

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous) Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION FORM

Course Title	ENGINEERING CHEMISTRY			
Course Code	AHS006			
Course Structure	Lectures	Tutorials	Practicals	Credits
	3	-	-	3
Course Coordinator	Ms. V Anitha Rani, Assistant Professor			
Team of Instructors	Ms. V Anitha Rani, Mr. B Raju, Ms. G Satyakala, Ms. M Malathi			
	Mr. G Mahesh Kumar, Mr. M Praveen, Ms. T Mallika			
	Mr. V Tarak Rama	a Rao		

I. COURSE OVERVIEW

The primary objective of an Engineering Chemistry course is to introduce the students to the concepts and applications of chemistry in Engineering. It should cultivate in them an ability to identify chemistry in each piece of finely engineered products used in households and industry. It aims to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications. It deals with applied and industrially useful topics, such as Water Technology, Engineering materials, Electrode Potential and Cells, Fuels, Polymers and Corrosion. This course will involve minimum lecturing, content will be delivered through assigned reading and reinforced with large and small group discussions, as well as assigned in class (and occasional out of class) group activities. Water and its treatment for various purposes, engineering materials such as plastics, composites, ceramic, abrasives, their preparation, properties and applications, corrosion and control of metallic materials.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	3	3	Basic concepts of physical chemistry

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Chemistry	70 Marks	30 Marks	100 Marks

Semester End Examination 70 Marks All the Units (1, 2, 3, 4 and 5)	70 Marks (3 Hours)	5 questions to be answered. Each question carries 14 Marks
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Continuous Internal Assessment - 1

Average of two CIA Examinations	30 Marks (2 Hours)	Units I, II and III (half)	Continuous Internal Examination (CIE)	Part - A 5 questions to be answered out of 5 questions, each carries 1 mark.	
			(2 hours)	4 questions to be answered out of 5 questions, each carries 5 marks.	
			Quiz-I /Alternate Assessment Tool (AAT- I)	5 marks for assignment.	
	Continuous Internal Assessment - 2				
	30 Marks Units (2 Hours) IV and V	Continuous Internal	Part – A 5 questions to be answered out of 5 questions, each carries 1 mark.		
		Units III (half) IV and V	(2 hours)	Part - B 4 questions to be answered out of 5 questions, each carries 5 marks.	
			Quiz-II /Alternate Assessment tool (AAT- II)	5 marks for assignment.	

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	CIE - I Examination	2 hour	25
2	Quiz - I / AAT - I	-	05
	TOTAL	30	
3	CIE - II Examination	2 hour	25
4	Quiz - II / AAT - II	-	05
TOTAL			30
	CIA Examination marks to be co	nsidered as average of abov	e two CIA's
5	EXTERNAL Examination	3 hours	70
	GRAND TOTAL		100

V. COURSE OBJECTIVES

The course should enable the students to:

- I. Apply the electrochemical principles in batteries units.
- II. Understand the fundamentals of corrosion and development of different techniques in corrosion control.
- III. Analysis of water for its various parameters and its significance in industrial applications.
- IV. Improve the fundamental science and engineering principles relevant to materials.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

- 1. **Extrapolate** the knowledge of electrode, cell, anode, cathode, electrolysis, electromotive force and reference electrodes.
- 2. Identify the electrolytic cell and electrochemical cells with the different types of batteries.
- 3. **Know** the main factors affecting the rate of corrosion.
- 4. Apply the corrosion control methods to prevent corrosion on metals.
- 5. **Understand** the basic principles of polymers.
- 6. **Explore** the engineering applications of polymeric materials.
- 7. **Justify** the immense importance of basic constructional material, Portland cement in Civil Engineering works.
- 8. Assess the quality and utility of suitable water for industrial as well as domestic applications.
- 9. **Describe** the combustion process of the fuels and the calorific values of the fuels.
- 10. Develop awareness about the usage of lubricants in industries.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

	Program outcomes	Level	Proficiency assessed by
PO1	Engineering knowledge : Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Н	Assignments
PO2	Problem analysis : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	Н	Assignments
PO3	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 the public health and safety, and the cultural, societal, and environmental considerations.	S	Assignments
PO4	Conduct investigations of complex problems : Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Assignments
PO5	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.	S	
PO6	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.	S	
PO7	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.	S	
PO8	Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	
PO9	Individual and team work: Function effectively as an individual,	Ν	

	and as a member or leader in diverse teams, and in multidisciplinary settings		
PO10	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	N	
PO11	Project management and finance : Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	
PO12	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.	Н	

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

	Program Specific Outcomes	Level	Proficiency
			Assessed by
PSO 1	Professional Skills: The ability to research, understand and	S	Lectures and
	implement computer programs in the areas related to algorithms,		Assignments
	system software, multimedia, web design, big data analytics, and		
	networking for efficient analysis and design of computer-based		
	systems of varying complexity.		
PSO 2	Problem-Solving Skills: The ability to apply standard practices and	S	Assignments
	strategies in software project development using open-ended		
	programming environments to deliver a quality product for business		
	success.		
PSO 3	Successful Career and Entrepreneurship: The ability to employ	S	Assignments
	modern computer languages, environments, and platforms in creating		
	innovative career paths, to be an entrepreneur, and a zest for higher		
	studies.		
N - 1	None S - Supportive H – Highly I	Related	•

