GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3173914
Semester – VII
Subject Name: SURFACE AND INTERFACES

Type of course: Chemical and Material Technology

Prerequisite: Basic knowledge of Chemistry, Nano synthesis and Material Science

Rationale: Fundamental and applied aspects of solid/liquid/vapor surfaces and interfaces including metals, oxides, polymers, microbes, water and other materials. Their structure and defects, thermodynamics, reactivity, electronic and mechanical properties. Applications depend on class interests, but have previously included microelectronics, soils, catalysis, colloids, composites, environment-sensitive mechanical behavior, UHV single crystal studies, materials durability, batteries & fuel cells, vacuum science & technology, and surface bioactivity. A student who successfully completes the course can:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

6	**Content**	**Total Hrs**
1	Structure – Free surfaces of solids and liquids; internal interfaces, grain boundaries; dissimilar materials. Atomic and molecular determinants; Modifications of bulk: relaxation, reconstruction, defects, ad-structures Attached (sorbed) species structures Description and nomenclature Surface-dominated materials: nanoparticles/colloids, intercalates, emulsions, micelles; nanofibers; membranes/thin films Surface melting, adjacent bulk effects.	**9**
2	Energetics Approaches: classical thermodynamics, statistical thermodynamics, atomistic	**9**

	models Experimental measurements: solids, liquids, interfaces Diffusion: mobility at surfaces and interfaces Vibrations- surface phonons Applications: solutions (segregation) nanoparticle formation and stability (ripening)	
3	Electronic and Magnetic properties Approaches: band structure in 2 & 3 dimensions, local cluster models, plasmons, band-bending, surface magnetic anisotropy applications: work function, field & thermionic emission, sensors; storage media	**9**
4	Adsorption I – Gas/vacuum interactions with solid surfaces Kinetic theory picture; Energetics: atomistic picture,;classical and statistical thermodynamics; Physisorption and sticking; chemisorption and bonding; Measurements – energetics, uptake, kinetics, surface area, porosity, acidity; Applications – separations, catalysis	**8**
5	Adsorption II – Liquid interactions with solids 5.1) non-electrolytes- small molecules, polymers Water – ions, double layer model, surface complexes, proteins Surface electrochemistry – electrochem refresh; phase stability analyses: potential/pH diagrams; electrode processes: voltammetry Nanoparticles/colloids – intraparticle forces, dispersion stability Biosurfaces, proteins Self-assembled monolayers, LB films Emulsions, micelles, foams	**7**

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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**35**	**35**	**-**		

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

References:

1. "Surface Science: An Introduction" John B. Hudson and "Physical Chemistry of Surfaces" 6th edn. Adamson & Gast (e-book).

Supporting Texts: "Prin. of Colloid & Surface Chemistry" 3rd edn. Hiemenz & Rajagopalan ; "Colloid Dispersions" Morrison and Ross; "Chemistry of the Solid-Water Interface" Werner Stumm; "Colloids and Interfaces in Life Sciences" William Norde; "The Materials Science of Thin Films" 2nd edn. Milton Ohring; "Electrochemistry": Hamann, Hamnett & Vielstich.; "Physics of Surfaces and Interfaces" H. Ibach.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe a science or technology situation in terms of its surfaces/interfaces aspects and mechanisms	25%
CO-2	Analyze surface/interface phenomena quantitatively	25%
CO-3	Set forth in detail a program of experimental studies to address surface/interface issues	25%
CO-4	Analyze and interpret results of surface/interface experiments in terms of mechanisms and impacts	25%