GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: All branches

Course / Subject Code : BE01R00031

Course / Subject Name : Chemistry

w. e. f. Academic Year:	2024-25
Semester:	Ist 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 / 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)	PBL (I)	ESE (V)	
45	0	30	45	120	04	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

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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^3d and sp^3d^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**

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, Cencage Learning.
4. Engineering Chemistry by N. Krishnamurthy, P. Vallinaygam and D. Madhavan, PHI Learning.
5. Engineering Chemistry by K. Sesha 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.

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

- **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 papers based on relevant subject. Summarize research papers and evaluation critical parameters.	5 research papers can be included. Each one has 5 hrs	**25**
6	Students will have to prepare posters, charts or PowerPoint presentations on technical topics related to subject content.	Duration of each activity = 6 hrs Max. two topics can be considered.	**12**
7	Students will have to do Group Discussion on emerging, Trending technical topics based on the subject.	Preparation and discussion on one topic	**5**
8	Flipped Classroom Activity	Preparation and discussion on one topic	**5**
9	Hands-On Experiments and Virtual Labs	Duration of video = 4 hrs Journal Preparation = 4hrs	**8**

10	Identification and remediation of the chemical processes that lead to pollution, climate change.	Research=3 hrs Report preparation=2 hrs	**5**
11	Working/ Non working models on technical topics.	Working= 12 hrs Non working = 8 hrs	**12/8**
12	Online Technical Quizzes/Simulations.	Multiple quizzes summing up to 10 hrs	**10**
Max. Hours to be allotted			**45**

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