GUJARAT TECHNOLOGICAL UNIVERSITY,AHMEDABAD

PHYSICAL, ANALYTICAL AND INORGANIC CHEMISTRY

1 RATIONALE :

Rapid development in the study of external universe lead to the separation of Chemistry as a special branch of natural science. Chemical changes are always associated with a number of diversified physical changes. Physical chemistry uses the theoretical principles and experimental techniques to investigate the Chemical transformations and Physical changes accompanying them. Many industrial process that have been developed are the results of Physio-Chemical investigations which are increasingly employed by organic, in-organic and analytical chemists. Inorganic chemistry explains chemistry of metals and non-metals while analytical chemistry deals with the qualitative and quantitative analysis. Hence study of physical, analytical and inorganic chemistry in engineering branch has become essential. This being a core course provides suitable background for Chemical Engg. Technicians for understanding their respective courses and will make them suitable for their job in industries.

2. SCHEME OF TEACHING :

SR. NO.	NAME OF TOPICS	NO. OF HOURS		
		LECT.	PRACT	TOTAL
1.	CHEMICAL THERMODYNAMICS	12	2	14
2.	PROPERTIES OF LIQUID	3	4	07
3.	CHEMICAL KINETICS AND CATALYSIS	6	4	10
4.	COLLOIDS AND EMULSIONS	6	2	08
5	ELECTROMETRIC METHODS OF ANALYSIS	9	8	17
6.	QUALITATIVE AND QUANTITATIVE ANALYSIS	3	4	07
7.	PREPARATION OF STANDARD SOLUTION	3	4	07
	TOTAL	42	28	70

3. COMMUNICATION SKILLS

* Ask pertinent questions as well as to answer them.
* Describe an object, process or procedure.
* Write reports on experiments conducted in laboratories.

4. TOPICS/SUB-TOPICS

TOPIC- 1 : CHEMICAL THERMODYNAMICS 12 hrs.

1.1 System and surroundings

1.1.1 Types of system and suitable illustrations
1.1.2 Thermodynamic property- extensive and intensive

1.2 First law of thermodynamics in five different ways

1.2.1 Define state function and identify all parameters in it
1.2.2 Define internal energy
1.2.3 State the meaning of the term Enthalpy
1.2.4 State the rule of assigning sign to work done(W) and heat transferred (Q) as positive and negative
1.2.5 Define moler heat capacity- at constant volume (Cv) and at constant pressure (Cp)
1.2.6 Derive the relationship Cp - Cv = R
1.2.7 Define :
* Adiabatic change
* Isothermal change
* Reversible process
* Ir-reversible process
1.2.8 Derive equation for isothermal reversible expansion for maximum work done
1.2.9 Derive equation for Adiabatic change
1.2.10 Solve problems on the above two changes

1.3 Second law of thermodynamics

1.3.1 Second law of thermodynamics in seven different ways
1.3.2 Carnot cycle
1.3.3 Problems on carnot cycle

1.4 Aspects of thermo-chemistry

1.4.1 Phenomenon of heat of reaction

1.4.2 Types of heat of reactions - Define.

1.4.3 Exothermic and endothermic processes with examples

1.4.4 State Hess's law of constant heat summation

1.4.5 Problems applying Hess's law

TOPIC -2 PROPERTIES OF LIQUID **3 hrs.**

2.1 Physical properties of liquid

2.2 Types of physical properties and characteristics of each property.

2.3 Define the terms and explain : Surface tension, Parachor, Refractive index, Molar refraction, Specific refraction, Viscosity, Molecular viscosity

2.4 Surface tension and viscosity

2.5 Drop pipette method (Stalagmometer) to determine the surface tension.

2.5.1 List other methods also

2.6 Methods to determine viscosity
2.7 Use of Ostwald's viscometer to determine viscosity

TOPIC -3 CHEMICAL KINETICS & CATALYSIS **6 hrs**.

