

AME-104: ENGINEERING CHEMISTRY

Course Title	Engineering Chemistry	Course Code	AME-104
Semester	I	Course Group	Basic Science
Teaching Scheme in Periods(L:T:P)	60:15:0	Credits	3.0
Methodology	Lecture + Tutorial	Total Contact Periods	75
CIE	60 Marks	Semester End Exam (SEE)	40 Marks

Pre requisite: Basic knowledge of chemistry in secondary education.

Course objective: After studying this course the student will be able to understand and appreciate the role of chemistry and environmental studies in different spheres of industries.

Course Outcome: On successful completion of the course, the students will have ability to attain following Course Outcomes (CO):

CO1	Understand the fundamental chemical concepts and apply the problem-solving abilities for various engineering and industrial applications.
CO2	Identify the hardness and degree of hardness of water and apply the relevant water treatment methods to solve domestic and industrial problems.
CO3	Use the knowledge of metallurgical processes in the extraction of metals and in making alloys and apply the knowledge of corrosion to protect the metal.
CO4	Understand the applications and environmental impacts of engineering materials, and fuels to explore sustainable options.
CO5	Understand the basic concepts of electrochemistry and apply for preparation of chemicals, electroplating, electrolytic refining and for construction of various batteries
CO6	Understand the concept of bio diversity and its conservation, pollution impacts, and apply the knowledge for sustainable practices in engineering/technical fields

CO-PO-Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	-	-	1	-	2
CO2	3	1	-	-	2	-	2
CO3	3	-	-	-	1	-	2
CO4	3	1	-	-	1	-	2
CO5	3	1	-	-	1	-	2
CO6	3	-	-	-	3	-	3

COURSE CONTENTS:

UNIT-I: FUNDAMENTALS OF CHEMISTRY

L10 + T3 Periods

Atomic structure - Atomic number – Mass number- Orbitals - Shapes of s, p and d orbitals – Aufbau principle - Hund's rule, Pauli's exclusion principle-Electronic configuration of elements

Chemical bonding–Ionic bond, Covalent bond - Properties of ionic and covalent compounds.

Oxidation-Reduction: Electronic concept of Oxidation, Reduction and Redox reaction.

Solutions –Atomic weight - Molecular weight, Equivalent weight - Mole concept – Molarity – Normality - Numerical problems on mole, molarity and normality - Ionic product of water - pH and related numerical problems- Buffer solutions - Applications of buffer solutions

UNIT-II: WATER TECHNOLOGY

L10+ T2 periods

Introduction - Soft and hard water - Causes of hardness –Types of hardness-Disadvantages of hard water using in industries-Degree of hardness-Softening methods- Permutit process, Ion exchange process– Osmosis - Reverse Osmosis - Advantages of Reverse osmosis – Desalination by Electro dialysis- Drinking water - Municipal treatment of water for drinking purpose .

UNIT -III: METALLURGY AND CORROSION

L10 + T2 Periods

Characteristics of metals - Mineral, Ore, Gangue, Flux, Slag -Concentration of ore - Roasting, Calcination, Smelting - Extraction of aluminium –Alloys-Purpose of making alloys –Composition and uses of Brass, Nichrome and Duralumin.

Corrosion - Factors influencing the rate of corrosion – Electrochemical theory of corrosion – Composition cell, Stress cell and Concentration cell - Rusting of iron and its mechanism - Prevention of corrosion – Protective coatings - Cathodic protection.

UNIT–IV: ENGINEERING MATERIALS AND ENERGY RESOURCES: L10+

T3 Periods

Polymers - Polymerization - Types of polymerization – Addition polymerization, Condensation polymerization - Plastics - Advantages of plastics over traditional materials - Disadvantages of using plastics- Types of plastics - Preparation and uses of the following plastics: 1. Polythene 2.PVC 3. Urea formaldehyde resin 4. Bakelite - Natural rubber –Vulcanization of natural rubber - Elastomers – Preparation and uses of Buna-s, Neoprene rubber - Biodegradable polymers -

Advantages of bio degradable polymer

Lubricants– Classification and functions of lubricants.

Definition and classification of fuels - Calorific value - Advantages of Gaseous fuel – Composition and uses of gaseous fuels - a) CNG b) LPG c) Producer gas.

UNIT-V: ELECTROCHEMISTRY

L10+ T3 Periods

Conductor, insulator, electrolyte –Electrolysis – Electrolysis of fused NaCl - Applications of electrolysis - Faraday's laws of electrolysis - Numerical problems.

