24CY101 Applied Chemistry

(CS, IT, AI-DS, AI-ML branches only)

Category: Basic Sciences (BS) **3L 0T 0P 3C**

Course Outcomes:

At the end of the course, the student will be able to...

CO 1: Apply the principles of electrochemistry to analyse working of electrodes and sensors **[K3]**.

CO 2: Analyse various electrochemical energy systems for their application in engineering **[K4]**.

CO 3: Assess the challenges arising due to corrosion of electronic devices **[K4]**.

CO 4: Demonstrate the knowledge of conducting materials for their use in manufacture hardware components of computer systems **[K3]**.

CO 5: Compare chemical aspects of different types of materials used in memory and display systems **[K4]**.

Course Content

Unit 1: Electrochemistry

- Electrodes, electrode potentials and electrochemical cells
- The Nernst equation with numerical problems for calculating electrode potential and emf
- Reference electrodes – Calomel and Ag/AgCl electrodes, Ion-selective electrodes, glass electrode - construction, working, advantages, and disadvantages
- Potentiometry – redox titrations
- Conductometry (acid-base reactions)
- Electrochemical sensors – principle and applications

Unit 2: Electrochemical Energy Systems

- Types of electrochemical energy systems – charging vs. discharging
- Primary vs. secondary batteries
- Lithium-ion batteries – Lithium iron phosphate and lithium cobalt oxide – construction and working of the batteries including cell reactions
- Fuel cells – hydrogen-oxygen fuel cell and polymer electrolyte membrane fuel cell
- Super capacitors – principle, classification and applications
- Chemistry of fast charging EVs.

Unit 3: Corrosion and Its Control

- Introduction to corrosion, causes and examples
- Electrochemical corrosion: hydrogen evolution and oxygen absorption corrosion
- Differential aeration corrosion
- Galvanic corrosion and its control, including the galvanic series

- Corrosion in computer and microelectronic devices
- Factors influencing corrosion
- Electroplating and electroless plating

Unit 4: Chemistry of Conducting Materials

- Conducting polymers: Types of conducting polymers, mechanisms of conduction in undoped, doped polyacetylene and engineering applications of conducting polymers.
- Other materials of conduction: Production of electronic grade silicon from quartz and its applications, metal compounds as semiconductors, applications of carbon nanotubes and graphene in electrical and electronic industry.

Unit 5: Materials for Memory and Display Systems

- Basic concepts of electronic memory, classification of electronic memory devices (Transistor-type, Capacitor-type, Resistor-type and Charge transfer type), types of organic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials).
- Photoactive and electroactive materials – principle, Organic materials – Light absorbing materials – polythiophenes, Light emitting materials – Poly(9-vinylcarbazole) – their uses in optoelectronic devices, Organic light emitting diodes (OLED) and Quantum light emitting diodes (QLED) – properties and applications.

Textbook(s) / Reference(s):

Textbooks:

1. Ramesh, S. (2013). *Engineering chemistry* (2nd ed.). Wiley India.
2. Shikha Agarwal, (2015). *Engineering chemistry: fundamentals and applications* (1st ed.). Cambridge University Press.
3. Jain, P.C. (2018). *Engineering chemistry* (17th ed.). Dhanpat Rai.

References:

1. Prasantha Rath, & Aruna Kumari, S. (2023). *Engineering chemistry* (1st ed.). Cengage.
2. Arun Bahl, Bahl, B. S., & Tuli, G. D. (2020). *Essentials of physical chemistry* (28th ed.). S. Chand.
3. Haghi, A. K., Mercader, A. G., Balkoese, D., & Mukbaniani, O. V. (2021). *Applied chemistry and chemical engineering*, (1st ed.). CRC Press, Taylor & Francis Group.
4. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2022). *Fundamentals of analytical chemistry* (10th ed.). Cengage.
5. Fontana, M. G. (2017). *Corrosion engineering* (3rd ed.). McGraw-Hill Education.
6. Swaminathan, P. (2017). *Semiconductor materials, devices, and fabrication*. Wiley.
7. Banwell, C. N., & McCash, E. M. (2017). *Fundamentals of molecular spectroscopy* (4th ed.). McGraw-Hill Education.