Semester - 1

ENGINEERING CHEMISTRY – C

Course Code	Teaching hours per week				Credits	Exam hours	Course type	CIE Marks	ESE Marks
	L	T	P	R					
26NNCBS103	2	0	2	0	3	2Hr. 30Mns.	Theory + Lab	40	60

1. **Preamble:** This course aims to enable students to acquire knowledge of the fundamental concepts of chemistry relevant to engineering applications and to familiarize them with various application-oriented topics such as electrochemistry, spectroscopy, and instrumental methods. It also aims to familiarize students with the mechanisms of corrosion and its prevention methods, SEM, conducting polymers, water treatment, and other related topics, thereby developing the knowledge, abilities, and skills relevant to the study and practice of chemistry.

2. **Prerequisites:** Fundamental understanding of core concept in Chemistry

Module Number	Syllabus Description	Contact Hours
1	**Electrochemistry and Corrosion Science** Electrochemical Cell- Electrode potential- Nernst equation for single electrode and cell (Numericals), Reference electrodes – SHE and Calomel electrode –construction and working, Glass Electrode and pH measurement, Li-ion battery and H_2-O_2 fuel cell (acid electrolyte only) - construction and working, Supercapacitors. Corrosion –electrochemical corrosion- mechanism (acidic and alkaline medium), Galvanic series, Corrosion control methods - cathodic protection - sacrificial anodic protection and impressed current cathodic protection, Electroplating of copper	7
2	**Engineering Materials** Fuels: Calorific value – HCV and LCV – experimental determination of calorific value of solid fuels, Octane and Cetane Number, Biofuels- biodiesel-green hydrogen. Lubricants: Classification - solid, semisolid and liquid lubricants- properties of lubricants - viscosity Index, flash point, fire point, cloud point, pour point and aniline point.	7

	Cement: Manufacture of Portland cement – theory of setting and hardening of cement. Nanomaterials: Classification based on dimension and materials, synthesis – Sol gel and chemical reduction methods - applications of nanomaterials, Carbon nanotubes, fullerenes and graphene – structure, properties & applications. Polymers: ABS and Kevlar - synthesis, properties and applications. Conducting polymers- classification – applications.	
3	**Instrumental Methods of Analysis** Molecular Spectroscopy: Beer Lambert's law - numericals, Electronic spectroscopy - principle, types of electronic transitions - role of conjugation in absorption maxima - instrumentation-applications, Vibrational spectroscopy - principle- number of vibrational modes - vibrational modes of CO_2 and H_2O – applications. Thermal analysis: TGA - principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Electron Microscopic Techniques: SEM - principle, instrumentation and applications.	7
4	**Environmental Chemistry** Water characteristics - hardness - types of hardness- temporary and permanent - disadvantages of hard water - degree of hardness (Numericals), Water softening methods - Ion exchange process-principle, procedure and advantages, Reverse osmosis – principle, process and advantages. Water disinfection methods – chlorination - ozone and UV irradiation. Dissolved oxygen (DO). Sewage water treatment- primary, secondary and tertiary - flow diagram - trickling filter and UASB process. Air pollution - sources and effects, Solid waste - disposal methods - composting, land fill and incineration. Sustainable development - An introduction to Sustainable Development Goals (SDG).	7
	Total hours (Theory)	28
	Total hours (Practical)	10
	Total hours	38

Experiment No.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution.
7	Determination of molar absorptivity of a compound (KMnO4 or any water-soluble food colorant)
8	Analysis of IR spectra
9	Identification of drugs using TLC
10	Estimation of total hardness of water-EDTA method
11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil
15	Verification of Nernst equation for electrochemical cell.
Note: Any 8 Experiments Mandatory	

Course Assessment Method
(CIE: 40 Marks, ESE: 60 Marks)
Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination -1 (Written)	Internal Examination -2 (Written)	Internal Examination - 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE):
In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module • Total of 8 Questions, each carrying 3 marks. **(8 x 3 = 24 marks)**	• Each question carries 9 marks • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4 x 9 =36 marks)**	**60**

3. Course Outcomes

At the end of the course students should be able to:

Course Outcomes	Description	Blooms Taxonomy Level
CO1	Apply the basic concepts of electrochemistry and corrosion to explore the possible applications in various engineering fields	K3
CO2	Describe the properties and applications of engineering materials used in different industries.	K2
CO3	Apply appropriate analytical techniques to synthesize and characterize various engineering materials.	K3
CO4	Apply water treatment and waste water management methods to address water quality, hardness, and environmental issues.	K3
CO5	Apply fundamental principles of chemistry to perform laboratory experiments.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

4. Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	2	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	2
CO4	3	3	2	-	-	2	3	-	-	-	2
CO5	3	3	2	3	-	2	3	3	-	-	2

5. Text Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International - 2018
3	Instrumental Methods of Analysis.	H. H. Willard, L. L. Merritt	CBS Publishers	7th Edition,2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17th Edition 2015
5	Modern Engineering Chemistry	Dr. Kochu Baby Manjooran	Kannatheri publications	2010
6	Engineering Chemistry for Information Science and Electrical Science	Dr. Muhammed Arif M and Dr Dhanya S R	Owl Publications	2024

6. Reference Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024

7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

7. Video Links or any other Reference Materials

Sl No	Details Like Weblink, Publication Details	Module
1	https://tinyurl.com/3ms7srhd	1
2	https://tinyurl.com/bdhe6n7z https://tinyurl.com/42h9z89z	2
3	https://tinyurl.com/p6tkmcva	3
4	https://tinyurl.com/yjw72bf6	4

Continuous Assessment (10 Marks)

1. Preparation and Pre-Lab Work (2 Marks)

- Assignments or quizzes to assess the understanding of the experiments.

2. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments

3. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports.
- Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab rough records and maintaining a well-organized rough record.

4. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and rough record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for Lab Examination (5 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (2 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task
2. **Result (2 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (1 Marks)**
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

MODEL QUESTION PAPER

FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY(FISAT)
(Autonomous)
<FIRST/SECOND> SEMESTER B. TECH DEGREE EXAMINATION (2026 Scheme), <Month & Year>

Course Code: 26NNCBS103

Course Name: Engineering Chemistry -C

Max. Marks: 60 | Duration: 2 Hours 30 Minutes

PART A

Q. No	*Answer all questions. Each question carries 3 marks*	Marks	CO
1	Write any three differences between electrochemical series and galvanic series.	3	CO1
2	How does impressed current cathodic protection differ from sacrificial anodic protection	3	CO1
3	What is the difference between LCV and HCV? How are they interrelated	3	CO2
4	Explain sol-gel method with suitable example	3	CO2
5	Sketch the TGA and DTA profile of $CaC_2O_4.H_2O$.	3	CO 3
6	State Beer Lambert's Law. Write its differential form.	3	CO3
7	Calculate the hardness of 0.05M $CaCl_2$ solution.	3	CO 4
8	Explain ozone layer depletion?	3	CO 4

PART B				
Answer any one full question from each module. Each full question carries 9 marks				
Module 1				
9	a	Explain the construction and working of H_2-O_2 fuel cells. List any two application?.	5	CO1
	b	Explain the principle of electroplating. Write the reactions involved in the electroplating of copper?	4	CO1
		OR		
10	a	Explain the construction and working of a calomel electrode as a reference electrode? What is the variation in the potential of a calomel electrode with change in chloride ion concentration?	5	CO1
	b	Explain the mechanism of electrochemical corrosion of iron in oxygen rich acidic environment	4	CO1
Module 2				
11	a	Describe the various steps involved in the manufacture of Portland cement.	5	CO2
	b	Explain the classification of conducting polymers?	4	CO2
		OR		
12	a	Explain the working of a Bomb calorimeter for determining the calorific value of a solid fuel with the help of a neat diagram.	5	CO2
	b	Briefly outline the following properties of lubricants a) viscosity index b) flash and fire points	4	CO2
Module 3				
13	a	Explain the principle, instrumentation and application of GC.	5	CO3
	b	Explain the various modes of vibrations possible in H_2O molecule. Which of them are IR active? Give reasons.	4	CO3
		OR		
14	a	Briefly explain the principle and instrumentation of SEM	5	CO3
	b	UV-Visible spectroscopy is also known as ‘Electronic Spectroscopy’. Justify the comment.	4	CO3
Module 4				
15	a	Explain Trickling Filter process	5	CO4
	b	Describe various disinfection methods	4	CO4
		OR		
16	a	Describe the methods for Solid waste disposal?	5	CO4
	b	What are the various sources of air pollution and how can this be controlled?	4	CO4