Galvanic cell – Standard electrode potential –Electro chemical series – EMF of cell – Batteries -Types of batteries – Leclanche' cell, Lithium - ion Battery – H₂-O₂ Fuel cell.

UNIT-VI: ENVIRONMENTAL STUDIES

L10+ T2 periods

Introduction - Environment – Segments of environment - Important terms - Biodiversity, definition, threats to Biodiversity - e-waste –Management of e-waste.

Air pollution - Causes, effects, and controlling methods - Water pollution – Causes, effects, controlling methods– Carbon credit and carbon trading - Sustainable development

Reference Books:

1. Engineering chemistry–Jain &Jain –Dhanpat Rai Publishing Company.
2. A Text book of Engineering Chemistry–S.S. Dara – S. Chand Publications.
3. Environmental Studies –A.K. De.
4. Environmental Studies, R. Rajagopalan,2nd Edition,2011, Oxford University Press
5. Intermediate Chemistry I and II–Telugu Academy TS
6. Engineering chemistry– Prasanta Rath, B.Ramadevi, Ch. Venkataramana Reddy & Subhendu Chakroborty–CENGAGE

E- Learning links:

<https://iupac.org>, <https://www.khanacademy.org>, www.nptel.ac.in.

Learning outcome: Upon completion of this course the student will be able to

UNIT- I: FUNDAMENTALS OF CHEMISTRY

- 1.1 Define and explain atomic number and mass number.
- 1.2 Define an orbital and explain the shapes of s, p and d orbitals.
- 1.3 Define electronic configuration and apply Aufbau principle, Hund's rule, and Pauli's exclusion principle in writing electronic configuration of elements up to atomic number 30.
- 1.4 Define chemical bond.
- 1.5 Define ionic bond and explain the ionic bond formation in NaCl.
- 1.6 Define and explain the covalent bond formation in homo atomic molecules: H₂, O₂, N₂
- 1.7 Compare the properties of ionic compounds and covalent compounds
- 1.8 Define and explain the electronic concept of oxidation, reduction and redox reaction.
- 1.9 Define the terms: solution, solute and solvent with examples.
- 1.10 Define atomic weight, molecular weight and equivalent weight
- 1.11 Find the molecular weight and the equivalent weight of acids, bases and salts.
- 1.12 Explain mole concept and solve the numerical problems on mole concept.
- 1.13 Define and explain molarity and normality.
- 1.14 Solve numerical problems on molarity and normality.
- 1.15 Define and explain the ionic product of water and solve numerical problems.
- 1.16 Define pH and solve numerical problems on pH.
- 1.17 Define buffer solution and explain the general applications of buffer solutions.

UNIT II: WATER TECHNOLOGY

- 2.1 Define the terms soft water and hard water.
- 2.2 Define hardness of water and name the salts responsible for hardness.
- 2.3 Define and explain the types of hardness of water – temporary and permanent hardness
- 2.4 Identify the disadvantages of using hard water in industries: i) Laundry, ii) Paper industry, iii) Sugar industry iv) Pharmaceutical industry and v) Boilers
- 2.5 Define degree of hardness of water and its units – ppm, mg/L
- 2.6 Solve the numerical problems on degree of hardness of water.
- 2.7 Removal of total hardness by i) Permutit process and ii) Ion exchange process.
- 2.8 Define osmosis and reverse osmosis (RO).
- 2.9 List the applications and advantages of reverse osmosis.
- 2.10 Define and explain the desalination of sea water by electro dialysis process.
- 2.11 List the essential qualities of drinking water.
- 2.12 Explain the method of municipal treatment of water for drinking purpose with diagram.
 - a) Sedimentation and coagulation b) filtration, c) sterilization by bleaching powder and ozonization,

UNIT–III: METALLURGY AND CORROSION

- 3.1 List the characteristics of metals.
- 3.2 Define and explain the terms 1.Mineral 2.Ore 3.Gangue, 4.Flux and 5.Slag -with examples
- 3.3 Methods for the concentration of ore i) Froth floatation and ii) Electromagnetic separation
- 3.4 Explain the roasting, calcination and smelting processes with examples.
- 3.5 Extraction of aluminium from bauxite (Flow chart only).
- 3.6 Define an alloy and explain the purpose of making alloys.
- 3.7 Explain the composition and uses of the following alloys i) Brass ii) Nichrome iii) Duralumin
- 3.8 Define corrosion
- 3.9 Explain the factors influencing the rate of corrosion based on i) Nature of metal and ii) Environment of

metal.

