RAGHU ENGINEERING COLLEGE

(Autonomous)
(Approved by AICTE, New Delhi, Permanently Affiliated to JNTU-GV, Vijayanagaram
Accredited by NBA (EEE, ME, ECE & CSE) & NAAC by A+ Grade)
Dakamarri, Bheemunipatnam Mandal, Visakhapatnam Dist. – 531 162 (A.P.)
Ph: +91-8922-248001, 248002 Fax: + 91-8922-248011
e-mail: principal@raghuenggcollege.com website: www.raghuenggcollege.com

Subject Code : 23BS105

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3	0	0	3

ENGINEERING CHEMISTRY

(Common to Civil, Mechanical Engineering)
(AR23)

COURSE OVERVIEW:

Engineering Chemistry course is designed to provide a fundamental understanding of the principles and applications of chemistry as they relate to engineering and technology. This course is a crucial foundation for students seeking to comprehend the properties and applications of materials like batteries, polymers, fuels, lubricants, refractories, nanomaterials and their applications as well as the principles underlying water treatment methods. This course also covers a wide range of topics related to the practical application of chemical principles and techniques in various industries and scientific fields. The specific content and focus of the course is made to provide basic analytical skills to be cherish for lifelong to the graduate students.

Course Objectives:

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

SYLLABUS:

UNIT I Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth (free radical) and step growth polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC, Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S and Buna N

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- methanol, ethanol

Learning Outcomes:

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

1. use different types of polymers for various applications (L2)
2. explain the preparation, properties and applications of some plastics and rubbers. (L2)
3. discuss various types of fuels . (L2)

UNIT II Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells –lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

G. V. Siva

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection.

Learning outcomes:

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

1. illustrate the construction of electrochemical cells. (L3)
2. apply redox principles for construction of batteries and fuel cells. (L3)
3. understand the reasons for corrosion and study methods to control corrosion.(L2)

UNIT III Water Technology

Soft and hardwater, Estimation of hardness of water by EDTA Method- Boiler troubles –Priming, foaming, scale and sludge, Industrial water treatment specifications for drinking water, World health organization(WHO) standards, 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. Discuss the estimation of hardness of water by EDTA method(L2)
2. Explain various boiler troubles and preventive measures(L2)
3. Demonstrate water treatment/softening methods(L3)

UNIT IV Modern Engineering Materials

Composites- Definition, Constituents, Classification-Fibre reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors leading to the failure of refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Thin layer mechanism, Properties of lubricating oils, Flash point, Fire point, Cloud point, pour point and Applications.

Building materials-Manufacturing of Portland Cement, constituents, Setting and Hardening of cement.

Learning outcomes:

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

1. Understand the properties and applications of modern engineering materials like composites, refractories, lubricants.(l2)
2. Understand the mechanism of lubrication (L2)
3. explain the chemistry behind the setting and hardening of cement (L2)

UNIT V Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, chemical methods of preparation of nanometals and metal oxides, and nanomaterials, adsorption isotherm (Freundlich and Longmuir) applications of colloids and nanomaterials – catalysis, medicine,

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Learning outcomes:

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

1. explain the synthesis of nano materials and colloids. (L2)
2. discuss role of colloids & nanomaterials in the field of medicine and catalysis (L2)
3. compare Freundlich and Longmuir adsorption isotherms. (L3)

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman,1992.

COURSEOUTCOMES:

By the end of the course, the learners will be able to:

S.No.	Description	Bloom's Taxonomy Level (BTL)
1.	Explain properties of polymers & fuels	2
2.	Demonstrate the essentials of electrochemistry and corrosion prevention	3
3.	Demonstrate water quality parameters and various purification techniques	2
4.	Explain properties and applications of engineering materials and setting and hardening of cement.	3
5	Summarize the concepts of colloids, micelle and nanomaterials.	2

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CO – PO Mapping:

Course outcomes (CO)	Program Outcomes (PO)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1							1			1
CO2	3	2							1			1
CO3	3	2							1			1
CO4	3	1							1			1
CO5	3	1							1			1
Average	3	1.4							1			1
Average (rounded)	3	1							1			1

1 - Slight (Low); 2 - Moderate (Medium) 3 - Substantial (High)

Program Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to solve complex engineering problems.

2. **Problem analysis:** Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental concerns.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods, including design of experiments, analysis, interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.