



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

QUESTION BANK

Course Title	ENGINEERING CHEMISTRY				
Course Code	AHSD03				
Program	B.Tech				
Semester	I	CSE			
Course Type	FOUNDATION				
Regulation	IARE - BT23				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr V Anitha Rani, Associate Professor				

COURSE OBJECTIVES:

The students will try to learn:

I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The polymerization reactions with respect to mechanisms and its significance in industrial applications.
IV	The significance of green chemistry to reduce pollution in environment by using natural resources.

COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Implement the principles of electrochemical systems to control the corrosion in metals.
CO 2	Analyze the water quality characteristics for its usage in domestic and industrial purposes.
CO 3	Use complexometry for calculation of hardness of water to avoid industrial problems.

CO 4	Extend the applications of polymers based on their degradability and properties.
CO 5	Choose the appropriate fuel based on their calorific value for energy efficient processes.
CO 6	Predict the knowledge on viability of advanced materials for technological improvements in various sectors.

MODULE I				
BATTERIES CHEMISTRY AND CORROSION				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	QUESTION	Taxonomy	How does this subsume the level	CO's
1	Why lithium is best reducing agent whereas Fluorine is best oxidizing agent. Explain?	Understand	Learner to recall the E^0 values of electrodes and understand to know the reducing and oxidizing agent with respect to standard hydrogen electrode.	CO1
2	What is the composition of salt bridge used between two half cells? Why is salt bridge used in construction of a cell?	Understand	Learner to recall the construction of galvanic cell and understand the inert electrolyte used in the cell to maintain electrical neutrality in both the half cells.	CO1
3	What are the electrodes and electrolytes used in lead acid battery and Li-ion battery?	Understand	Learner to recall the electrodes and electrolytes and understand the construction of batteries.	CO1
4	Copper gets deposited on iron nail immersed in copper sulphate solution. Give reason.	Understand	Learner to recall the electrochemical cell, understand the redox reaction.	CO1
5	Can we store CuSO_4 in zinc vessel or silver vessel? Justify	Apply	Learner to recall the electrochemical series, understand the reduction electrode potential values (E^0) values and apply to prevent corrosion.	CO1

6	Why does a steel pipe in a large copper tank corrode and causing rapid destruction?	Understand	Learner to recall the electrochemical corrosion in metals and understand the oxygen absorption type corrosion.	CO1
7	Iron does not rust even if Zinc coating is broken in a galvanized iron pipe but rusting occurs much faster if tin coating is over iron is broken. Explain?	Understand	Learner to recall the concept of anodic and cathodic coatings and understand the formation of electrochemical cell on the surface of coating metal.	CO 1
8	How is cathodic protection of iron different from its galvanization?	Understand	Learner to recall the concept of metallic coatings and cathodic protection understand the process of how metal can be protected without undergoing corrosion.	CO 1
9	“can we use aluminium in place of zinc for cathodic protection of rusting of iron”.Explain?	Understand	Learner to recall the electrochemical series and understand to use the electrodes with high negative potentials as anodes..	CO 1
10	Galvanized container is not used for storage of food products, but tin coated container is used. Comment on the statement..	Understand	Learner to recall the galvanizing and tinning understand the toxic nature of zinc and non toxic nature of tin metal. cathodic coatings and understand the formation of electrochemical cell on the surface of coating metal.	CO 1
PART B-LONG ANSWER QUESTIONS				
1	What is Galvanic cell? Explain the construction of Galvanic cell with electrode reactions.	Understand	Learner recall the concept of redox reaction and understand the production of electrical energy from chemical energy.	CO 1