- 3.10 Explain the electrochemical theory of corrosion.
- 3.11 Explain the formation of a) Composition cell b) Stress cell and c) Concentration cell.
- 3.12 Define rust and explain the mechanism of rusting of iron with chemical equations.
- 3.13 Explain the following methods of prevention of corrosion:
 - a) Protective coatings i) Metallic coatings (anodic and cathodic coatings)
 - ii) Inorganic coatings and iii) Organic coatings
 - b) Cathodic protection i) Sacrificial anode method and ii) Impressed voltage method

UNIT-IV: ENGINEERING MATERIALS AND ENERGY RESOURCES

- 4.1 Define polymer and polymerization
- 4.2 Explain addition polymerization and condensation polymerization with examples.
- 4.3 Define the term plastic
- 4.4 Summarize the advantages of plastics over traditional materials
- 4.5 Explain the disadvantages of using plastics on environment.
- 4.6 Explain the types of plastics (thermo and thermosetting plastics) with examples.
- 4.7 Identify the differences between thermo plastics and thermosetting plastics
- 4.8 Explain a preparation method and uses of the following plastics: a) Polythene, b) Poly vinyl chloride, c) Urea formaldehyde resin and d) Bakelite (flow chart for Bakelite i.e. without chemical equations).
- 4.9 Define the term natural rubber
- 4.10 Explain the processing of natural rubber from latex.
- 4.11 Write the chemical structure of natural rubber.
- 4.12 Explain the process of vulcanization of natural rubber with chemical equations.
- 4.13 Compare the characteristics of natural rubber and vulcanized rubber
- 4.14 Define the term elastomer.
- 4.15 Explain the preparation and uses of the following elastomers - a) Buna-S b) Neoprene rubber.
- 4.16 Define a biodegradable polymer and mention the advantage of bio degradable polymers.
- 4.17 Define and classify the lubricants based on physical state.
- 4.18 Explain the functions of lubricants
- 4.19 Define fuel and classify the fuels based on their occurrence and physical state with examples.
- 4.20 Define calorific value
- 4.21 Explain the advantages of gaseous fuels
- 4.22 Explain the chemical composition and uses of a) CNG b) LPG c) Producer gas

UNIT V: ELECTROCHEMISTRY

- 5.1 Define the terms – a) conductor b) insulator c) electrolyte and d) non-electrolyte.
- 5.2 Define electrolysis.
- 5.3 Explain the electrolysis of fused NaCl.
- 5.4 Explain the applications of electrolysis a) Electrolytic refining of copper and b) Electroplating.
- 5.5 State and explain Faraday's laws of electrolysis
- 5.6 Define chemical equivalent, electrochemical equivalent and find the relationship between them
- 5.7 Numerical problems based on Faraday's first law and second law of electrolysis.
- 5.8 Define galvanic cell.
- 5.9 Explain the construction and working of Daniel cell.
- 5.10 Distinguish between electrolytic cell and galvanic cell.
- 5.11 Explain electrode potential, oxidation potential, reduction potential and standard electrode potential.
- 5.12 Define electrochemical series and explain its significance.
- 5.13 Define and explain the EMF of galvanic cell and solve the numerical problems.

- 5.14 Define battery and state the types of batteries (primary and secondary battery) with examples.
- 5.15 Explain the construction, working and applications of a) Dry cell (Leclanche' cell), b) Lithium - ion battery.
- 5.16 Explain the construction, working and advantages of Hydrogen - Oxygen fuel cell

UNIT-VI: ENVIRONMENTAL STUDIES

- 6.1 Define and explain different segments of environment: i) Atmosphere, ii) Hydrosphere, iii) Lithosphere and iv) Biosphere
- 6.2 Define the terms: i) Pollutant, ii) Contaminant iii) Pollution, iv) Receptor v) Particulates.
- 6.3 Define biodiversity and explain the threats to biodiversity
- 6.4 Explain the methods of conservation of biodiversity
- 6.5 Define e-waste and explain the sources of e-Waste
- 6.6 Explain the effect of e-waste on environment and human beings
- 6.7 Explain the management of e-waste-a) Land filling, b) Incineration and c) Recycling.
- 6.8 Define air pollution
- 6.9 Explain the causes of air pollution
- 6.10 Explain the effects of air pollution on human beings.
- 6.11 Explain greenhouse effect, its consequences and control methods
- 6.12 Explain acid rain, its consequences and control methods
- 6.13 Explain ozone layer depletion, its consequences and control methods
- 6.14 Explain the controlling methods of air pollution
- 6.15 Define water pollution
- 6.16 Explain the causes of water pollution
- 6.17 Explain the effects of water pollution on living and non-living things
- 6.18 Explain the control methods of water pollution.
- 6.19 Understand the concept of carbon credits and carbon trading (elementary level only)
- 6.20 Understand the advantages and disadvantages of carbon trading
- 6.29 Sustainable development a) Environmental sustainability b) Social sustainability c) Economic sustainability

