SIDDHARTHA
ACADEMY OF HIGHER EDUCATION
An Institution Deemed to be University
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24CY103 **Chemistry for Engineers**

(For CE and ME 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 knowledge of basic electrochemistry principles to electrodes, batteries and fuel cells **[K3]**.

CO 2: Analyse various corrosion processes and control methods **[K4]**.

CO 3: Analyse the dependence of applications of polymers, glasses and alloy steels on their composition, bonding and structures **[K4]**.

CO 4: Correlate the characteristic features of cements, concrete and refractories with chemical composition and chemical reactions involved **[K4]**.

CO 5: Apply the chemical aspects of lubricants and composite materials to assess their engineering applications **[K3]**.

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
- Conductometric analysis (acid-base reactions)
- Batteries, with a focus on lithium-ion ($LiCoO_2$) battery
- Fuel cells, specifically the hydrogen-oxygen fuel cell

Unit 2: Corrosion and its control

- Introduction to corrosion and its causes
- Electrochemical corrosion: hydrogen evolution and oxygen absorption corrosion
- Differential aeration corrosion
- Scaling and corrosion in boilers and their control
- Galvanic corrosion and its control, including the galvanic series
- Surface coatings: types of metallic coatings
- Hot dipping processes: galvanizing and tinning

Unit 3: Polymer Chemistry, Glasses and Alloy Steels

- Polymer chemistry: Introduction, types of polymerization, thermoplastics and thermosetting plastics, preparation, properties and applications of PVC, Nylon-6,6, Urea-formaldehyde and Polyurethane.

- Glasses: Composition, types of glasses, properties and engineering applications.
- Alloy Steels: Types of steels, specific effects of alloying elements, industrial applications of alloy steels.

Unit 4: Chemistry of Cement and Refractories

- Cement: Composition, manufacture of Portland cement, setting and hardening of cement and chemical reactions involved, concrete and RCC, reactions involved in corrosion of reinforcement steel, degradation and protection of concrete.
- Refractories: Classification and properties – refractoriness, RUL test, porosity, and applications of refractories.

Unit 5: Lubricants and Composite Materials

- Lubricants: Friction and effects of frictional heat, lubricants, mechanisms of lubrication, types of lubricants based on physical state, properties of lubricants – viscosity, flash and fire points, mechanical stability.
- Composite materials: Constituents of composites, types of composites and engineering applications of composites.

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. Billmeyer Jr, F. W. (2007). *Textbook of polymer science* (3rd ed.). John Wiley & Sons.
4. Haghi, A. K., Mercader, A. G., Balkoese, D., & Mukbaniani, O. V. (2021). *Applied chemistry and chemical engineering*, (1st ed.). CRC Press, Taylor & Francis Group.
5. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2022). *Fundamentals of analytical chemistry* (10th ed.). Cengage.
6. Fontana, M. G. (2017). *Corrosion engineering* (3rd ed.). McGraw-Hill Education.
7. Taylor, H. F. W. (1997). *Cement chemistry* (2nd ed.). Thomas Telford.