2	Differentiate between electrolytic cell and electrochemical cell. Explain the construction of electrolytic cell with chemical reactions	Understand	Learner to recall the concept of types of cells and understand the conversion of electrical energy to chemical energy.	CO 1
3	State electrochemical cell ? Explain the construction and functioning of Daniel cell.	Understand	Learner recall the concept of redox reaction and understand the production of electricity from spontaneous redox reaction.	CO 1
4	Define electrochemical series and Explain the Electrochemical series with its applications.	Understand	Learner to recall the concept of standard hydrogen electrode and understand the potential of various electrodes with its applications.	CO 1
5	How a battery is different from a cell? Classify the batteries with example.	Understand	Learner to recall the concept of electrochemical cell and understand the types of batteries.	CO 1
6	Illustrate the construction and working principle of Zinc air battery with reactions and mention its applications.	Understand	Learner to recall the working of electrochemical cell and understand the discharging of Zinc air battery	CO1
7	Describe the construction and working of lead-acid battery. Write the discharging, charging reactions and Mention its applications and limitations	Understand	Learner to recall the types of batteries and understand the working of secondary cell.	CO1
8	Compare primary and secondary cells. Explain the construction of Lithium ion battery with relevant reactions. Mention its applications.	Understand	Learner to recall the working of electrochemical cell and understand the discharging and charging of Li-ion cell	CO1

9	Explain the construction and working of Lithium Ion battery with reactions occurring during charging and discharging.	Understand	Learner to recall the working of rechargeable batteries and understand the discharging and charging of Li-ion cell.	CO1
10	What is secondary battery? Explain about working of secondary battery with one example and write its applications.	Understand	Learner to recall the working of electrochemical cell and electrolytic cell and understand the working of rechargeable battery.	CO 1
11	Define corrosion. Explain dry corrosion and its mechanism.	Understand	Learner to recall the concept of corrosion in metals and understand the formation of metal oxide on the surface of metals in presence of oxygen.	CO 1
12	What is oxidation corrosion and how does it takes place? Describe the mechanism of oxidation corrosion?	Understand	Learner to recall the electrochemical principles and understand the formation of metal oxide on the surface of metals in presence of oxygen.	CO 1
13	Illustrate the rusting iron with the help of electro-chemical theory of corrosion.	Understand	Learner to recall the electrochemical principles and understand the formation of electrochemical cell on the surface of metals in presence of moisture..	CO 1
14	What is electrochemical corrosion? Describe the mechanism of electrochemical corrosion by hydrogen evolution and oxygen absorption.	Understand	Learner to recall the chemical corrosion and understand the metal undergoing corrosion in presence of moisture conditions.	CO 1
15	Distinguish between chemical and electrochemical corrosion. Discuss the mechanism of wet corrosion by evolution of hydrogen.	Understand	Learner to recall the chemical corrosion and understand the metal undergoing corrosion in presence of moisture conditions.	CO 1

16	Define metallic coating? Explain the process of galvanization of iron. How does it prevent the corrosion of iron and mention its applications.	Understand	Learner to recall the concept of surface coatings in metals, understand the process of hot dipping and apply to use galvanized sheets for manufacture of bolts, screws and nuts etc	CO 1
17	What is cathodic metal coating? Describe tinning process of protecting iron sheet from corrosion and mention its applications.	Understand	Learner to recall the concept of surface coatings in metals, understand the process of hot dipping and apply to use tinned sheets for manufacture of cooking utensils, storage bins etc	CO 1
18	What is cathodic protection? Explain the sacrificial anode method of protection and mention its applications.	understand	What is cathodic protection? Explain the sacrificial anode method of protection and mention its applications.	CO 1
19	Explain corrosion control by impressed current cathodic protection and write its applications	understand	-Learner to recall the types of cathodic protection, understand that less active metal is protected by more active metal by passing direct current to base metal) and apply this method to protect iron metals .Ex: ships and large pipes.	CO 1
20	Define electro plating? Explain the process of electro plating of Copper.	understand	Learner to recall the process of electrolysis. understand the protection of less active metals by more noble metals by passing direct current and apply this method to protect metals (iron) and non metals (plastics, gold plating)-	CO 1

