

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL TECHNOLOGY (36)

PHYSICAL CHEMISTRY

SUBJECT CODE: 2133607

B.E. 3RD SEMESTER

Type of Course: Chemical Technology

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)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Gaseous state: Molecular diffusion & effusion, critical constants & liquefaction of gasses, equation of state, supercritical fluids & their applications.	4	10
2.	Kinetics & molecular reaction dynamics: Significance of reaction kinetics, rate law, rate constants, order of reaction, reversible reactions & equilibrium, parallel & consecutive reactions, chain reactions, photochemical reactions, rate determining parameters. Chemical potential & chemical reactions. Effect of temperature on reaction rates, free energy of reaction, collision theory.	6	15
3	Catalysis: Criteria for catalysis, Homogenous catalysis : Acid Base, Enzymatic & Catalysis by metal salts, Heterogeneous catalysis, Concept of promoters, inhibitors & poisoning, Physorption & Chemisorption	4	10
4.	Electrochemistry: Equilibrium electrochemistry – electrochemical cells, half-cell reactions, type of electrochemical cells, redox & concentration cells, free energy & EMF, Nernst equation, EMF measurements. Relevance of electrochemical reactions.	12	20
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	6	15

6.	Three laws of thermodynamics Helmoholtz – Gibbs equation. Thermodynamic systems of variable composition.	6	15
7.	Interfacial chemistry: Surface free energy, capillary & surface tension, liquid – liquid interfaces, bubbles, droplets, Young Laplace & Kelvin equation, super saturation, solid – liquid interfaces, electrical phenomena at the interface, surface active agents, emulsions.	6	15

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, Arun Bahl, S.Chand Publisher, 2000.
4. Physical Electrochemistry: Fundamentals, Techniques and Applications, Eliezer Gileadi, Wiley-VCH, 2011.
5. Physical Chemistry : A molecular approach , D.A. Mcquarrie & J.D. Simon, 1998
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
12. Elements of Physical Chemistry, Atkins P., Oxford Press, 3rd Ed., 2000
13. Catalytic Chemistry, Gates B.C., John Wiley & Sons, 2nd Ed., 1992
14. Principles & Practice of Heterogeneous Catalysis, Thomas J.M. & Thomas W.J., John Wiley & Sons, 1996

Course Outcomes:

At the end of this course students will be able to:

1. To express fundamentals of physical chemistry
2. To understand the properties of matter, as well as for the development of new technologies for the environment, energy and medicine.
3. To carry out various chemical process with the help of physical parameters.
4. To be able to apply this knowledge to other areas of the degree course to design project.
5. To build a bridge between theoretical and practical concept used in industry for process development.

List of Practicals:

Minimum 5 practicals to be performed and remaining time should be allotted to open-ended projects/study reports/latest outcomes in technology study:-

1. In the beginning of the academic term, faculties will have to allot their students at least one Open-ended Project / Study Report / Latest outcome in technology.
2. Literature survey including patents and research papers of fundamental process

- Design based small project **or**
 - Study report based on latest scientific development **or**
 - Technology study report/modeling/ simulation/collection report **or**
 - Computer based simulation/web based application/analysis presentations of basic concept field which may help them in chemical engineering.
3. These can be done in a group containing maximum **three** students in each.
 4. Faculty should cultivate problem based project to enhance the basic mental and technical level of students.
 5. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to study the design module of given task

In the semester student should perform **minimum 5** set of experiments and complete **one small open ended dedicated project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER**

1.	Safety and Overview of an Synthetic Organic Laboratory
2.	Organic Qualitative analysis of Solids
3	Organic Qualitative analysis of Liquids
4.	Crystallization and checking the purity by TLC
5.	Distillation and checking the purity by Boiling point
6.	Organic qualitative analysis of Ternary mixtures
7.	Organic estimation
8.	Two step organic synthesis
9.	Three step organic synthesis
10.	Techniques like TLC, UV etc.

Open Ended Problem:

Students are free to select any area of science and technology based on chemical technology applications to define Projects.

Some suggested projects are listed below:

- Study of named reactions & their application in industry
- Study of individual reactions & their application in industry
- Literature survey of new technics

List of Open Source Software/learning website:

- 1) Delnet

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.