

Savitribai Phule Pune University First Year of Engineering (2024 Pattern) Course Code: BSC-103-BES Course Name: Engineering Chemistry		
Teaching Scheme	Credit	Examination Scheme
Theory : 03 Hours/Week Practical : 02 Hours/Week	03 01	CCE : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks
Prerequisite Courses, if any: Types of titrations, structure property relationship, classification and properties of polymers, electromagnetic radiation, electrochemical series.		
Course Objectives: To acquire knowledge of water quality analysis technology and electro-analytical techniques for chemical analysis. Learn about specialty polymers and nanomaterials. Study conventional and alternative fuels, and understand corrosion mechanisms and prevention methods.		
Course Outcomes: After successful completion of the course, learner will be able to: CO1: Understand the practical approaches and techniques required to effectively monitor water quality. CO2: Select appropriate electro analytical techniques for understanding the materials. CO3: Demonstrate the structure and properties of advanced engineering materials for various technological applications. CO4: Analyze different types of conventional and alternative fuels. CO5: Explain causes of corrosion and methods for minimizing corrosion.		
Course Contents		
Unit I	Water Technology	(08 Hours)
Impurities in water, hardness of water: Types, Units and Numerical. Determination of hardness (by EDTA method using molarity concept) and alkalinity, numerical. Ill effects of hard water in boilers - priming and foaming, scale and sludge. Water treatment: i) Zeolite method and numerical ii) Demineralization method. Purification of water: Reverse osmosis and Electrodialysis. Modern technique for /of atmospheric water generation.		
Unit II	Instrumental Methods of Analysis	(08 Hours)
Introduction: Types of reference electrode (calomel electrode), indicator electrode (glass electrode), ion selective electrode (solid membrane electrode) [A] Conductometry: Introduction, conductivity cell, conductometric titrations of acid versus base with titration curve. (Strong acid- Strong base). Applications of conductometry. [B] pHmetry: Introduction, standardization of pH meter, pH metric titration of strong acid versus strong base with titration curve and its applications.		

[C] UV-Visible Spectroscopy: Introduction, statement of Beer's law and Lambert's law, Electronic transitions in organic molecule, terms involved in UV-visible Spectroscopy. Instrumentation (double beam) and its applications. Numerical: Based on Absorption laws i.e. Molar absorptivity and concentration.

Unit III	Advanced Engineering Materials	(08 Hours)
-----------------	---------------------------------------	-------------------

A] Polymers: Introduction, Definition Polymer, Monomer, Functionality of monomers, Classification of polymer (Thermal Behavior-Thermoplastics and Thermosetting).

Specialty polymers: Introduction, preparation, properties and applications of the following polymers: 1. Engineering Thermoplastic: Polycarbonate, 2. Bio-degradable polymers: Poly (hydroxybutyrate-hydroxyvalerate), 3. Conducting Polymer: Polyacetylene.

[B] Nanomaterials: Introduction, classification of nanomaterials based on dimensions (zero dimensional, one-dimensional, two-dimensional and three-dimensional), structure, properties and applications of graphene and carbon nanotubes, quantum dots (semiconductor nanoparticles).

Unit IV	Energy Sources	(08 Hours)
----------------	-----------------------	-------------------

Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel), Calorific value, Higher calorific value and Lower calorific value, Determination of calorific value: Principle, construction and working of Bomb calorimeter and Boy's gas calorimeter and numerical, Solid fuel. Coal: Analysis of Coal-Proximate and Ultimate analysis, numerical, Alternative fuels: Power alcohol and biodiesel. Hydrogen gas as a future fuel. Lithium Ion Battery, construction, working, advantages, applications.

Unit V	Corrosion and its Prevention	(08 Hours)
---------------	-------------------------------------	-------------------

Introduction, Types of corrosion – Dry and Wet corrosion, mechanism of dry corrosion, nature of oxide films and Pilling-Bedworth's rule, wet corrosion – mechanism: hydrogen evolution and oxygen absorption, Factors influencing rate of corrosion. Methods of corrosion control and prevention: Cathodic Protection (Sacrificial Anode and Impressed Current), metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, electroplating. Corrosion Resistant / Anti corrosive paints.

List of Laboratory Experiments (Any 8 experiments from the given list).

1. To determine hardness of water by EDTA method.
2. To determine alkalinity of water.
3. To determine strength of strong acid using pH meter
4. To determine maximum wavelength of absorption of CuSO₄/FeSO₄/ KMnO₄, verify Beer's law and find unknown concentration of given sample.

5. Titration of a mixture of weak acid and strong acid with strong base using conductometer.
6. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin.
7. To determine molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
8. Proximate analysis of coal
9. To coat copper and zinc on an iron plate using electroplating.
10. Preparation of biodiesel from oil.
11. Colloidal synthesis of 2-6 or 3-5 semiconductor quantum dots nanoparticles.

Learning Resources

Text Books:

1. Textbook of Engineering Chemistry by Dr. S. S. Dara, Dr. S. S. Umare, S. Chand & Company Ltd.
2. Engineering Chemistry by O. G. Palanna, Tata Magraw Hill Education Pvt. Ltd.
3. Textbook of Engineering Chemistry by Dr. Sunita Rattan, S. K. Kataria & Sons Publisher.

Reference Books:

1. Basic Concept of Analytical Chemistry, 2ed, S. M. Khopkar, New Age-International Publisher.
2. Instrumental Methods of Chemical Analysis, G. R. Chatwal & S. K. Anand, Himalaya Publishing House.
3. Spectroscopy of organic compounds, 2ed, P. S. Kalsi, New Age-International Ltd., Publisher.
4. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, Wiley Eastern Limited.
5. Inorganic Chemistry, 5ed, Shriver and Atkins, Oxford University Press.
6. Fundamentals of Nanotechnology, G. L. Hornyak, J. J. Moone, H. F. Tihale, J. Dutta, CRC press.

e-Books:

1. https://chem.nju.edu.cn/_upload/article/files/b5/6f/01f0f2434d708df797208aea2613/83f2b441-65ee-44a6-ac47-ed21db462c5d.pdf.
2. https://edisciplinas.usp.br/pluginfile.php/5955761/mod_resource/content/1/CORROSION_AND_CORROSION_CONTROL_An_Intro%20%20Revie%20and%20Uhlig.pdf

MOOC / NPTEL/YouTube Links:

1. <https://nptel.ac.in/courses/113104082>