BOARD DIPLOMA EXAMINATIONS (C-26)
FIRST SEMESTER EXAMINATION MID – I
AME–104, ENGINEERING CHEMISTRY

Time: 1 hour

Max. Marks: 20

PART – A

Instructions: Answer all questions. Each question carries one mark

4 x 1 = 4 marks

1. Define orbital.
2. Define mole.
3. Define soft water.
4. What is osmosis?

PART – B

Instructions: Answer the following questions. Each question carries three marks. 2 x 3 = 6 marks

5. a) State and explain Hund's rule.

(or)

b) Explain any three general applications of buffer solutions

6. a) Outline any three disadvantages of using hard water in industries?

(or)

b) Write any three advantages of reverse osmosis?

PART – C

Instructions: Answer the following questions. Each question carries five marks. 2 x 5 = 10 marks

7. a) Identify and explain the chemical bonding in NaCl and O₂ molecules.

(or)

b) Calculate the molarity of 500 ml of aqueous solution containing 2 grams of NaOH.

8. a) Explain the process of removal of hardness of water by ion exchange process.

(or)

b) How to utilize the electro dialysis process for desalination of sea water? Explain with a neat diagram.

BOARD DIPLOMA EXAMINATIONS (C-26)
FIRST SEMESTER EXAMINATION MID – II
AME–104, ENGINEERING CHEMISTRY

Time: 1 hour

Max. Marks: 20

PART – A

Instructions: Answer all questions. Each question carries one mark

4 x 1 = 4 marks

1. Define mineral.
2. Mention any two factors influencing rate of corrosion.
3. Define polymerization.
4. What are elastomers?

PART – B

Instructions: Answer the following questions. Each question carries three marks. 2 x 3 = 6 marks

5. a) Explain the process of roasting with examples.
(or)
b) Explain the formation of composition cell formed during corrosion.
6. a) Outline any three differences between thermoplastics and thermosetting plastics.
(or)
b) Classify the fuels based on physical state.

PART – C

Instructions: Answer the following questions. Each question carries five marks. 2 x 5 = 10 marks

7. a) Build a flow chart for extraction of aluminium from bauxite.
(or)
b) Explain sacrificial anode method of prevention of corrosion.
8. a) Explain the vulcanization of natural rubber with equations.
(or)
b) Explain any five functions of lubricants.

BOARD DIPLOMA EXAMINATIONS (C-26)
FIRST SEMESTER END EXAMINATION
AME-104, ENGINEERING CHEMISTRY

Time: 2 hours

Max.Marks: 40

PART – A

Instructions: Answer all questions. Each question carries one mark

8 x 1 = 8 marks

1. Define atomic number.
2. Define fuel.
3. Define particulate.
4. List the chemicals that cause temporary hardness
5. What is electrolyte?
6. Define emf.
7. Define hydrosphere.
8. What is carbon trading?

PART – B

Instructions: Answer the following questions. Each question carries three marks. 4 x 3 = 12 marks

9. a) Explain the formation of chemical bonding in NaCl.

(or)

- b) Explain the electrolysis of fused NaCl.

10. a) Explain the mechanism of rusting of iron with equations.

(or)

- b) Explain any three causes of water pollution

11. a) What is electrochemical series and explain its significance.

(or)

- b) Distinguish the galvanic cell and electrolytic cell.

12. a) Explain environmental sustainability

(or)

- b) Explain the reasons for greenhouse effect, its consequences and controlling methods.

PART – C

Instructions: Answer the following questions. Each question carries five marks. 4 x 5 = 20 marks

13. a) Find out the pH value of 100 ml of aqueous solution containing 0.0365 grams of HCl.

(or)

- b) Making use of the electrolytic refining process, explain the purification of copper.

14. a) What are biodegradable polymers? Explain any four advantages of biodegradable polymers.

(or)

- a) Choose the methods of conservation of biodiversity and explain.

15. a) Calculate the weight of copper deposited when 2 amperes of electric current is passed for two hours through CuSO₄ solution. (Atomic weight of Cu is 63.5)

(or)

- b) Explain the construction and working of Dry cell with equations.

16. a) Identify any five controlling methods of air pollution and explain.

(or)

- b) Select and explain any three management methods of e-waste.