UNIT – I

Electrochemistry: Basic concepts of electrochemistry; Conductance: Specific, equivalent and molar conductance and effect of dilution on conductance; Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; Electrochemical series and its applications; Nernst equation; Types of electrodes: Calomel electrode, quinhydrone electrode; Batteries: Classification of batteries, primary cells (dry cells) and secondary cells (lead-acid battery, Ni-Cd cell), applications of batteries, numerical problems.

UNIT – II

Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions.

UNIT – III

Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement.

Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, Sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.

UNIT – IV

Materials chemistry: Polymers-classification with examples, polymerization-addition, condensation and copolymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of Polyvinylchloride, Teflon, Bakelite and Nylon-6, 6; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, Preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples, propertiesviscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples.

UNIT – V

Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal, analysis of coalproximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of Natural gas, LPG and CNG; Combustion: Calorific value-Gross calorific value(GCV) and net calorific value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

Textbooks:

- 1. P. C. Jain, Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 15th Edition, 2015.
- 2. Shasi Chawla, "Text Book of Engineering Chemistry", Dhantpat Rai Publishing Company, New Delhi, 1st Edition, 2011.

Reference Books:

- 1. B. Siva Shankar, "Engineering Chemistry", Tata Mc Graw Hill Publishing Limited, 3rd Edition, 2015.
- 2. S. S. Dara, Mukkanti, "Text of Engineering Chemistry", S. Chand & Co, New Delhi, 12th Edition, 2006.
- C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5th Edition, 2013.
- 4. R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	Understands the concept of electrochemistry. Differentiate the electronic conductors and electrolytes.	Concept of Electro Chemistry- conductors; electrolyte and electrolysis.	T2
2	Define the terms specific, equivalence and molar conductance. Explain the dilution effect on these conductance	Conductance - Specific, Equivalent and Molar conductance and their Units	Τ2
3	Understands the concept of specific, equivalence and molar conductance. Define the EMF of the cell. Demonstrate the Daniel cell.	Numerical problems EMF: Galvanic Cells	T2
4	Describe the construction and chemical reactions of different electrodes. Use the Calomel	Types of Electrodes : (Calomel)	T1,T2
5	quinhydrone electrodes in calculation of potential of the single electrode.	Types of Electrodes : (Quinhydrone)	T1,T2
6	Derive the relation between cell reaction and emf of the single electrodes.	Nernst equation and its applications	T1, T2
7	Use the standard potential values of elements from electrochemical series.	Use the standard potential values of elements from electrochemical series	T2
8	Define the battery; differentiate the primary and secondary batteries. Demonstrate the construction of the dry cell.	Batteries: Primary cells (dry cells)	T2
9	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	Secondary cells (lead-Acid cell). Applications of batteries	T2
10	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	Secondary cells (Ni-Cd cell). Applications of batteries	T2,R4
11	Define corrosion and its disadvantages.	Corrosion-Definition ,Causes and effects of corrosion	T1,T2,R4
12	Explain the mechanism of oxidation corrosion when dry gases attack on metal.	Theories of corrosion – Chemical corrosion theory	T1,T2,R4
13	Explain the mechanism of hydrogen evolution type and oxygen absorption type corrosion.	Electrochemical corrosion	T1,T2,R4

14	Distinguish the types of corrosion.	Types of corrosion (water line, crevice)	T2,R4
15	Analyze the effect of different factors on rate of corrosion.	Factors affecting rate of corrosion based on Nature of metal& Nature of Environment	T1,T2,R4
16	Explain the process of cathodic protection with examples.	Corrosion control methods – Cathodic protection (sacrificial anodic and impressed current)	T2,R4
17	Use the methods of application of metallic coatings and Relate the galvanization and tinning	Surface coatings: Metallic coatings & methods of application of metallic coatings Hot dipping (galvanization & tinning)	T2,R4
18	Explain the process of electroplating. Apply the organic coatings for control of corrosion.	Electroplating (copper plating) Organic coatings – Paints - constituents and their functions.	T2,R4
19	List the various sources of water, Differentiate the temporary and permanent hardness and give its units.	Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems.	T2,R4
20	Calculate the total, permanent and temporary hardness of sample hard water by using EDTA	Estimation of temporary & permanent hardness of water by EDTA.	T2,R4
21	Calculate the dissolved oxygen in water by Winkler's method	Determination of dissolved oxygen by Winkler's method	T1,T2
22	Recognize the boiler troubles.	Boiler troubles – Priming and foaming, caustic embrittlement	T2,R4
23	Recognize the boiler troubles.	Boiler troubles – Scale & sludges	T2,R4
24	Discuss the internal treatment methods of boiler feed water. Name the different chemicals used in internal treatment.	Treatment of boiler feed water – Internal treatment (Phosphate,carbonate and calgon conditioning)	T2,R4
25	Explain the process of zeolite and analyze the advantages and disadvantages.	External treatment –Zeolite process	T2,R4
26	Explain ion-exchange process. Demonstrate the treatment of potable water.	Ion exchange process, Potable water-its specifications, steps involved in the treatment of potable water.	T2,R4
27	Purification of potable water. Describe the process of reverse osmosis	Sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.	T2,R4
28	Define monomer and polymer Explain the mechanism of different types of Chain and step growth polymerization.	Materials chemistry: Polymers- classification with examples, polymerization-addition, condensation and co-polymerization.	T1,T2,R4
29	Distinguish the thermoplastic and thermo set plasites. Illustrate the compounding of plastics.	Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics.	T1,T2,R4
30	Identify the preparation, properties and	Preparation, properties and applications	T2,R4