3.1 Chemical kinetics
3.1.1 Meaning of the term
Define the terms :
* Rate of reaction
* Specific reaction rate
* Velocity constant

3.1.2 Distinguish between molecularity and order of reaction

3.2 Define the terms :

* First order reaction
* Half concentration period

3.2.1 Derive equation for first order reaction

* Solve problems on it

3.3 Define the term :

* Second order reaction

3.3.1 Derive equation for second order reaction

3.3.2 Half life period for second order reaction

* Solve problems on it

3.4 Define : Catalyst and Catalysis

3.4.1 Characteristics of catalyst
3.4.2 Types of catalysis
3.4.3 Classification of catalysts

* Positive * Negative * Auto * Induced catalyst
* Acid based catalyst * Enzyme catalyst

3.4.4 Theories of catalysis

3.4.5 Use of catalysts in different industrial products

TOPIC -4 COLLOIDS AND EMULSIONS **6 hrs**.

4.1 Colloids and its various aspects

4.1.1 Characteristics of true solution, suspension and colloidal solution

4.1.2 Classification of colloides
* Based on the state of aggregation of the dispersed phase and dispersion medium
* Based on the affinitive of the two phases

4.1.3 Distinguish between Lyophobic and Lyophilic solutions

4.2 Methods of preparing colloidal solutions

4.2.1 State the methods

* Condensation methods
* Dispersion methods

4.2.2 Describe each method

4.3 Purification of colloidal solutions
* Dialysis
* Ultrafiltration

4.4 Important properties of colloidal solution and explain the following in details :

* Scattering of light (Tyndall effect)
* Colour
* Broanian movement
* Charge
* Electrophoresis
* Electro osmosis
* Co-agitation
* Protection

4.5 Phenomenon of Emulsion

4.5.1 Meaning of the term
4.5.2 Types
4.5.3 Cleansing action of soap
4.5.4 Advantages of synthetic detergents over alkali soap

4.6 Properties and utility of Gel

4.7 Process of adsorption

4.7.1 Define :
* Adsorption * Adsorbate * Adsorbent

4.7.2 Types of adsorption
* Physical and chemical

4.7.3 Distinguish between them

4.8 Applications of colloids

TOPIC -5 ELECTROMETRIC METHODS OF ANALYSIS 9 hrs.

5.1 Define the term ` Electrode '

5.2 Types of Electrodes

5.3 Distinguish between :

* Inert electrode * Working electrode
* Reference electrode; with suitable illustrations

5.4 Various electrometric methods

5.4.1 pH metry :
* Define pH and poH, give their relationship

5.4.2 Standard Oxidation potential

5.4.3 Functions of :

* Hydrogen electrode * Calomel electrode
* Quinhydrone electrode * Glass electrode
* Ag/ Agcl/ Kcl electrode

5.4.4 Problem to ascertain pH and poH of solutions

5.4.5 Methods of determining pH of given solution

* By pH meter * By indicator
* By potentiometer using Buffer solution

5.4.6 Various aspects of conductometry

5.4.7 Define terms :

* Specific conductance * Cell constant
* Equivalent conductance * Molecular conductance
* Conductance water

5.4.8 Kohlrausch Law of independent migration of ions.

5.5 Name possible conductometric titrations

* Acid based titration
* Precipitation titration
* Replacement titration

5.6 Chrometography

5.6.1 Define and explain Chrometography

5.6.2 Types and classification

5.6.3 Explain :

* Thin layer chromatography
* Ion- exchange chromatography
* Paper chromatography

TOPIC -6 QUALITATIVE AND QUANTITATIVE INORGANIC ANALYSIS 3 hrs.

6.1 Explain :

* Common ion effect * Ionic product
* Solubility * Solubility product

Give suitable illustrations

6.2 State conditions for precipition considering Ip and Ksp

6.3 Use of H2S and NH4Cl in qualitative inorganic analysis

TOPIC -7 PREPARATION OF STANDARD SOLUTION 3 hrs.

7.1 Phenomenon of Concentration

7.1.1 Define the terms: Solute, Solvent and Solution

7.1.2 Name different methods of expressing concentration

i) Weight/Weight method (W/W)

ii) Weight/Volume method (W/V)

7.1.3 Explain W/W and W/V methods

7.1.4 Name types of W/W methods

* Molality (M)
* Mole fraction (X)
* Parts per million (PPM)

