



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: All branches

Course / Subject Code : BE01000031

Course / Subject Name : Chemistry

w. e. f. Academic Year:	2024-25
Semester:	I st Year
Category of the Course:	BSC

Prerequisite:	Basic knowledge of general chemistry.
Rationale:	Every material is made up of atoms. Material is deeply integrated with engineering, therefore, basic chemistry is essential to understand the nature and properties of material. The selection, characterization, and suitability assessment of natural raw materials essentially requires principles and concepts of basic chemistry. Successful completion of this course content will enable engineers to understand, ascertain and analyze the various new materials and enable to solve engineering problems.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Define chemical properties of atom, molecule, metal, alloys and energy sources.	R
02	Relate atomic and molecular structure with their reactivity	U
03	Solve the engineering problems related to fuel, water and corrosion	A
04	Compare recent Nano-material, ecofriendly materials and energy storage devices	E
05	Analyze properties of materials by various tools.	N

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Basic chemistry: Wave mechanical concept of structure of atom; de Broglie's concept, Heisenberg's uncertainty principle, Schrodinger's wave equation. Shape and structure of diatomic molecules; types of hybridization (sp, sp ² , sp ³ , sp ³ d and sp ³ d ²). Hard soft acids and bases concept and its applications.	8	18
2.	Water technology: Hardness of water, softening of water, boiler problems; caustic embrittlement, sludge, scale, priming and foaming. Corrosion: Introduction to corrosion, theories of corrosion, types of corrosion, protective measurements against corrosion; organic and inorganic materials, inhibitors, cathodic protection.	10	22
3.	Material chemistry: Properties and applications of fullerenes, fullerols, carbon nanotubes, nanowires and metal nanoparticles. Top down and bottom up approaches for synthesis of nanomaterials. Biodegradable polymers. Bio-based feedstock. Metals and Alloys: properties and applications. Heat treatments of steel. Types of alloys, Alloys of copper, aluminum and nickel.	10	22
4.	Fuel and batteries: Refining of petroleum, determination of calorific value by bombs calorimeter, Knocking and octane number. Ultimate and proximate analysis of coal. Biofuels; Biodiesel and biomass briquettes. Introduction to rechargeable cells, lithium batteries; construction and working. Photolysis of water. Fermentation: Synthesis of ethanol, acetic acid and pharma products by fermentation.	10	22
5.	Instrumental analysis: Principle and working of UV-Visible, Infra-Red, and NMR spectroscopy and their applications. Introduction to chromatographic techniques; thin layer chromatography, gas chromatography, liquid chromatography.	7	16
	Total	45	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
16	16	36	11	21	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Engineering Chemistry, Willey-India.
2. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publishing Co.
3. Engineering Chemistry by Marry Jane Shultz, Cengage Learning.
4. Engineering Chemistry by N. Krishnamurthy, P. Vallinayagam and D. Madhavan, PHI Learning.
5. Engineering Chemistry by K. Sessa Maheswaramma and Mridula Chugh, Pearson India Education Pvt Ltd.
6. Engineering Chemistry by B K. Sharma, Krishna, Prakashan Media (P) Ltd.
7. A textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Co. Ltd.
8. Fundamentals of Biotechnology by B D Singh, Kalyani Publisher. New Delhi.
9. Essential of Physical Chemistry by Bahl and Tuli., S Chand & Co. Ltd, New Delhi.
10. Introduction to Nano Science by N N. Lindsay, Oxford University Press.
11. NANO: The Essentials by T Pradeep Tata McGraw-Hill Publishing Company, New Delhi.

(b) Open source software and website:

1. <https://nptel.ac.in/>
2. https://chem.libretexts.org/Courses/Remixer_University/Download_Center
3. https://ocw.uci.edu/collections/open_chemistry.html#
4. <https://ocw.mit.edu/courses/5-111sc-principles-of-chemical-science-fall-2014/>

Suggested Course Practical List:

1. To determine the total hardness of the given samples by EDTA titrimetric method.
2. To estimate moisture content in the given coal sample.
3. To determine the amount of alkalinity present in the given samples.
4. To determine the amount of chloride present in the given water sample by Mohr's method.
5. To determine the saponification value of an oil sample.
6. To determine the concentration of unknown solution by spectrophotometer.
7. To determine the percentage of iron in the given steel sample.



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8. To determine the amount of copper in a given brass sample.
 9. To study the rate of corrosion by weight loss method.
 10. To carry out analysis of pyrolusite ore.
 11. To determine the R_f value of given sample by TLC method.
 12. To synthesis of metal nanoparticles (silver, gold or copper etc.)
- (Minimum 8 experiments to be performed)

List of Laboratory/Learning Resources Required:

1. Spectrophotometer.
2. Laboratory oven.
3. Melting point Instrument.
4. Electronic balance
5. TLC plates
6. Various chemicals and glassware

Suggested Project List:

1. Construction of bio-reactor
2. Construction of Li-cell
3. Set-up for photolysis of water
4. Synthesis of bio-degradable polymers
5. Design concept based on circular economy

Any other suitable project suggested by mentor or students.

Suggested Activities for Students:

1. Industrial visit
2. Organizing seminar and workshop
3. Participate in technical events
4. Participate and involve in startup

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