PART C-SHORT ANSWER QUESTIONS				
1	Define the terms electrochemical and electrolytic cell.	Remember	-	CO 1
2	State the role of the salt bridge in the voltaic cell??	Remember	-	CO1
3	Define EMF of a galvanic cell? How to represent a galvanic cell.	Remember	-	CO 1
4	Define batteries. How are they classified?	Remember	-	CO 1
5	Differentiate between Primary and Secondary cells with suitable examples.	Understand	Learner to recall the concept of batteries and understand primary cells and secondary cells.	CO 1
6	Explain the discharging and charging reactions of a lead acid battery.	Understand	Learner to recall the working of electrochemical cells and understand the discharging and charging reactions of a lead acid battery.	CO 1
7	Write the advantages and applications of Li-ion battery.	Remember	-	CO 1
8	What is single electrode potential? How do you determine the electrode potential of Zn/ZnSO ₄ ?	Remember	-	CO 1
9	Define electrochemical series and write its applications.	Remember	-	CO 1

10	Explain the discharging and charging reactions of a Zinc-air battery.	Understand	Learner to recall the working of electrochemical cells and understand the discharging and charging reactions of a Zinc-air battery. CO1 11 Write the advantages and applications of Zn-air battery. Remember -	CO 1
11	Write the advantages and applications of Zn-air battery.	Remember	-	CO 1
12	Define corrosion of metals. Write any two causes and disadvantages of corrosion.	Remember	-	CO1
13	State pilling-bed worth rule?	Understand	Learner to recall the chemical and electrochemical corrosion in metals and understand the dry and wet corrosion.	CO1
14	Define liquid metal corrosion?	Remember	-	CO1
15	Differentiate between dry corrosion and wet corrosion.	Remember	-	CO1
16	List cathodic protection? Explain sacrificial anodic protection method.	Understand	Learner to recall the nature of the metal influencing the rate of corrosion and understand the formation of electrochemical cell on metal surface.	CO1
17	What is impressed current cathodic protection method?	Understand	Learner to recall the cathodic protection and understand the sacrificial anode to protect the base metal.	CO1

18	Write the applications of galvanizing.	Apply	Learner to recall the cathodic coatings, understand the significance of tinning process in corrosion control and apply tinned products for domestic and industrial purpose.	CO1
19	What is hot dipping? Give the importance of tinning in corrosion control.	Remember	-	CO1
20	What is electroplating ?	Remember	-	CO1
MODULE II				
WATER AND ITS TREATMENT				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	A sample of hard water contains the following dissolved salts per liter. Mg (HCO ₃) ₂ =14.6mgs; Ca(HCO ₃) ₂ =16.2mgs; CaCl ₂ =111mgs; CaSO ₄ =1.36mgs; silica=40 mgs; Turbidity=10 mgs. Calculate the temporary, permanent and total hardness of water in ppm, degree Clark.	Apply	Learner to recall types of hardness in water, understand the expression of hardness and apply hardness causing salt formula to determine hardness in water ppm, degree Clark	CO3
2	One liter of water sample collected from a water source in telangana has shown the Following analysis. Mg (HCO ₃) ₂ =14.6 mg, MgSO ₄ =12 mg, Ca (HCO ₃) ₂ =16.2 mg, CaCl ₂ =22.2 mg, MgCl ₂ =9.5 mg and organic impurities 100 mg. determine temporary and permanent hardness in Degree French and degree Clark.	Apply	Learner to recall types of hardness in water, understand the expression of hardness and apply hardness causing salt formula to determine hardness in water in Degree French and degree Clark.	CO3

