



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3133607
Semester – III
Subject Name: Physical Chemistry

Type of course: Basic Science

Prerequisite: Needs basic knowledge of Chemistry

Rationale: The main objective of this subject is to provide a strong basis of physical chemistry that will be applicable to other areas of the degree course such as chemical reaction engineering and the design project, with specific reference to applications relating to sustainable development

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	4	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Gaseous state & Interfacial chemistry: Molecular diffusion & effusion, critical constants & liquefaction of gasses, equation of state, supercritical fluids & their applications. Surface free energy, capillary & surface tension, bubbles, droplets, Young Laplace equation, super saturation, solid – liquid interfaces, surface active agents, emulsions.	07
2	Kinetics & molecular reaction dynamics: Significance of reaction kinetics, rate law, rate constants, order of reaction, reversible reactions & equilibrium, parallel & consecutive reactions, chain reactions, rate determining parameters. Chemical potential & chemical reactions. Effect of temperature on reaction rates, free energy of reaction, collision theory.	08
3	Catalysis: Criteria for catalysis, Homogenous catalysis: Acid Base, Enzymatic & Catalysis, Heterogeneous catalysis, Concept of promoters, inhibitors & poisoning.	05



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4	Electrochemistry: Equilibrium electrochemistry – electrochemical cells, half-cell reactions, type of electrochemical cells, free energy & EMF, Nernst equation, EMF measurements. Relevance of electrochemical reactions.	07
5	Phase rule: Definition & various terms, Gibb’s phase rule, Application of Phase rule to one component system : Water & Sulphur & two component system : Lead & Silver	05
6	Thermodynamics Internal Energy ,Isothermal reversible expansion work of an ideal gas, Isothermal irreversible expansion work of an ideal gas, First Law of Thermodynamics, Enthalpy of a System, Molar Heat Capacities at constant pressure & volume, Relation between Cp and Cv Entropy, Statement of second law of thermodynamics, Free energy function(G) and work function(A),Gibb’s Helmholtz equations	07

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	18	13	10	9	10

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.

Reference Books:

1. Physical Chemistry , 4th Edition, Silbey, Alberty and Bawendi, Wiley, 2006.
2. Physical Chemistry of surfaces,6th Edition , Arthur W.Adamson, Alice P. Gast, Wiley, 1997.
3. Essential of Physical Chemistry, G D Tuli, B S Bahl, ArunBahl, S.Chand Publisher, 2000.
4. Physical Electrochemistry: Fundamentals, Techniques and Applications, EliezerGileadi, Wiley-VCH, 2011.
5. Physical Chemistry : A molecular approach , D.A.Mcquarrie& J.D.Simon,1998



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6. Surfaces, Interfaces & Colloids: Principles & applications, Drew Myers, Wiley VCH, 2nd Ed., 1999
7. The Elements of Physical Chemistry, Peter Atkins, Oxford, 3rd Ed., 2000
8. Introduction to Colloid & Surface Chemistry, Duncan J Shaw, Butterworth-Heinemann, 5th Ed., 1992
9. Physical Chemistry of Surfaces, Arthur W. Adamson, Alice P. Gast, John Wiley & Sons, Indian Ed., 1997
10. Chemical Kinetics & Catalysis, Masel R.J., John Wiley & Sons, 1st Ed, 2001
11. Chemical Kinetics & Reaction Dynamics, Houston P.H., McGraw Hill Book Company, 2nd Ed, 2001
13. Elements of Physical Chemistry, Atkins P., Oxford Press, 3rd Ed., 2000
14. Catalytic Chemistry, Gates B.C., John Wiley & Sons, 2nd Ed., 1992
15. Principles & Practice of Heterogeneous Catalysis, Thomas J.M. & Thomas W.J., John Wiley & Sons, 1996

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To express fundamentals of physical chemistry.	15
CO-2	To understand the properties of matter, as well as for the development of new technologies for the environment, energy and medicine.	15
CO-3	To carry out various chemical process with the help of physical parameters.	20
CO-4	To be able to apply this knowledge to other areas of the degree course to design project.	15
CO-5	To build a bridge between theoretical and practical concept used in industry for process development.	15
CO-6	To be able to find out rate and order of various chemical reaction.	20



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List of Experiments:

1	To study the relative strength in the hydrolysis of methyl acetate in presence of an acid.
2	To determine the solubility of Benzoic Acid at room temp. & two higher temp. (40°C to 50°C) and calculate its heat of solution.
3	To study the first order reaction in the hydrolysis of methyl acetate in presence of an acid at two different initial concentrations.
4	To standardize the solution of NaOH & HCl using 0.1 N oxalic acid.
5	To determine the strength of the given Hydrochloric acid using Sodium hydroxide pHmetrically.
6	To Determine the turbidity of given sample in NTU unit by turbidity meter.
7	To determine the Phase Diagram for acetic acid, chloroform and water system. (three component system)
8	To determine λ_{\max} and concentration of unknown solution of KMnO_4 in 2 N H_2SO_4 using Colorimeter.

Major Equipment:

1. Turbidity meter
2. pH meter
3. Colorimeter
4. Hot Air Oven

List of Open Source Software/learning website:

1. NPTEL
2. MIT Open course lecture available on Internet etc
3. Delnet