	applications of different thermo and thermo set plastics.	of Polyvinylchloride, Teflon and Nylon- 6, 6.	
31	Identify the preparation, properties and applications of thermo set plastics. Explain about natural rubber.	Preparation, properties and applications of Bakelite Rubbers: Natural rubber its process and vulcanization.	T2,R4
32	Explain the preparation, properties and applications of synthetic rubbers.	Elastomers: Buna-s and Thiokol rubber.	T2,R4
33	Explain the preparation, properties and applications of fibers.	Fibers: Characteristics of fibers, Preparation properties and applications of Dacron. Characteristics of fiber reinforced plastics.	T2,R4
34	Generalize the process of setting and hardening reactions of cement	Composition of Portland cement, setting and hardening of Portland cement.	T2,R4
35	Define the term lubricant and it's classification.	Lubricants: Classification with examples	T2,R4
36	Compare the different types of lubricants based on their properties.	Lubricant properties- viscosity, flash, fire, cloud and pour point	T1,R4
37	Name the different types of refractories. Discuss the characteristics and applications of refractories.	Refractories: Characteristics and classification with examples	T1,R4
38	Define the fuel with examples. Categorize the different types of fuels.	Fuel: Definition, classification of fuels and characteristics of a good fuels;	T1,T2,R4
39	Analyze the different types of coals. Explain the significance of proximate analysis of coal.	Solid fuels: Coal, analysis of coal- proximate and	T1,T2,R4
40	Explain the significance of Ultimate analysis of coal.	Analysis of coal -ultimate analysis;	T1,T2,R4
41	Identify the chemical constituents of petroleum. Describe the refining of petroleum. Define the term cracking. Distinguish the fixed bed and catalytic cracking.	Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking;	T1,T2,R4
42	Evaluate the octane and cetane rating of the petrol and diesel.	Knocking: Octane and cetane numbers;	T1,T2,R4
43	Identify the chemical constituents of the gaseous fuel. Discuss the characteristics of natural gas.Compare the LPG and CNG.	Gaseous fuels: Composition, characteristics and applications of Natural gas, LPG and CNG	T2,R4
44	Explain the combustion process of different chemical constituents present in the fuel. Differentiate the HCV and LCV.	Combustion: Calorific value-Gross calorific value(GCV) and net calorific value(NCV)	T1,T2,R4
45	Evaluate the air quantity required for complete combustion of fuel.	calculation of air quantity required for complete combustion of fuel, numerical problems.	T1,T2,R4

IX. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes													Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
Ι	Н	S	Н	Н	S	S	S		Н	S	Н	S	S	S	S	
Π	Н	Н	Н	S	S	Н	Н		S	S	S	S				
III	Н	Н	Н	Н	S	Н	Н		S	S	S	S		S	S	
IV	Н	Н	Н	S	S	Н	Н		Н	S	Н	S	S	S	S	
S = Supportive											H = Highly related					

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
1	Н	S	S	Н	S	Н	S		S	S	S	S	S	S		
2	Н	S	S	Н	Н	S	S		Н	Н	Н	S	S	S		
3	Н	S	S	S	Н	Н	Н		S	S	S	S	S	Н		
4	Н	Н	S	Н	Н	Н	Н		S	S	S	S	Н	Н	S	
5	Н	S	S	S	S	S	Н		S	S	S	S	S	S		
6	Н	Н	S	Н	Н	Н	Н		S	S	Н	S	Н	Н	S	
7	Н	S	S	S	S	S	Н		S	Н	Н	S	S	S		
8	Н	Н	S	Н	Н	S	Н		Н	Н	Н	S	S	S	S	
9	Н	S	S	S	Н	S	Н		S	S	S	S	S	S		
10	Н	S	S	S	Н	Н	S		S	S	S	S	S	Н		
S = Supportive									H = Highly related							

Prepared by: Ms. V Anitha Rani, Assistant Professor

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