3	One liter of water from an underground reservoir in thirupathi town in andhrapradesh showed the following analysis for its contents $\text{Mg}(\text{HCO}_3)_2 = 42\text{mg}$, $\text{MgSO}_4 = 48\text{mg}$, $\text{Ca}(\text{HCO}_3)_2 = 146\text{ mg}$, $\text{CaCl}_2 = 71\text{mg}$, determine temporary and permanent hardness of the sample of 10000 liters of water	Apply	Learner to recall types of hardness in water, understand the expression of hardness and apply hardness causing salt formula to determine hardness in water.	CO3
4	A water sample contains the following. $\text{Mg}(\text{HCO}_3)_2 = 73\text{mg/l}$; $\text{MgCl}_2 = 95\text{mg/l}$; $\text{NaCl} = 410\text{mg/l}$. Calculate temporary, permanent and total hardness of the sample water in ppm, degree Clark and degree French.	Apply	Learner to recall types of hardness, understand the expression of hardness and apply hardness causing salt formula to determine total hardness in water ppm, degree Clark and degree French.	CO3
5	Determine temporary and permanent hardness of a water sample in ppm which contains 6.8mg of CaSO_4 , 33mg of CaCl_2 , 40mg of MgCl_2 , 24mg of MgSO_4 per liter of the water sample. (Given Molar mass of $\text{Ca} = 40\text{g}$, $\text{Mg} = 24\text{g}$, $\text{S} = 32\text{g}$, $\text{O} = 16\text{g}$, $\text{Cl} = 35\text{g}$).	Apply	Learner to recall the types of hardness, expression of hardness, understand the various units of hardness and apply hardness causing salt formula to determine hardness in water.	CO3

6	<p>One gram of CaCO_3 was dissolved in dil. HCl and the solution was diluted to one litre. 100 ml of this solution required 90 ml of EDTA solution, while 100 mL of sample water required 40 ml of EDTA solution. On the other hand, 100 ml of boiled water sample, when titrated against EDTA, consumed 20 ml of the solution. Calculate total, permanent and temporary hardness of water sample in ppm.</p>	Apply	Learner to recall types of hardness, understand EDTA method and apply formula of hardness in terms of calcium carbonate equivalents to determine total hardness in water.	CO3
7	<p>A sample water of 100 ml required 12.6 ml of 0.02M EDTA solution with EBT as indicator and 8.4 ml of 0.02 M EDTA for the same volume of water after removing the carbonate hardness. determine the total, permanent hardness in terms of calcium carbonate equivalents.</p>	Apply	Learner to recall types of hardness, understand EDTA method and apply formula of hardness in terms of calcium carbonate equivalents to determine total hardness in water.	CO3
8	<p>100 ml of water sample required 18 ml of 0.1 M EDTA solution, while same water after boiling required 12 ml of 0.1 M EDTA solution. Calculate carbonate and non carbonate hardness of water</p>	Apply	Learner to recall types of hardness, understand EDTA method and apply formula of hardness in terms of calcium carbonate equivalents to determine total hardness in water.	CO3

9	one gram of CaCO_3 was dissolved in dil.HCl and the solution was diluted to one litre. 100 mL of this solution required 20 mL of EDTA solution, while 100 mL of sample water required 10 mL of EDTA solution. On the other hand, 100 ML of boiled water sample, when titrated against EDTA, consumed 5 mL of the solution. Calculate total , permanent and temporary hardness of water sample in ppm.	Apply	Learner to recall types of hardness, understand EDTA method and apply formula of hardness in terms of calcium carbonate equivalents to determine total hardness in water.	CO3
10	0.5 gm of CaCO_3 was dissolved in dil.HCl and the solution was diluted to 1000 mL. 50 mL of this solution required 48 mL of EDTA solution, while 50 mL of sample water required 15 mL of EDTA solution. On the other hand, 50 ML of boiled water sample, when titrated against EDTA, consumed 10 mL of the solution. Calculate each type of hardness in ppm.	Apply	Learner to recall types of hardness, understand EDTA method and apply formula of hardness in terms of calcium carbonate equivalents to determine total hardness in water.	CO 3
PART B-LONG ANSWER QUESTIONS				
1	List the salts responsible for hardness? Write the disadvantages of using hard water in industries.	Understand	Learner to recall the hardness of water and understand the causes of hardness of water	CO3
2	Explain the following: i. Why do we express hardness of water in terms of CaCO_3 equivalent? ii. Why hard water fails to produce lather with soap solution? iii. Distinguish between Hard water and Soft water	Understand	Learner to recall the hardness of water and understand the dissolved salts in water and compare hard water and soft water.	CO3

