S	S	S	S	S	S
CO3	S	S	M	M	S	S
CO4	S	S	S	S	S	S
CO5	S	M	M	S	S	S

(S – Strong; M – Medium; L – Low)

UNIT–I: Phase Equilibrium **12 Hours**

1.1 Definition of the terms – Phase, Components and Degrees of freedom – Gibb's phase rule and its Thermodynamic derivation – Phase diagram – Criteria of Phase equilibrium – Application of phase rule to One component systems – Water and Sulphur systems – Reduced phase rule – Two component systems – Simple eutectic system – Lead-Silver system – Freezing mixtures – Potassium iodide-Water system.

1.2 Thermal analysis and cooling curves – Compound formation with congruent melting point – Zinc-Magnesium system, Ferricchloride-Water system – Compound formation with incongruent melting point – Sodium-Potassium system.

UNIT – II: Surface Chemistry **12 Hours**

2.1 Adsorption – Characteristics of Adsorption – Differences between Adsorption and Absorption – Physisorption and Chemisorption – Differences between Physisorption and Chemisorption – Adsorption of gases by solids – Different types of Adsorption isotherms – Freundlich adsorption isotherm – Langmuir's theory of adsorption – BET theory of multilayer adsorption (no derivation) – Applications of Adsorption.

2.2 Catalysis – Definition – Catalyst – Promoters – Catalytic poisons – Autocatalysis – Examples – General characteristics of catalytic reactions – Types of catalysis – Acid-Base catalysis – Enzyme catalysis – Turnover Number – Michaelis-Menten equation – Michaelis constant – Effect of Temperature and pH on Enzyme Catalysis – Homogeneous Catalysis – Function of a catalyst in terms of Gibb's free energy of activation – Heterogeneous catalysis – Surface Reactions – Kinetics of unimolecular surface reactions.

UNIT – III: Chemical Kinetics **12 Hours**

3.1 Introduction – The rate equation – Rate of a reaction – Factors influencing the rate of the reaction – Rate constant – Order and Molecularity of a reaction – First order, Second order and Zero order reactions with examples – Pseudounimolecular reactions – Examples – Derivation of rate constants of First order, second order and zero order reactions – Half-life of a reaction – Derivation of time for half change – Methods of determination of order of a reaction.

3.2 Arrhenius equation – Effect of Temperature on reaction rates – Temperature coefficient of a reaction – Concept of activation energy – Determination of activation energy from Arrhenius equation – Energy barrier – Catalyst – Effect of catalyst on the rate of the reaction.

UNIT – IV: Kinetics and Group Theory **12 Hours**

4.1 Theories of reaction rates – Lindemann's theory of unimolecular reactions – Principle of Collision theory and derivation of rate constant for bimolecular gaseous reactions – Theory of Absolute Reaction Rates (ARRT) – Thermodynamic derivation for the rate constant for a bimolecular reaction (same type of reactants) – Eyring equation – Comparison of collision theory and ARRT – Significance of entropy and free energy of activation – Consecutive reactions – Chain reactions – Parallel reactions – Reversible reactions (Examples only).

4.2 Group theory – Symmetry elements – Symmetry operations – Identity, Proper axis of symmetry, Plane of symmetry, Centre of symmetry, Improper axis of symmetry (Definition and 2 examples for each) – Product of Symmetry Operations – Rules of a Group – Group Multiplication Table for C_{2v} – Point group – Definition – Point group of H_2O, NH_3, BF_3, $PtCl_4$ and CH_4.

UNIT – V: Photochemistry **12 Hours**

5.1 Introduction – Difference between Thermal reactions and Photochemical reactions – Beer-Lambert law – Limitations of Beer- Lambert's law – Laws of photochemistry – Grothus-Draper law and Stark-Einstein's law of Photochemical Equivalence – Primary and Secondary processes – Quantum yield and its determination – Photochemical rate law.

5.2 Kinetics of photochemical reactions – Kinetics of Decomposition of hydrogen iodide and Photodimerisation of anthracene – Fluorescence, phosphorescence, Photosensitization, Bioluminescence and Chemiluminescence – Ozone layer in Stratosphere – Photosynthesis in plants – Applications of Photochemical reactions.

TEXT BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	P. L. Soni, O. P. Dharmarha and U. N. Dash	Text Book of Physical Chemistry	Sultan Chand and Co.	2006
2.	B. R. Puri, L. R. Sharma and Madan S. Pathania	Principles of Physical Chemistry	Vishal Publishing Co.	2013
3.	B. R. Puri, L. R. Sharma and Madan S. Pathania	Elements of Physical Chemistry	Vishal Publishing Co.	2004
4.	Arun Bahl, B. S. Bahl and G. D. Tuli	Essentials of Physical Chemistry	S. Chand and Company Limited	2009
5.	M. V. Sangaranarayanan and V. Mahadevan	Text Book of Physical Chemistry	Universities Press (India) Private Limited	2011

REFERENCE BOOKS:

S. No.	Authors	Title	Publishers	Year of publication
1.	V. K. Gupta and R. G. Sharma	Advanced Physical Chemistry	K. Nath and Company	1987
2.	S. Swarnalakshmi, T. Saroja and R. M. Ezhilarasi	A Simple Approach to Group Theory in Chemistry	University Press	2008
3.	K. V. Raman	Group Theory and its Applications to Chemistry	Tata McGraw-Hill Publishing Company Ltd	1996
4.	V. Ramakrishnan and M. S. Gopinathan	Group Theory in Chemistry	Vishal Publications	1998
5.	Donald A. McQuarrie and John D. Simon	Physical Chemistry – A Molecular Approach	Viva Books Private Limited	1999
6.	A. S. Negi and S. C. Anand	Physical Chemistry	Eastern Wiley Private Ltd	1985
7.	N. Kundu and S. K. Jain	Physical Chemistry	S. Chand and Co.,	1992
8.	K. L. Kapoor	Physical Chemistry	Macmillan India Pvt. Ltd.	1980
9.	Samuel Glasstone	Textbook of Physical Chemistry	Macmillan (India) Ltd	1946

10.	Samuel Glasstone and David Lewis	Elements of Physical Chemistry	Macmillan (India) Ltd	1963
11.	Samuel H. Maron and B. Lando	Fundamentals of Physical Chemistry	Macmillan (India) Ltd	1974
12.	G. W. Castellan	Physical Chemistry	Narosa Publishing House	2004
13.	Walter J. Moore	Physical Chemistry	Orient Longman	1972
14.	A. Ghoshal	Numerical Problems on Physical Chemistry	Books and Allied (P) Ltd.	2013
15.	A. Arunabashan	General and Physical Chemistry	Books of Allied (P) Ltd.	2009
16.	P. K. Battacharya	Group Theory and its Chemical Applications	Himalaya Publishing House	1986

TEACHING METHODOLOGY:

- Power Point Presentations
- Assignments
- Animated videos
- Chalk and Board

SYLLABUS DESIGNER:

- Dr. M. Nagarathinam, Head and Associate Professor of Chemistry