7.1.5 Explain each of W/W methods

7.1.6 Name different types of W/V method

i) gms/litre

ii) Normality (N)

iii) Molarity (M)

iv) Formality (F)

v) P.P.M. (for aqueous solutions) as mg/litre

7.1.7 Explain each W/V method

7.1.8 Define: Atom, Mole, Molecule, Molecular weight and Equivalent weight

7.1.9 Define the term V/V

7.1.10 Solve problems on them

7.2 Standard solution

7.2.1 Differentiate concept of standard and standard solution

7.2.2 Name types of chemicals

i) Industrial chemicals

ii) Fine chemicals

7.2.3 State characteristics of these two types of chemicals

7.2.4 Classify industrial chemicals as

a) Crude chemicals

b) Pure chemicals

7.2.5 State reasons for above classification

7.2.6 Name types of fine chemicals

i) Laboratory Reagent (LR)

ii) Analytical Reagent (AR)

7.2.7 Explain L.R. & A.R.

7.2.8 State that L.R. is also G.P.R. (General Purpose Reagent)

7.2.9 State reasons for equivalence of L.R. & G.P.R.

7.2.10 Name types of different standards

* Primary standards
* Secondary standards

7.2.11 State conditions for primary standard

7.2.12 Describe the procedure for preparing primary standard solution

7.2.13 Name primary standard for standardization of acids

i) Anhydrous Na2 Co3

ii) Anhydrous K2 Co3

iii) Saturated solution of Ca (OH)2

7.2.14 Describe the procedure for preparing secondary standard solution

7.2.15 Name primary standard for standardization of Base

* Oxalic Acid
* Succinic Acid
* Benzoic Acid
* Boric Acid
* Constant-Boiling mixture of Hcl
* Potassium hydrogen phthalate

7.2.16 List primary standard for:

(a) standardization of KMnO4

i) K2C2O4
ii) Na2C2O4
iii) H2C2O4.2H2O
iv) FeSO4,(NH4)2 SO4, 6H2O.

(b)for standardization of FeSo4, 7H2O

i) Resublimized iodine
ii) KBrO3
iii) KIO3

7.2.17 List primary standard for standardization of AgNO3

i) Nacl
ii) Kcl

7.2.18 State that for standardization of E.D.T.A. primary standard is Cacl2 (Caco3 + Kcl)

7.2.19 State that approximate concentration of aqueous solutions viz.Kcl, H2So4, HNo3, H3Po4, CH3CooH, NH4oH

7.2.20 Solve problems on preparation of solution and standard solution

5. LABORATORY EXPERIENCES : **28 hrs.**

1. Determination of viscosity by Ostwald's viscometer

2. Determination of surface tension Stalegmometer

3. Determine the first order reaction

4. Determine the second order reaction

5. Study the adsorption of the given organic acid on charcoal

6. Find out pH value by :
   * Universal indicator method/ pH paper
   * pH meter

7. Determine the amount of Hcl in the given solution using NaoH solution by pH metrically

8. Titrate Hcl -> NaoH by conductometer and explain the nature of graph

9. Titrate Nacl -> AgNo3 conductrometrically and explain the nature of graph

10. Study the primary and secondary standards :
    i) Preparation of standard solution
    ii) Acid-Base titration
    iii) Redox titration

11. Experiments based on qualitative analysis can be given (use of H2S & NH4cl)

12. Determine heat of neutralisation using Hcl & NaoH

Note :- Minimum 10 experiences should be performed by the students from the above given list

6. REFERENCES

1. Elements of Physical chemistry Glasston & Lewis

2. Essentials of Physical chemistry Bahl & Tuli

3. Instrumental methods of chemical analysis Galen-w-Ewing

4. Instrumental methods of analysis — Willard Merrit Dean

5. Vogel's textbook of practical organic chemistry — E.L.B.S.

6. Vogel's textbook of quantitative analysis (including instrumental methods) — E.L.B.S.

7. Quantitative analysis — R.A.Day and A.L.Underwood

7. ASSESSMENT SCHEME:

SR. NO	NAME OF TOPICS	% WEIGHTAGE
1	CHEMICAL THERMODYNAMICS	25
2	PROPERTIES OF LIQUID	09
3	CHEMICAL KINETICS AND CATALYSIS	16
4	COLLOIDS AND EMULSIONS	14
5	ELECTROMETRIC METHODS OF ANALYSIS	18
6	QUALITATIVE AND QUANTITATIVE ANALYSIS	06
7	PREPARATION OF STANDARD SOLUTION	12
	TOTAL	100