3	What is hardness of water? Explain the terms temporary and permanent hardness of water.	Understand	Learner to recall the types of hardness of water and understand the salts responsible for temporary and permanent hardness	CO3
4	List the salts responsible for temporary hardness and permanent hardness. Explain different units of hardness of water and Write their inter conversion.	Understand	Learner to recall the express of hardness and understand the hardness of water to express in terms of CaCO_3 equivalents.	CO3
5	Define carbonate and non-carbonate hardness of water. Differentiate between temporary and permanent hardness of water and write the various units of hardness.	Understand	Learner to recall the types of water and underst and the types of hardness.	CO3
6	Define hard water and soft water? Compare between temporary and permanent hardness of water. Mention the salts responsible for permanent and temporary hardness.	Understand	Learner to recall the types of water and understand the types of hardness.	CO3
7	Explain the Principle and experimental procedure for the determination of total hardness by EDTA method.	Understand	Learner to recall the method of finding hardness of water and understand the determination of total hardness, permanent hardness and temporary hardness.	CO3
8	Explain the determination of hardness of water by complexometric method..	Understand	Learner to recall the method of finding hardness of water and understand the reactions in complexometric method	CO3

9	Demonstrate the hardness of water by Ethylene diamine tetra acetic acid method.	Understand	Learner to recall the method of finding hardness of water and understand the reactions in the formation of complex ions by EDTA method	CO3
10	What are requisites of drinking water? Explain about coagulation and filtration in treatment method of potable water.	Understand	Learner to recall the treatment methods in potable water and understand the process of coagulation and filtration.	CO 2
11	What is sterilization of water? How is natural water sterilized by chlorine, bleaching powder, chloramines?.	Understand	Learner to recall the treatment methods in potable water and understand the process of chlorination.	CO 2
12	What is potable water? Explain sterilization of water by chlorination and ozonization.	Understand	Learner to recall the treatment methods in potable water and understand the process of disinfection to kill bacteria present in water..	CO 2
13	What are the specifications of potable water? Explain break-point chlorination of water.	Understand	Learner to recall the treatment methods in potable water and understand the amount chlorine required to kill the bacteria present in water.	CO 2
14	What are ion exchange resins? Describe their application in water softening.	Understand	Learner to recall the treatment methods in boiler feed water and understand the cation and anion exchange process to remove dissolved salts present in water.	CO 2
15	Explain the demineralization process of softening of hard water and write its advantages.	Understand	Learner to recall the treatment methods in boiler feed water and understand the cation and anion exchange process to remove dissolved salts present in water.	CO 2

16	Explain ion exchange process used to soften water? Why is it considered as the best method to soften hard water?	Understand	Learner to recall the treatment methods in boiler feed water and understand the cation and anion exchange process to remove dissolved salts present in water.	CO 2
17	What is external treatment of water? Explain any one of the method with a neat diagram and write its advantages and disadvantages.	Understand	Learner to recall the treatment methods in boiler feed water and understand to remove dissolved salts in water in the form of scales..	CO 2
18	What are cation exchange and anion exchange resin? Illustrate the deionization process of hard water with a neat diagram.	Understand	Learner to recall the treatment methods in boiler feed water and understand the cation and anion exchange process to remove dissolved salts present in water.	CO 2
19	Discuss the principle and the process involved in the purification of water by reverse osmosis method. How sea water is purified by using this technique.	Understand	Learner to recall the process of osmosis and understand that purification of water by the flow of solvent through semipermeable membrane.	CO 2
20	What is desalination? Describe desalination by reverse osmosis and write its advantages..	Understand	Learner to recall the process of osmosis and understand that purification of water by the flow of solvent through semipermeable membrane.	CO 2
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PART C-SHORT ANSWER QUESTIONS				
1	Define hardness of water.	Remember	-	CO3
2	Compare temporary and permanent hardness of water.	Understand	Learner to recall the hardness of water and understand the temporary and permanent hardness of water.	CO3

