Master of Science, Chemistry
M. Sc. Chemistry, Semester – I

Course Code	PS01CCHE53	**Title of the Course**	Topics in Physical Chemistry-I
Total Credits of the Course	04	**Hours per Week**	04

Course Objectives:	1. The concepts of chemical thermodynamics, chemical kinetics, electrochemistry and surface sciences will be expanded to aid in quantification and understanding of several concepts in physical chemistry that have already been studied at UG level. 2.The course contents aim at developing principles, theoretical back ground and further applications of chemical thermodynamics, chemical kinetics, electrochemistry and surface sciences. 3. The students will be taught how to interpret chemical thermodynamics, chemical kinetics, electrochemistry and surface chemistry approaches in solving chemical science problems.

Course Content:

Unit	Description	Weightage* (%)
1.	**Chemical Thermodynamics :** Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity, Non-ideal systems : Excess functions for non-ideal solutions, Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients ; ionic strength.	25
2.	**Chemical Kinetics – I :** Chemical kinetics and its scope, rate of reaction, factors influencing the rate of a reaction, measurements of reaction rates, differential and integral rate laws, rate laws and equilibrium constants for elementary reactions, temperature dependence of rate constants, Arrhenius equation, concept of activation energy, reaction mechanisms and examples ; uni-molecular reactions, bi-molecular reactions, trimolecular reactions, nuclear decay reactions, polymerization reactions.	25
3.	**Electrochemistry :** Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions, Thermodynamics of electrified interface equation,Derivation of electro-capillary, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Tobin, Bockris, Devanathan	25

	models, Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot.	
4.	**Surface Chemistry :** Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surface. Micelles : Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelle concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization – phase separation and mass action models.	25

Teaching-Learning Methodology	We have forged over the last few years traditional and some of the innovative approaches as teaching learning methodologies such as: Direct Instruction; flipped classrooms; classroom discussion; unit based quizzes and assignments; problem solving activities; student presentations; project-based learning; problem-based learning; providing a repository of quality questions on a subject; reevaluation of - quizzes, scripts, assignments, online platforms etc. Self Study: The course coordinator may allot a segment of the syllabus (max-10% of the syllabus or equivalent to maximum 4 lecture hours) as self study by the students.

Evaluation Pattern:

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to:

1.	Analyze, determine and correlate concepts of laws of thermodynamics, free energy, chemical potential and entropies, partial molar properties, ideal and non-ideal systems.
2.	Rationalize scope of chemical kinetics, quantify the ideas (not overshadowed by mathematics) about the behavior of molecules and systems in order to be able to cope with experimental methods of chemical kinetics, thinks and reflect importance of reaction mechanisms and specific reactions such as nuclear decay reactions,

	polymerization reactions.
3.	Recognize the electrochemistry principles for understanding the solution properties and behaviour
4	Identify and distinguish the ideal and non-ideal systems in terms of excess functions, activity and activity coefficient of electrolytic solutions in terms of Debye-Huckeland Onsager theories and models to realize charge interfaces and overpotentials etc.
5	Interpret the surface phenomenon, micellization process, phase separation and mass action models.

Suggested References:

Sr. No.	References
1.	An Introduction to Chemical Thermodynamics, R. P. Rastogi and P. R. Misra, (Vikas Publishing House Pvt.Ltd.
2.	Thermodynamics, P. C. Rakshit, (The New Book Stall, Calcutta)
3.	Fundamentals of Chemical Thermodynamics, M. L. Lakhanpal, (Tata McGraw-Hill Publishing Company, New Delhi).
4.	Elements of Physical Chemistry, Peter Atkins, Julio De Paula, David Smith,(Oxford University Press, 6th Edition)
5.	Physical Chemistry, Ira N Levine (Tata McGraw-Hill Publishing Company, New Delhi, Fifth Edition).
6.	Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum Press
7.	Modern Electrochemistry, Vol. I and Vol. II, J. O. M. Bockris and A. K. N. Reddy, Plenum press
8.	Chemical Kinetics, K. J.Laidler, Mc-Graw Hill Publisher
9.	Thermodynamics for Chemists, S. Glasstone, (East-West Edition, Third Edition)
10.	Surfactants and Interfacial Phenomena, Milton J. Rosen, (Willey Interscience, Third Edition)
11.	Colloid and Interface Science, Pallab Ghosh (PHI Learning Private Limited)

On-line resources to be used if available as reference material:

On-line Resources: From time to time there are many online resources, including web sites, databases, *e*-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.
Major Web Sites used for chemical education such as: Education, American Chemical Society (ACS);ChemCollective; LearnChemistry; Chemical Education Digital Library (ChemEd DL); The Green Chemistry Education Network (GCEdNet); ACS Examinations Institute; Process Oriented Guided Inquiry Learning (POGIL) Curriculum Materials; Resources for Chemistry Education; NPTEL online resources etc.