Name of the Programme: M.Sc. Part-II (Physical Chemistry)

Course Code: CHP-624 **Title of the course:** Colloids and Surface Chemistry

Number of Credits: 4

Effective from AY: 2023-24

Prerequisites for the course:	Students should have studied chemistry courses at M.Sc. I.	
Course Objective:	1. To introduce some core concepts of colloidal chemistry including DLVO theory, electrokinetic phenomena and diversity in colloids. 2. To introduce fundamental concepts and applications of colloids in day-today life.	
Content	**1. Colloids and Liquid Surfaces** a. Colloids: General introduction, classification and structural characteristics of colloidal system, preparation and purification b. Microscopic picture of liquid surface c. Surface tension and its measurement. Surfactant and reduction of surface tension. Curved liquid surfaces. d. Nucleation theory. e. Surface modification: self-assembly monolayer formation. Physisorption of polymers. Polymerization on surfaces.	No of hours 10
	2. Electrostatic Forces and Electrokinetic Phenomenon a. Electrical double layer. Surface interactions between surfaces (dipole, induced dipole, H-bonding) b. Surface forces: Van der Waals forces between molecules. Surface energy and Hamaker constant. Measurement of surface forces. The DLVO theory c. Charged surfaces such as mercury, silver iodide and oxides. Measurement of surface charge densities d. Electrocapillarity - theory and measurement e. Electrokinetic phenomena: concept of zeta potential. Electroosmosis and streaming potential. Electrophoresis and sedimentation potential. f. Contact angle and its measurements. Wetting and dewetting. Important wetting geometries.	12
	3. Colloidal Stability a. Charged colloids. Electrical charge distribution at interfaces b. Factors affecting colloidal stability. Effect of electrolyte.	8

	c. Flocculation and coagulation. Kinetics of coagulation d. Steric stabilization of solid and liquid colloids	
	4. Preparation of colloids a. Chemical methods for synthesis of colloids: Sol-gel method, polyol synthesis, plasma enhanced chemical vapor deposition, hydrothermal synthesis b. Colloidal synthesis of semiconductor nanoparticles: Hot-injection synthesis. Synthesis of colloidal core-shell heterostructures c. Surface directed colloidal patterning: Colloidal self-assembly approaches d. Reducing agents in colloidal nanoparticle synthesis	12
	5. Surfactants, Micelles, Emulsions and Thin Liquid Films a. Classification of surfactants. Solubilization and micelle formation b. Spherical micelles: cmc and influence of temperature. Thermodynamics of micellization. Structure of surfactant aggregates. c. Emulsions: Macro and microemulsions, properties, formation and factors affecting the stability. Evolution and aging. Coalescence and demulsification. Size of droplets. Elasticity of surfactant films. d. Thin films on surfaces of liquids: Introduction and phases. Bubbles and foams. Optical and X-Ray methods to study monolayers. e. Langmuir Blodgett Transfer	13
	6. Applications of Colloids in Science, Technology and Industry a. Colloids as drug delivery agents b. Colloidal nanocrystals for optical applications and solar cells. c. Biomedical applications	5
Pedagogy	Mainly lectures and tutorials. Seminars / term papers /assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References / Readings	H. J. Butt, K. Graf and M. Kappl, Physics and Chemistry of Interfaces, Wiley-VCH, 2003. A. W. Adamson and A.P.Gast, Physical Chemistry of Surfaces, Wiley-VCH, 1997, 6th edition R. D. Vold and M. J. Vold, Colloid and Interface Chemistry, Addison-Wesley, 1983.	

	K. S. Birdi, Surface and Colloid Chemistry, Principles and Applications; Taylor & Francis Group ,2010. D. Meyers, Surfaces, Interfaces and Colloids, Principles and Applications; John Wiley & Sons, Inc. 1999. 2nd edition. E. D. Shchukin, A. V. Pertsov, E. A. Amelina, A. S. Zelenev, Studies in Interface Science, Colloid and Surface Chemistry; Elsevier, 2001. D. J. Shaw, Introduction to Colloid and Surface Chemistry, 4th Ed Elsevier, 1992. F. Caruso, Colloids and Colloid Assemblies, Wiley-VCH, 2004 V. Lesnyak, M. Yarema, S. Miao, Colloidal Semiconductor Nanocrystals: Synthesis, Properties and Applications, Frontiers Media SA, 2020.
Course Outcome:	1. Students will be able to explain various fundamental and core concepts of colloid chemistry. 2. Students should be in a position to apply the knowledge of colloidal chemistry for their dissertation and research work 3. Students should be in a position to apply these concepts during the lab course in physical chemistry. 4. Students will understand applications of colloids.