Chemistry of Materials
[Common to Civil, Mechanical, Mechanical (Robotics)]

Course Code: 22BC1103

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Course outcomes: After the completion of the course, the student will be able to:

CO1: Illustrate the working of energy storage devices (L3).
CO2: Apply the principles involved in corrosion to predict and prevent corrosion in real life systems (L3).
CO3: Determine the water quality and prescribe the remedial measures for domestic as well as industrial usage (L3).
CO4: Use different types of polymers to specific purposes (L3).
CO5: Explain the importance of nano and smart materials (L2).

UNIT- I **10 Lectures**

ENERGY SOURCES, SYSTEMS AND APPLICATIONS

Electrode potential, determination of single electrode potential-Nernst equation; Reference electrodes - hydrogen and calomel electrodes; Electrochemical series and its applications; Primary cell - dry or Leclanche cell, Weston Cadmium Cell; Secondary cell - lead acid storage cell, nickel-cadmium cell, lithium ion batteries; Fuel cell, hydrogen-oxygen fuel cell (AFC); Solar energy- photovoltaic cell and applications.

Learning outcomes:

At the end of the module the student will be able to

1. apply standard reduction potential data to calculate the standard cell potential. (L3)
2. apply redox principles for construction of batteries and fuel cells. (L3)
3. illustrate the construction and working of a pv cell. (L3)

UNIT- II **10 Lectures**

CORROSION AND ITS CONTROL

Corrosion: Definition, theories of corrosion-dry corrosion and electrochemical corrosion; factors affecting corrosion- nature of the metal and nature of the environment.

Corrosion controlling methods: Sacrificial anodic and Impressed current cathodic protection; Inhibitors -anodic and cathodic inhibitors; Metallic coatings-anodic coatings, cathodic coating, galvanizing and tinning; Organic coatings-paints and varnishes (constituents and their functions).

Learning outcomes

At the end of the module the student will be able to

1. explain theories of corrosion. (L2)
2. discuss various factors affecting corrosion (L2)
3. apply the principles of corrosion control methods (L3)

UNIT- III **10 Lectures**

TREATMENT OF WATER

Introduction –Hard and Soft water, Estimation of hardness by EDTA Method; Boiler troubles

- scaling and sludge-priming and foaming; specifications for drinking water - Bureau of Indian Standards (BIS) and World Health Organization (WHO) standards; Industrial water treatment – zeolite and ion-exchange processes; desalination of brackish water - reverse osmosis (RO) and electrodialysis.

Learning outcomes:

At the end of the module the student will be able to

1. determine total hardness of a water sample (L3)
2. illustrate problems associated with hard water. (L3)
3. explain the principles of reverse osmosis and electrodialysis (L2)
4. demonstrate the Industrial water treatment processes. (L3)

UNIT- IV **12 Lectures**

ENGINEERING MATERIALS

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Lubricants- Introduction, functions of lubrication, mechanism of lubrication, types of lubricants and properties

Polymers: Introduction, Types and mechanism of polymerization, differences between thermoplastic and thermosetting plastics, Preparation, properties and uses of polystyrene and Nylon 6,6.
Refractories-Definition, Classification, Characteristics and failures of refractories.

Learning outcomes:

At the end of the module the student will be able to

1. explain the properties of refractories and lubricants (L2)
2. illustrate the chemical reactions involved in the manufacturing of cement. (L3)
3. differentiate thermoplastic and thermosetting resins. (L3)

UNIT- V **8 Lectures**

NANO AND SMART MATERIALS

Nano Materials: Introduction to Nanomaterials - nanoclusters, fullerenes, carbon nanotubes (CNT) and nanowires; Sol-gel synthesis of nanomaterials: Reverse micellar method; Applications of nanomaterials in wastewater treatment, lubricants and engines.
Smart Materials: Introduction – Types of smart materials-self healing materials-shape memory alloys and Uses of smart materials.

Learning outcomes:

At the end of the module the student will be able to

1. classify nano and smart materials (L2)
2. explain the synthesis and characterization methods of nano materials. (L2)
3. explain the importance of different types of smart materials. (L2)

Text Books:

1. P.C. Jain and M. Jain, *Engineering Chemistry*, 15th edition, Dhanpat Rai & Sons, Delhi, 2014.
2. B.S Murthy and P. Shankar, *A Text Book of NanoScience and NanoTechnology*, University Press, 2013.

Reference Books:

1. O.G.Palanna, *Engineering Chemistry*, Tata McGraw Hill Education Pvt Ltd, 2009.
2. Sashi Chawla, *A Textbook of Engineering Chemistry*, Dhanapath Rai and sons, 2003.
3. S.S. Dara, *A Textbook of Engineering Chemistry*, S.Chand & Co, 2010.