GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Chemical Engineering
Subject Code: BE04005051
Subject Name: Applied Chemistry

w.e.f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Basic Science Course

Prerequisite:	Applied Chemistry
Rationale:	Applied Chemistry is considered as Basic Science subject

Course Outcome:

After Completion of the Course, Students will be able to:

No	Course Outcomes
01	Explain theoretical principles underlying molecular structure, bonding, and mechanism in organic reaction
02	Describe stereochemical properties of compounds
03	Predict behavior of heterogenous system in various conditions
04	Apply principles of chemistry to explain the thermodynamics, reaction orders and catalysis
05	Apply different analytical techniques to explain the chemical & surface characteristic of molecules.

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

- ***Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION OF MATTER:** Additive & Constitutive properties: Parachor, Viscosity, Dipole Moment, Molar Refraction, Optical activity, Magnetic properties. Preparation and theory of Solution: Mole Fraction, Normality, Molality, Molarity, Lowering of vapor pressure, Elevation of Boiling point, Depression of Freezing point, Osmosis & Osmotic pressure.	4	9
2	**General Principle of Organic Reactions:** Electronegativity, Electron Displacement Effect, Fission of Covalent Bond, Reactive Intermediate, Organic Species based on Carbon and Nitrogen, Types of Organic reaction and Mechanism.	10	22
3	**Stereochemistry:** Optical, Geometrical and Conformational Isomerism: Optical activity, Polarimeter, Specific rotation, Enantiomers, Diasteromers, Optical activity in Lactic and Tartaric acid, R and S configuration of Optically active compound and E and Z designation of Geometrical isomers. Resolution of racemic mixture.	4	9
4	**The Phase Rule:** Introduction, Phase, Components, Degree of freedom, Derivation of Gibb's Phase rule, Three & Four Phase-One component system like water, sulphur systems, Two component -Eutectic systems like Silver-Lead, Zinc-Cadmium, Ferric Chloride-Water system.	7	16
5	**Chemical Kinetics and Catalysis:** Introduction, Reaction rate, Units of rate, Rate laws, Order of a reaction, Zero order reaction, Molecularity of a reaction, Pseudo-order, first order reaction with numericals, second order reaction, units of rate constant, Adsorption and catalysis, introduction of homogeneous and heterogeneous catalysis.	5	11
6	**Thermochemistry:** Introduction, Internal Energy, 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.	5	11

7	**Analytical Techniques:** Basic principle, working and applications of Mass spectroscopy and TGA, Introduction to experimental techniques like SEM, TEM, XRD, for material characterization highlighting links between molecular structure and macroscopic properties.	10	22

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	20	20	5	5	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze; E: Evaluate and C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Experimental Physical Chemistry, by Athawale. V D, Publisher: New Age International Publishing Ltd.
2. Vogel's Textbook of Practical Organic Chemistry by Hannaford, Smith &Tatchell, Publisher: Elbs with Longman
3. Vogel's textbook of Quantitative/ Qualitative Chemical Analysis, by Arthur I Vogel, Revised by Jeffery et al, Publisher: Addison Wesley,Longman Ltd, England
4. Engineering Vogel's Textbook of Quantitative Chemical Analysis by Jeffery. G H Publisher: Addison Wesley Longman/Pearson Education Asia.

List of Experiments:

1. To determine the strength of given HCl by pH--metry, a standard solution of NaOH of 0.1 N is provided.
2. To determine the strength of a solution of hydrochloric acid by a standard solution of sodium hydroxide by using conductometer.
3. To verify Lambert – beer's law for KMnO4 colorimetrically.
4. To calculate the heat of solution of a salt.
5. To determine the viscosity and density of liquids.

6. To determine the turbidity of the given water sample.
7. To isolate and purify the given sample by fractional crystallization.
8. To estimate the amount of Fe(II) present in the whole of the given solution potentiometrically.
9. To determine the amount of sulphate ions in the given sample of water gravimetrically.
10. To determine the specific rotation of a cane sugar solution by polarimeter.
11. To determine the rate constant of the hydrolysis of Ethyl acetate using an acid as a catalyst.

Note: Students must perform at least 10 experiments from the above list

Major Equipments:

1. Spectrophotometer, Conductometer, Potentiometer, pH meter, Polarimeter.
2. Laboratory Oven, Stirrer Hot Plate, Heating mantle.
3. Turbidity Meter, Viscometer, Temperature Control Bath.
4. Electronic Balance
5. Calorimeter

List of Open Source Software/learning website:

NPTEL, World Wide Web, etc.

List of suggested activities for Problem Based Learning:

Sr. No.	Description	No. Of hours	Total Hrs.
1	Students will have to undergo industrial visit related to any one of the content mentioned in syllabus and submit the report for the same.	Visit = 5 hrs Report Preparation = 5 hrs	**10**
2	Students will have to undergo technical video based learning related to subject and have to present it or prepare a report of that learning.	Duration of video = 5 hrs Report Preparation = 5hrs	**10**

3	Students will have to submit assignment work assigned to them. Numerical base assignment is preferable.	5 assignments of 2 hrs each.	**10**
4	Self learning on-line course.	Min. Duration of the course should be 10 hrs	**10**
5	Discussion on research paper based on relevant subject. Summarize research paper and evaluation critical parameters	5research papers can be included. Each one has 5 hrs	**25**
6	Students will have to prepare poster, chart or PowerPoint presentation on technical topic related to subject content.	Duration of each activity = 6 hrs Max. two topic can be considered.	**12**
7	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	**12/8**
8	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	**20**
9	Student will have to do Group Discussion on emerging, Trending technical topics based on subject.	Preparation and discussion on one topic	**5**
10	Real world case studies based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	**5**
		Max. Hours to be allotted	**15**

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