GUJARAT TECHNOLOGICAL UNIVERSITY

PHYSICO-CHEMICAL PROCESSES

SUBJECT CODE: 2133506
B.E.Semester: III (Environmental Science and Technology)

Type of course: Environmental Science and 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 andExamination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	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.	Topic	Teaching Hours	Module Weightage (%)
1.	**Colloidal chemistry** Types of colloids, applications of interfacial phenomena, example of interfacial phenomena, colloid dispersions, classification of colloids, electric charge on colloid particles, stability of colloids, effect of polymers on colloid stability of colloids, effect of polymers on colloid stability, colloid preparation and purification technique.	10	20
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, collisiontheory.	08	15
3.	**Catalysis:** Criteria for catalysis, Homogenous catalysis : Acid Base, Enzymatic & Catalysis bymetal salts, Heterogenous catalysis, Concept of promoters, inhibitors & poisoning.	06	10
4.	**Electrochemistry:** Equilibrium electrochemistry – electrochemical cells, half-cell reactions, type of electrochemical cells, redox	12	15

	&concentration cells, free energy & EMF, Nernst equation, EMF measurements. Relevance of electrochemical reactions.		
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	06	20
6.	**Ionic Equilibria:** Arhenius theory of electrolytic dissociation, ionic product of water, pH scale, measurement of pH, common ion effect, buffer capacity, buffer in biological systems, Henderson's equations, hydrolysis of salts, hydrolysis constant, relation between Kh, Ka, Kb, Kw, degree of hydrolysis, acid base indicators, theory of indicators, concept of solubility product, solution preparation .	08	20

ReferenceBooks:

- Physical Chemistry , 4th Edition, Silbey, Alberty and Bawendi, Wiley, 2006.
- Physical Chemistry of surfaces,6th Edition , Arthur W. Adamson, Alice P. Gast, Wiley, 1997.
- Essential of Physical Chemistry, G D Tuli, B S Bahl, Arun Bahl, S.Chand Publisher, 2000.
- Physical Electrochemistry: Fundamentals, Techniques and Applications, Eliezer Gileadi, Wiley-VCH, 2011.
- Physical Chemistry : A molecular approach , D.A.Mcquarrie& J.D.Simon,1998
- Surfaces, Interfaces& Colloids: Principles & applications, Drew Myers, Wiley VCH, 2nd Ed., 1999
- The Elements of Physical Chemistry , Peter Atkins, Oxford ,3rd Ed. ,2000
- Introduction to Colloid & Surface Chemistry, Duncan J Shaw,Butterworth-Heinemann, 5th Ed.,1992
- Physical Chemistry of Surfaces, Arthur W. Adamson, Alice P. Gast, John Wiley & Sons, Indian Ed.,1997
- Chemical Kinetics & Catalysis, Masel R.J., John Wiley & Sons, 1st Ed, 2001
- Chemical Kinetics & Reaction Dynamics, Houston P.H., McGraw Hill Book Company, 2nd
- Ed, 2001
- Elements of Physical Chemistry, Atkins P., Oxford Press, 3rd Ed., 2000
- Catalytic Chemistry, Gates B.C., John Wiley & Sons,2nd Ed., 1992
- Principles & Practice of Heterogeneous Catalysis, Thomas J.M. & Thomas W.J., John Wiley & Sons, 1996

Course Outcome: After learning the course the students should be able:

1. To express fundaments 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 Experiments and Open Ended Projects:

PRACTICALS (ANYFIVE):

1.	Chemical Kinetics
2.	Adsorption on Charcoal
3	Heat of Solution
4.	Partition Coefficient
5.	Surface Tension of different detergents
6.	pH metric titration of single acid
7.	pH metric titration of mixed acid
8.	Viscosity by using Viscometer
9.	Colorimetric Analysis
10.	Turbidity meter

Major Equipment:

1. pH Meter
2. Viscometer
3. Stalagmometer
4. Colorimeter
5. Turbidity meter

OpenEndedProject fields:-
Studentsarefreetoselectanyareaofscienceandtechnologybasedonchemical technology applicationstodefine Projects.

Some suggested projectsarelisted below:

- Laboratory set up of ionization unit.
- Carry out analysis (cost & composition) of soap, detergent, different oils, etc…
- Product profile and its manufacturingprocess like cement, glass, ceramic etc.

List of Open Source Software/learning website:

1) Literatureavailable inanylaboratorymanual of Chemical Process Industries.
2) Handbook on Soaps- Detergents & Acid Slurry 2nd Edition by Niir Board
3) NPTEL
4) MIT Open course lecture available on Internet etc…

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 is 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 be sent to achievements@gtu.edu.in.