GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)

PHYSICAL AND INORGANIC CHEMISTRY

SUBJECT CODE: 2140501

B.E. 4th SEMESTER

Type of Course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: It is the basic subject for Chemical Engineering Students

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)	
					PA	ALA	ESE	OEP		
3	0	4	7	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**The Phase Rule:** Introduction, Phase, Components, Degree of freedom, Derivation of Gibb's Phase, One component system like water, sulphur systems, two component system, Eutectic systems like silver-lead, zinc-cadmium system	6	**20**
2	**Thermo chemistry:** Introduction, Enthalpy of reaction, Endothermic reaction, Exothermic reaction, ΔH and ΔE and numerical. Thermo-chemical equations like heat of reaction, heat of combustion, heat of neutralisation, heat of transition, Hess's Law of constant heat summation and its application, experimental measurement of heat of reaction	7	
3	**Electro Chemistry:** Introduction, half reaction, electrode potential, Nernst's equation, Electro chemical cell, type of electrodes, Reference electrodes, Faraday's Law of Electolysis, buffer solution, buffer capacity, Handerson-Hesselblatch equation for acidic and basic buffer with numerical.	6	**40**
4	**Chemical Kinetics:** Introduction, Reaction rate, Units of rate, Rate laws, Order of a reaction, Zero order reaction, Molecularity of a reaction, Pseudo-order reaction, first order reaction with numerical, second order reaction, third order reaction, units of rate constant .	7	
5	**Metallurgy:** Introduction, general metallurgical operations, metallurgy of Iron,Copper,Aluminium,properties of steel,important mechanical properties of metals	5	
6	**Chemical Bonding :** Introduction, type of chemical bonds-ionic and covalent(polar and non polar),Hydrogen bonding	5	
7	**Nuclear chemistry:** Introduction,radioactivity,type of radiations,dectection and measurement of radioactivity by Cloudchamber,Geiger-Muller counter, scintillation counter, ionisation chamber, film badges, type of radioactive decay, nuclear reaction, Fission &Fusion reactions ,nuclear reactor, breeder reactor and nuclear	6	**40**

	waste disposal.		
8	**Explosives and Propellants:** Introduction, classification, preparation and uses of explosives, blasting fuses , Rocket propellants , characteristics of good propellant , classification and applications of propellant.	6	
9	**Introduction to Instrumental methods:** Introduction, electro analytical methods , conductometry ,applications of conductometry , Potentiometric analysis, Electomagnetic radiation, Molecular spectroscopy, Beer-Lambert's Law, Basic spectroscopy instrumentation, block diagram of Absorption spectrophotometer and Emession spectrophotometer, Infra red spectroscopy, Nuclear Magnetic Ressonance Spectroscopy, Ultra Violet- Visible spectroscopy, Mass spectroscopy, Flame photometry, Chromatography-Liquid chromatography (LC, HPLC), Differential Thermal Analysis (DTA) and their applications	8	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
18	23	22	07	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Essential of Physical Chemistry by Bahl and Tuli., S Chand & Co. Ltd, New Delhi.
2. Inorganic Chemistry by P.L. Soni and Katyal., Sultan Chand & Sons, New Delhi
3. Engineering Chemistry Willey India Publisher
4. Engineering Chemistry by Marry Jane & Shult, Cencage Learning Publisher
5. A Text Book of Engineering Chemistry by Shashi Chawala, Dhanpat Rai and Co.
6. Engineering Chemistry 2e by Prasanth Rath, Cengage Learning

Course Outcomes:

After learning the course the students should be able

1. To build a basic knowledge of the structure of Physical and inorganic chemistry.
2. To analyze scientific concepts and think critically.
3. To review the importance and relevance of chemistry in our everyday life.
4. To be able to utilize the methods of chemical science as a logical means of problem solving

Minimum 4 practical's to be performed and remaining 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 Projects / Study Reports / Latest outcomes in technology.
2. Literature survey including patents and research papers of basic chemistry
   - 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 applied science field which may help them in their branches especially in their UDP/IDP projects.

3. These can be done in a group containing maximum Six students in each.
4. Faculties 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.
6. In the semester student should perform **minimum 4 set of experiments** and complete **one small open ended project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER.**

Open Ended Project fields:-

Students are free to select any area of science and technology based on their branches to define projects.

Some suggested projects are listed below:

1. A project on specific eutectic system.
2. A project on kinetics study of some specific process. .
3. Product profile and manufacturing process of Alum, chrome alum explosives, etc.

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Resources which may be helpful for students for Open Ended project work

1) Any literature available in laboratory manual of Physical and Inorganic Chemistry.
2) Vogel's book of inorganic chemistry.
3) World Wide Web.

PRACTICALS(ANY FOUR):

1. To determine the strength of the given Hydrochloric acid by Sodium hydroxide conduct metrically.
2. To Determine the turbidity of given sample in NTU unit by turbidity meter.
3. To study the effect of concentration of reactant on the rate of reaction between sodium Thiosulphate and hydrochloric acid.
4. To study the effect of temperature on the rate of reaction between sodium Thiosulphate and hydrochloric acid.
5. To separate the components of chlorophyll by ascending paper chromatography.
6. To synthesise alum.
7. To synthesise Chrome Alum.

References Books:

1. Laboratory Manual of Engineering Chemistry.By S K. Bhasin & Sudha Rani. Publisher: Dhanpat Rai Publishing Company Ltd.
2. Engineering Chemistry with Laboratory Experiments By M S. Kaurav. Publisher: PHI Learning Pvt. Ltd. New Delhi
3. Vogel's textbook of Quantitative Chemical Analysis.By Arthur I Vogel, Revised by Jefferey et al.Publisher: Addison Wessley Longmann Ltd, England
4. Engineering Chemistry with Laboratory Experiments.By R. P. Mani & Mishra, Cencage Publisher.

Major Equipments:

1. Conductivity meter.

2. NepeheloTurbidity meter.
3. Melting Point Instrument.

List of Open Source Software/learning website:

1. NPTL, World Wide Web, 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 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.