3	What is the basic principle involved in estimation of hardness of water by EDTA method?	Remember	-	CO3
4	Define PPM and Degree Clark.	Remember	-	CO3
5	Define Mg/L and Degree French.	Remember	-	CO3
6	What are the disadvantages of hard water ?	Remember	-	CO3
7	Compare soft water and hard water.	Understand	Learner to recall concept of the hard water and soft water and understand that hard water contains dissolved salts.	CO3
8	What is soft water gives the examples of any two soft water sources ?	Remember	-	CO3
9	How permanent hardness is removed from hard water?	Understand	Learner to recall types of hardness of water and understand the chemical process to remove permanent hardness.	CO3
10	List the salts responsible for the temporary and permanent hardness of water.	Remember	-	CO3
11	What is meant by treatment of water?	Remember	-	CO2
12	Define softening of water.	Remember	-	CO3
13	How is natural water sterilized by bleaching powder?	Understand	Learner to recall the external treatment methods in potable water and understand the sterilization process.	CO3

14	Explain break point of chlorination in treatment of potable water.	Understand	Learner to recall the treatment methods in potable water and understand the disinfection process by chlorination.	CO3
15	Explain the reverse osmosis process to produce potable water.	Understand	Learner to recall the desalination process and understand the Process to produce potable water.	CO3
16	What is screening of potable water?	Remember	-	CO3
17	What are the advantages of reverse osmosis?	Remember	-	CO3
18	What are the advantages and disadvantages of ion exchange process?	Remember	-	CO3
19	What is sedimentation?	Remember	-	CO3
20	What is potable water?	Remember	-	CO3
MODULE III				
POLYMER TECHNOLOGY				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	Why cannot thermosetting plastics be reused and reshaped?	Understand	Learner to recall the types of plastics and understand about the cross linked polymers which are hard and strong.	CO4
2	PVC is soft and flexible whereas Bakelite is hard and brittle. Why?	Understand	Learner to recall the types of polymerization reactions and understand polymers with different properties.	CO4
3	Write the monomers of PVC, Nylon 6,6 and Bakelite.	Understand	Learner to recall the polymerization process and understand the types of preparation of polymers	CO4

4	Why is PVC generally plasticized?	Understand	Learner to recall the properties of PVC and understand improvement of properties by adding organic compounds.	CO4
5	Why do all simple organic molecules not produce polymers?	Understand	Learner to recall the functionality of monomers and understand the polymerization process.	CO4
6	Explain how biodegradable polymers are used in various sectors	Apply	Learner to recall the types of polymers, understand the importance of biodegradable polymers and use the biodegradable polymers in various sectors.	CO4
7	Why Thiokol rubber cannot be vulcanized?	Understand	Learner to recall the process of vulcanization and understand that there should be a double bond in the monomer molecules.	CO4
8	How are the following produced? Mention their properties and uses i) Styrene-butadiene rubber ii) Thiokol rubber	Apply	Learner to recall the polymerization process, understand the types of preparation of synthetic rubbers and use the polymers in various sectors	CO4
9	Natural rubber needs vulcanization. Why?	Understand	Learner to recall properties of natural rubber and understand importance of vulcanization to obtain hard rubber.	CO4
10	What do you understand by vulcanization of rubber? Give the structural unit of vulcanized rubber.	Understand	Learner to recall the disadvantages of raw rubber and understand the improvement of properties of raw rubber.	CO4
PART B-LONG ANSWER QUESTIONS				
1	Define polymerization. Explain the types of polymerization with example.	Understand	Learner to recall the monomers and understand the addition and step wise polymerization.	CO4

2	What is a polymer? Explain with example the process of addition and step-growth polymerization.	Understand	Learner to recall the monomers and understand the addition and step wise polymerization.	CO4
3	List the synthetic polymers. Differentiate addition and condensation polymerization.	Understand	Learner to recall the polymers and understand the addition and step wise polymerization.	CO4
4	What are plastics? Differentiate thermoplastic resins and thermosetting resins. Give an example for each type	Understand	Learner to recall the polymers and understand the formation of polymers with strong and weak bonds between polymer chains	CO4
5	Describe the preparation, properties and uses of Bakelite.	Understand	Learner to recall the types of polymerization reactions and understand the preparation of cross linked polymers	CO4
6	Discuss the preparation, properties of polymers used in fabricating switches and Non lubricating bearings	Understand	Learner to recall the types of polymerization reactions and understand the synthesis of phenolic resins.	CO4
7	What are polymers? Explain the synthesis, properties and applications of polyvinyl chloride..	Understand	Learner to recall the types of polymerization reactions and understand the synthesis of synthetic polymers.	CO4
8	Differentiate thermoplastic and thermosetting polymers. Give an example for each type	Understand	Learner to recall the polymers and understand the bending and hard polymers.	CO4
9	What are polymers? Explain the synthesis, properties and applications of phenol- formaldehyde and polyvinyl chloride.	Understand	Learner to recall the types of polymerization reactions and understand the synthesis of synthetic polymers.	CO4

