Course Code	Course Title	L	T	P	J	S	C
	Chemistry	3	0	2	0	0	4
Course Owner	Department of Chemistry	Syllabus version				1.0	
Course Pre-requisite(s)	Chemistry Knowledge of +2 level	Contact hours				54 + 28	
Course Co-requisite(s)		Date Approved				28-04-21	
Alternate Exposure	NPTEL/Coursera						
Assessment	Continuous evaluation: 70M; End Examination/s:30M						

Preamble

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nano-materials, Analytical instruments and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Objectives

- To impart knowledge on various aspects of water and its treatment.
- To study about electrochemical energy systems, renewable energy sources, solar cells and their applications.
- To gain knowledge on materials such as steel, cement and polymers
- To create awareness on corrosion and its control.
- To introduce different types of nano-materials.
- To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

UNIT – I	Title: Water and its treatment	No of Hours: 9
Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization- industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.		
Learning Outcomes:		
After the completion of the Unit I, the student will be able to		
• **list** the differences between temporary and permanent hardness of water.		L1
• **explain** the principles of reverse osmosis.		L2
• **compare** the quality of drinking water with BIS and WHO standards.		L2
• **illustrate** problems associated with hard water.		L2
• **demonstrate** the Industrial water treatment processes.		L2
Pedagogy tools: Blended learning,Case let, video lectures, self-reading		
UNIT – II	**Title: Electrochemical Energy Systems**	**No of Hours: 9**
Battery Technology Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium ion cell, Li MnO_2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications.**- Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.		
Learning Outcomes:		

After completion of this unit, the student will be able to	
• **define** electrode potential.	L1
• **explain** Nernst's equation.	L2
• **illustrate** difference between primary and secondary cells.	L2
• **summarize** the applications of solar energy.	L2
• **construct** different cells.	L3
Pedagogy tools: Blended learning,Case let, video lectures, self-reading	

UNIT – III	**Title: Engineering materials and Polymer Chemistry**	**No of Hours: 9**

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

Learning Outcomes:	
After completion of this unit, the student will be able to	
• **classify** the types of steel.	L2
• **illustrate** the chemical reactions involved in the manufacturing of cement.	L2
• **identify** preparation and properties of polymers.	L3
• **distinguish** between thermoplastic and thermo setting resins.	L4
	L3
Pedagogy tools: Blended learning,Case let, video lectures, self-reading	

UNIT – IV	**Title: Corrosion and its control**	**No of Hours: 9**

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings- paints.

Learning Outcomes:	
After completion of this unit, the student will be able to	
• **explain** theories of corrosion.	L2
• **classify** different corrosion methods.	L2
• **summarize** the various factors affecting corrosion.	L2
• **identify** different organic coatings.	L3
• **apply** the principles of corrosion control.	L3
Pedagogy tools: Blended learning,Case let, video lectures, self-reading	

	Course Code	Course Title	L	T	P	J	S	C
		Chemistry	3	0	2	0	0	4
	Course Owner	Department of Chemistry	Syllabus version				1.0	
	Course Pre-requisite(s)	+2 level Chemistry	Contact hours				54+28	
	Course Co-requisite(s)		Date Approved				28/04/21	
	Alternate Exposure							

UNIT - V	Title: Nanomaterials and Analytical Instrumental Techniques	No of Hours: 9

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Learning Outcomes:

After completion of this unit, the student will be able to

• **classify** nanomaterials.	L2
• **explain** the synthesis and characterization methods of nano materials.	L2
• **describe** the principles of different analytical techniques.	L3
• **compare** the principles of SEM and TEM.	L4
	L1

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

Course Outcomes

After the completion of the course, the student will be able to

- **list** the important purification methods of water. (**L-1)**
- **illustrate** the principles and applications of batteries, solar energy. (**L-2)**
- **explain** the importance of materials such as steel, cement and polymers(**L-3)**
- **identify** different protective coatings. (**L-3)**
- **analyze** the importance of nano materials and the principles of SEM and TEM**. (L-4)**

Textbook(s):

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

Additional Reading

Reference Book(s):

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).

	Course Code	Course Title	L	T	P	J	S	C
		Chemistry Lab	0	0	2	0	0	1
	Course Owner	Department of Chemistry	Syllabus version				1.0	
	Course Pre-requisite(s)	+2 level Chemistry	Contact hours				28	
	Course Co-requisite(s)		Date Approved				28/04/21	
	Alternate Exposure							

1.
2.
Journal(s):
1. All Chemistry Journals from American, European, Royal Chemical Society Publishers
Website(s):
1. Department of Chemistry, GITAM Website for the Laboratory Manual

Practical Experiments

Topics	Type(Experiment, Project, Exercise) Choose an item.
1. Preparation of TiO2/ZnO nano particles	Experiment
2. SEM analysis of nano materials	Experiment
3. Determination of strength of an acid by pH metric method	Experiment
4. Determination of sulphuric acid in lead-acid storage cell	Experiment
5. Determination of conductance by conductometric method	Experiment
6. Determination of viscosity of a liquid	Experiment
7. Determination of surface tension of a liquid	Experiment
8. Preparation of Urea-Formaldehyde resin	Experiment
9. Determination of chromium (VI) in potassium dichromate	Experiment
10. Determination of copper in a copper ore	Experiment
11. Determination of Zinc by EDTA method.	Experiment
12. Estimation of active chlorine content in Bleaching powder	Experiment
13. Determination of Mohr's salt by potentiometric method	Experiment
14. Thin layer chromatography	Experiment
15. Preparation of Phenol-Formaldehyde resin	Experiment

Pedagogy tools:	**Practical**	**NPTEL**	**Practical**
	Practical	**Practical**	**Practical**

Components	Term End Examination	Internal Examination												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Marks	30	10	10	10	10	10	10	10						
Total Marks	30	70												
	Internal exam: 30M	Six graded experiments with 10 M each, record 10M. Total : 70 (internal) online or offline												

	Course Outcomes	**After the completion of the laboratory course, the student will be able to** • **explain** the functioning of the instruments such as pH, Conductometric and Potentiometric methods. **(L-2)** • **identify** different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods). (**L-3)** • **experiment with** the physical parameter of organic compounds. (**L-3)** • **compare** the viscosities of oils. (**L-4)** • **list** the preparation of polymers and nano materials. **(L-4)**	

Text Books	**Topics**
1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000). 2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).	

Additional Reading: Recorded demonstrations by Chemistry Faculty	

Reference Book(s):	**Topics**
1: Lab Manual provided by Chemistry department	

	Programme Objectives (POs)												**PSOs**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	
CO1	1														1	
CO2			1			1			3				1			
CO3		2									2					
CO4										1					3	
CO5					3									2		

1-Low, 2- Medium and 3- High Correlation