COURSE CODE	COURSE NAME	L	T	P	CREDIT	YEAR OF INTRODUCTION
101908/CH900B	ENGINEERING CHEMISTRY	3	1	0	4	2021

1. Preamble

To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, Engineering Materials, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of engineering chemistry.

2. Prerequisite

Concepts of chemistry introduced at the plus two levels in schools.

3. Syllabus

Module 1: Electrochemistry & Corrosion

Electrochemical cell, Single electrode potential, Helmholtz electrical double layer, cell representation. Free energy and EMF-Nernst Equation-Derivation-single electrode and cell (Numerical)– Applications- Different types of electrodes (brief) - Reference electrodes - Calomel electrode - Construction and Working. Determination of E^o using calomel electrode. Glass Electrode-Determination of pH using glass electrode. Potentiometric titration - Introduction -Redox titration only.

Energy storage devices- lithium batteries for electric vehicles - Lithium-ion battery, Lithium ion/Polymer battery, Lithium-sulphur battery - Super capacitors- Classifications based on mechanism with example - EDLC & Pseudo capacitors.
Corrosion - Electrochemical corrosion – mechanism. Galvanic series- electroless plating –Copper and Nickel plating.

Module 2: Spectroscopic Techniques & Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numerical). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule

(Numerical) –Applications. ^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3: Instrumental Methods

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 $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC- Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.Surface characterization Technique - SEM – Principle and instrumentation (block diagram).

Module 4: Polymers & Nanomaterials

Classification of polymers - Nomenclature of polymers, Degree of polymerization, Functionality, Tacticity-Types of polymerization - Addition polymerization - Mechanism -Free radical and Ionic -Condensation polymerization - Polymerization techniques - Bulk, solution, suspension, emulsion - Molecular weight of polymers – Number average molecular weight - Weight average molecular weight - Viscosity average molecular weight (numerical). Structure - property relationship of polymers – Strength - Effect of heat on polymers (T_g)– Plastics- compounding of plastics - Plasticizers, fillers, accelerators, stabilizers, coloring agents (only function and examples)-Moulding Techniques - Injection, transfer, extrusion, blow (onlybrief procedure)- Engineering polymers - Polyurethane, Epoxy resin (DGEBA), PF resin,ABS, Kevlar, Silicones (Structure, properties & applications)- Conducting polymers-Classification-Doping (Conducting mechanism) - Chemical synthesis of Polyaniline and Polypyrrole **–** Applications – OLED -Construction and working **–** Advantages. Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nonmaterial.

Module 5: Water Chemistry & Sewage Water Treatment

Water characteristics -Hardness- Types of hardness- Temporary and Permanent- Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) – Estimation of hardness-EDTA method (Numerical). Water softening methods -Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation. Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

4. Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, *Engineering Chemistry* (NPTEL Web-book), 2018.
2. P. W. Atkins, *Physical Chemistry*, Oxford University Press, 10th Edition, 2014.
3. C. N. Banwell, *Fundamentals of Molecular Spectroscopy*, McGraw-Hill, 4thEdition, 1995.
4. Donald L. Pavia, *Introduction to Spectroscopy*, Cengage Learning India Pvt. Ltd., 5th Edition, 2015.
5. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47thEdition, 2017.
6. H. H. Willard &L. L. Merritt, *Instrumental Methods of Analysis*, CBS Publishers, 7thEdition, 2005.
7. Raymond B. Seymour & Charles E. Carraher, *Polymer Chemistry: An Introduction*, Marcel Dekker Inc; 4thRevised Edition, 1996.

5. Reference Books

1. Muhammed Arif, Annette Fernandez, Kavitha P. Nair, *Engineering Chemistry*, Owl Books, 2019.
2. Ahad J., *Engineering Chemistry*, Jai Publication, 2019.
3. Roy K. Varghese, *Engineering Chemistry*, Crownplus Publishers, 2019.
4. Soney C. George & Rino Laly Jose, *Text Book of Engineering Chemistry*, S. Chand & Company Pvt Ltd, 2019.
5. Jain and Jain, *Engineering Chemistry*, DhanpatRai Publishers, 17th Edition, 2018.
6. Wiley India, *Engineering Chemistry*, ISBN 9788126543205.
7. V. K. Ahluwalia & Anuradha Mishra, *Polymer science: A text book*, CRC Press, 2008.
8. V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, *Polymer Science*, 4th Edition, New Age International Publishers, 2021.

6. Course Outcomes

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

CO1: To design and sketch electrochemical cells, to compare working and mechanism of different electrochemical energy storage devices, to understand corrosion control by applying the fundamentals of electrochemistry and corrosion.

CO2: To elucidate the structure and chemical parameters of organic compounds using various spectroscopic techniques like UV-Visible, IR and NMR spectroscopy.

CO3: To demonstrate understanding of the instrumentation and working of analytical methods like TGA, DTA and various chromatographic techniques to characterize a compound or mixture.

CO4: To be aware of the preparation and applications of engineering materials like polymers and nanomaterials in the field of engineering and technology.

CO5: To analyse different water quality parameters and to learn the fundamentals of industrial, domestic and waste water treatment processes.

7. Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1									
CO2	1	1		1	2							
CO3	1	1		1	2							
CO4	2	1										
CO5	1			1			3					

8. Assessment Pattern

Learning Objectives	Continuous Internal Evaluation (CIE)		End Semester Examination (ESE out of 100)
	Internal Examination 1(50)	Internal Examination 2 (50)	
Remember	8	8	20
Understand	8	8	25
Apply	14	14	25
Analyse	10	10	20
Evaluate	10	10	10
Create			

9. Mark Distribution

Total	CIE				ESE
	Attendance	Internal Examination	Assignment/Quiz/ Course Project	Total	
150	10	25 (Average of two scores)	15	50	100

10. End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question will have 2 sub-divisions (7 marks each) and carry 14 marks.

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