10	What is condensation polymerization? Explain the preparation, properties and engineering applications of Nylon 6,6	Understand	Learner to recall the types polymerization reactions and understand the synthesis of condensation reactions.	CO4
11	What are biodegradable polymers? Explain with preparation of biodegradable polymers with its applications.	Understand	Learner to recall the polymers, understand the monomers biodegradable polymers and use the biodegradable polymers to reduce pollution.	CO4
12	Explain the preparation method and uses of the following polymers: i) Poly lactic acid ii) poly vinyl acetate	Understand	Learner to recall the polymers, understand the monomers biodegradable polymers and use the biodegradable polymers to reduce pollution.	CO4
13	What are the advantages of using biodegradable polymers and write its applications.	Understand	Learner to recall the types of polymers, understand the importance of biodegradable polymers and use the biodegradable polymers in various sectors.	CO4
14	Define natural rubber? Explain the process of vulcanization of raw rubber with its advantages.	Apply	Learner to recall properties of natural rubber and understand the process, importance of vulcanization.	CO4
15	What you understand about the vulcanization of natural rubber? Write the advantages of vulcanization?	Apply	Learner to recall properties of natural rubber and understand the process, importance of vulcanization.	CO4
16	Which rubbers are used in the manufacture of automobile tyres and tubes? Discuss their properties with applications.	Apply	Learner to recall the elastomers, understand the properties of Buna-S rubber and use the rubbers in manufacture of tyres.	CO4
17	List the synthetic rubbers. Describe the synthesis, properties and applications of Styrene-Butadiene rubber.	Apply	Learner to recall the elastomers, understand the properties and uses of synthetic rubber	CO4

18	What are elastomers? Explain synthesis, properties and applications of Buna-S Rubber.	Understand	Learner to recall the elastomers, understand the properties and uses of Buna-S rubber	CO4
19	What is synthetic rubber? Explain the preparation, properties and applications of Thiokol rubber.	Understand	Learner to recall the natural rubber, understand the properties Thiokol rubber.	CO4
20	Write the composition of natural rubber? Describe the synthesis, properties and uses of polysulphide rubber.	Understand	Learner to recall the natural rubber, understand the properties Thiokol rubber.	CO4
PART C-SHORT ANSWER QUESTIONS				
1	Define the term monomer and polymer	Remember	-	CO4
2	Define addition and condensation polymerization.	Remember	-	CO4
3	What is meant by polymerization?	-	-.	CO4
4	Differentiate between homopolymer and copolymer	Understand	Learner to recall preparation of polymers from monomers and understand different types of plastics.	CO4
5	State the monomers used in making the poly vinyl chloride and Nylon 6:6.	Remember	-	CO4
6	Define thermoplastic and thermosetting resins.	Remember	-	CO4
7	Write the properties of Bakelite.	Understand	Learner to recall the types of polymerization reactions and understand the properties of synthetic polymers.	CO4
8	What is a resin?	Remember	-	CO4
9	State the monomers used in making the Bakelite	Remember	-	CO4

