20CY207 SURFACE AND INTERFACIAL CHEMISTRY (EL-I)

Hours Per Week :

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Course Description and Objectives:

This course is intended to deliver the principles and theories behind the forces controlling surface phenomena related to innumerable applications like paint, pharma, oil wells, soap, detergent industries. The surface energy characteristics at various interfaces and surfaces, which are very important in catalysis, adsorption, emulsion, blends and composite materials are addressed with real life examples from industries. This course also explains how to characterise surface properties using modern instrumentations compatible for surfaces and interfaces.

Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1.	Understand various theories controlling the surface and interfacial forces
2.	Analyse the interaction of surfactant at different interfaces/surfaces and their stabilization under different conditions.
3.	Apply the principles of intermolecular forces in various industrially relevant phenomena / applications
4.	Understand surface energy characteristics of surface parameters like adsorption and catalysis.
5.	Analyse the characteristics of surfactants using various surface sensitive instruments.

Unit - I :

Liquid Surface, Interface and Surface Forces :

Surface tension and its measurement, surface excess, Laplace equation, Kelvin equation, Gibbs energy and surface tension, Gouy – Chapman Theory and Grahame equation, the Stern layer and Gibbs free energy of the double layer. Surface forces – Van der Waals forces between molecules, DLVO forces, capillary forces, Surface energy and Hamaker constant, Measurement of surface forces. Contact angle and its measurements. Wetting and Adhesion Characteristics.

Unit - II:

Surfactant, Micelles and Emulsion :

Surface active agents and their classification, packing factor, micellization, critical micellar concentration (CMC), determination of CMC, factors affecting CMC of surfactants, thermodynamics of micellization, aggregation number, shape & size of aggregates, determination of aggregation number, shape and size, shape transition, reverse micelles, vesicles, colloids, emulsion, microemulsion and Macroemulsions: properties, Evolution, Aging, Coalescence and Demulsification.

Unit - III :

Applications of Self Assembled Structures :

Application of surfactants in gel electrophoresis, colloids and interfaces, Micellar Catalysis, Quantitative Models, Micellar Enzymology, Phenomenon of Solubilization, Solubilization in Mixed Micelles, Drug Surfactant Interaction, Protein Surfactant Interactions, Industrial Application of Surfactants: Detergents, paints, blends, composites, emulsions, in drilling oil, oil spillage, etc.

Unit - IV :

Surface Chemistry, Adsorption and Catalysis

Surface Phenomena, solid-liquid interfaces, solid-gas interface, Surface Films, Langmuir-Blodgett films, self-assembled mono layers, collapse pressure, Surface film of liquids. Physisorption and Chemisorption, Various adsorption isotherms: Freundlich, Langmuir and BET isotherms, Dubinin-Radushkevich isotherm, Temkin isotherm. Surface area determination. Kinetics of surface reactions involving adsorbed species, Langmuir-Hinshelwood mechanism, Langmuir-Rideal mechanism, Rideal-Eley mechanism. Mechanism of heterogeneous catalysis, phase transfer catalysis.

Unit - V :

Surface Analysis :

Chemical analysis of surfaces and interfaces: Tensiometer, Particle Size analyser, Static and dynamic light scattering, SNS, Fluorescence spectroscopy, Langmuir-Blodget technique: Surface films-different types, surface pressure and its measurement, surface potential and its measurements and interpretation. Examination of surfaces using low energy electron diffraction, photoelectron spectroscopy, ESCA, scanning probe microscopy, Auger electron spectroscopy , SEM and TEM.

Text Books:

1. Text Book of Physical Chemistry Vol-1-4 by K.L. Kapoor
2. Physical Chemistry by D.N. Bajpai
3. Physical Chemistry by A.W. Atkins
4. Introduction to Surface Chemistry and Catalysis by Gábor A. Somorjai (John Wiley & Sons)
5. Atkins, P. W. Physical Chemistry, 7th edn. (Oxford University Press, 2006).
6. Moore, W. J. Physical Chemistry, 5th edn. (Orient Longmann, 1990).
7. Adamson, A. W., Gast, A. P. Physical Chemistry of Surfaces (John Wiley and Sons, 1997).
8. Connors, K. A. Chemical Kinetics: A Study of Reaction Rates in Solution, (VCH Publications, 1990)
9. Castellan, G. W. Physical Chemistry, 4th edn. (McGraw Hill, 1999).
10. Chakrabarty, D.K. Solid State Chemistry, 1st edn (New Age Publishers, 2005).
11. West, A.R. Solid State Chemistry and its Applications, 4th edn., (Plenum, 2007).