Semester I/II

Engineering Chemistry - AB

Course Code	Teaching hours per week				Credits	Exam Hours	Course Type	CIE Marks	ESE Marks
	L	T	P	R					
26ABNBS103	2	0	2	0	3	2Hrs. 30 Mins.	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.

Syllabus

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 - pH Measurement, Li-ion battery and H_2-O_2 fuel cell (acid electrolyte only), 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

Module Number	Syllabus Description	Contact Hours
2	**Materials for Electronic Applications** Nanomaterials - Classification based on dimension and materials, Synthesis – Sol-gel and Chemical Reduction methods, Applications of nanomaterials, Carbon nanotubes, Fullerenes, Graphene and Carbon Quantum dots - structure, properties and applications. Polymers- Fire retardant polymers- halogenated and non-halogenated polymers (examples), Conducting polymers- classification. Organic electronic materials and devices- construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC). Materials used in quantum computing technology and spintronics.	**7**
3	**Molecular Spectroscopy and Analytical Techniques** Beer Lambert's law – numericals, Electronic spectroscopy – principle - types of electronic transitions –role of conjugation in absorption maxima- instrumentation-application, Vibrational spectroscopy – principle- number of vibrational modes - vibrational modes of CO_2 and H_2O – Applications. Thermal Analysis: Dielectric Thermal Analysis (DETA) of polymers- working and applications. 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- ozonation and UV irradiation, Dissolved oxygen (DO). Sewage water treatment- primary, secondary and tertiary - flow diagram -trickling filter and UASB process. E-waste, Methods of disposal – Recycle, recovery and reuse. Sustainable development- An introduction to Sustainable Development Goals (SDG).	**7**
	Total hours (Theory)	28
	Total hours (Practical)	10
	Total hours	**38**

Practical Questions :

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	

3. **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**

4. Course Outcomes

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

Course Outcomes		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

5. 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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), - : No Correlation

6. 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	11/e, 2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	12/e, 2018
3	Instrumental Methods of Analysis.	H. H. Willard, L. L. Merritt	CBS Publishers	7/e, 2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17/e, 2015

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
5	Modern Engineering Chemistry	Dr. Kochu Baby Manjoooran	Kannatheri publications	1/e, 2010
6	Engineering Chemistry for Information Science and Electrical Science	Dr. Muhammed Arif M and Dr Dhanya S R	Owl Publications	1/e, 2024

7. 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	4/e, 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47/e, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	5/e, 2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4/e, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	C. N. R. Rao, Achim Müller & A. K. Cheetham	Wiley‐VCH Verlag GmbH & Co. KGaA	1/e, 2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2/e, 2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	1/e. 2008

8. 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

9. 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.

10. 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

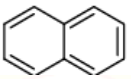
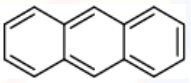
2. Result (2 Marks)

- 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.

11. Model Question Paper

MODEL QUESTION PAPER			
FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY(FISAT) **(Autonomous)** **FIRST/SECOND SEMESTER B. TECH DEGREE EXAMINATION (2026 Scheme)**			
Course Code: 26ABNBS103 **Course Name: Engineering Chemistry -AB**			
Programme : CSE/CSD/ECE/EEE/EIE			
Max. Marks: 60		**Duration: 2 Hours 30 Minutes**	
PART A			
Q. No	***(Answer all questions. Each question carries 3 marks)***	**CO**	**Marks**
1	Write the anode, cathode reactions and calculate the standard EMF of the cell formed by silver and aluminium electrodes. Given that $E^0Ag^{+/}Ag = 0.8V$ and $E^0Al^{+3}/Al = -1.66V$.	CO1	(3)
2	Explain single electrode potential.	CO1	(3)
3	What are conducting polymers? Give two examples	CO2	(3)
4	Explain the sol-gel method for synthesis of nanomaterials.	CO2	(3)
5	How IR spectroscopy can be used for distinguishing intra and intermolecular hydrogen bonds?	CO3	(3)
6	Predict which of the following molecules will have highest λ_{max} in UV- visible spectrum. Justify your reason a.  b.  c.  d. 	CO3	(3)
7	Define dissolved oxygen. Give one significance of dissolved oxygen.	CO4	(3)
8	Explain water disinfection by chlorination.	CO4	(3)
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 Li-ioncell	CO1	6
	b) What are reference electrodes? Give examples for primary reference and secondary reference electrodes.	CO1	3
10	a) Discuss the construction and working of H2-O2 fuel cell using acid electrolyte. Give one advantage of H2-O2 fuel cell	CO1	6
	b) Explain principle and procedure for copper electroplating	CO1	3
Module 2			
11	a) Discuss the construction and working of OLED. Give any two advantages of OLED.	CO2	5
	b) Describe the synthesis of polyaniline. List any two properties and	CO2	4

		applications of polyaniline.		
12	a)	Explain construction and working of Dye Sensitized solar cells with the help of a neat labeled sketch.	CO2	5
	b)	What is spintronics? Write any three materials used in spintronics.	CO2	4
Module 3				
13	a)	Explain the various modes of vibrations possible for CO2 and H2O and state which of these modes are IR active.	CO3	5
	b)	Briefly explain the principle and instrumentation of SEM	CO3	4
14	a)	Discuss the instrumentation and working of UV-Visible spectrometer.	CO3	5
	b)	Calculate the concentration of a solution if it shows a transmittance of 20% when taken in a cell of 2cm thickness (Molar absorption coefficient is 12000dm^2 mol^{-1}).	CO3	4
Module 4				
15	a)	Explain the principle and procedure of ion exchange process of water softening.	CO4	5
	b)	Calculate the temporary and permanent hardness of the water sample containing the following dissolved salts. Mg(HCO3)2 = 8mg/L; Ca(HCO3)2 = 6mg/L; CaSO4 = 8 mg/L, MgSO4=10 mg/L.	CO4	4
16	a)	Explain trickling filter method and UASB process with a neat sketch.	CO4	5
	b)	What is e-waste? Write a note on e-waste disposal methods?	CO4	4

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