10	Write the structures of addition and condensation polymers.	Remember	-	CO4
11	Differentiate between thermoplastic and thermosetting resins	Understand	Learner to recall the resin and understand the types of resins.	CO4
12	What is a Resin?	Remember	-	CO4
13	Write the preparation method of Nylon (6,6)	Understand	Learner to recall the types of polymerization reactions and understand the synthesis of polyamide resins.	CO4
14	Mention the applications of phenol formaldehyde resin.	Understand	Learner to recall the types of polymerization reactions and understand the use of polymers.	CO4
15	What are the biodegradable polymers?	Remember	-	CO4
16	Write the advantages of biodegradable polymers?	Understand	Learner to recall the types of polymers and understand the preparation of biodegradable polymers	CO4
17	State the monomers used in making the Thiokol rubber and Buna-S rubber	Remember	-	CO4
18	What are elastomers? Give any two examples.	Remember	-	CO4
19	Define the term vulcanization of rubber. mention its significance	Remember	-	CO4
20	Why natural rubber needs vulcanization and how it is carried out.	Understand	Learner to recall preparation of natural rubber from monomers and understand the importance of	CO4
MODULE IV				
ENERGY SOURCES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				

1	<p>A sample of coal weighing 1.98 gm, on heating for 1 hour at 110 0 C for one hour, left a residue weighed 1.78gms. The residue was heated in a suitable crucible with a lid at a at 950 0 C for exactly 7 min The residue weighed 1.59 gms. The residue was heated in presence of air till a constant weight was obtained. This residue weighed 0.231 gms. Calculate the proximate analysis of coal..</p>	Apply	<p>Learner to recall the analysis of coal and understand the significance of coal and calorific value of coal and apply the formulas of percentage of moisture, volatile matter and ash content to find the percentage of fixed carbon in a coal sample</p>	CO5
2	<p>A sample of coal was analysed as follows: 0.9824 g of an air dried coal sample was weighed in a silica crucible. After heating for 1 hour at 105 – 1100C, the dry coal residue weighed 0.9668g. The residue was covered with a vented lid and then heated strongly for exactly 7 min. at 9500C. The residue weighed 0.7900 g. The crucible was then heated strongly in air until a constant weight was obtained. The last residue was found to weigh 0.1200 g. Calculate the proximate analysis of the coal sample..</p>	Apply	<p>Learner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (GCV) and NCV and apply the formulas of GCV and NCV to determine the gross and net calorific values of a coal.</p>	CO5

3	Calculate the gross and net calorific values of a coal sample containing 84% of carbon, 1.5 % of Sulphur, 6% of nitrogen, 5.5% of hydrogen and 8.4% of oxygen. The calorific value of carbon, hydrogen and Sulphur are 8080 kcal/kg, 34500 kcal/kg and 2240 kcal/kg, respectively, and latent heat of steam is 587 cal/g.	Apply	Learner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (GCV) and NCV and apply the formulas of GCV and NCV to determine the gross and net calorific values of a coal.	CO5
4	Learner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (GCV) and NCV and apply the formulas of GCV and NCV to determine the gross and net calorific values of a coal.	Apply	Leaner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (HCV) and LCV and apply the formulas of HCV and LCV to determine the gross and net calorific values of a coal.	CO5
5	Determine the gross and net calorific values of a coal sample having the following composition Carbon=87%, Hydrogen=5%, Oxygen=3%, Sulphur=0.5%, Nitrogen=0.5% and Ash=4%. and the latent heat of steam is 587 cal/gm.	Apply	Learner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (GCV) and NCV and apply the formulas of GCV and NCV to determine the gross and net calorific values of a coal.	CO5
6	Determine the gross and net calorific values of a coal sample having the following composition Carbon=80%, Hydrogen=7%, Oxygen=3%, Sulphur=3.5%, Nitrogen=2% and Ash=5%..	Apply	Learner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (GCV) and NCV and apply the formulas of GCV and NCV to determine the gross and net calorific values of a coal..	CO5

7	Determine the gross and net calorific values of a coal sample having the following composition Carbon=80%, Hydrogen=7%, Oxygen=3%, Sulphur=3.5%, Nitrogen=2% and Ash=5%.	Apply	Learner to recall the composition of fuel, understand the concept of combustion of fuels and apply the formulas to find the amount of air required for combustion of fuels.	
8	Calculate the minimum amount of air required for complete combustion of 1kg of coal sample having the following compositions: C=80%,S=2%,H=5%,N=1% and ash=4%.Oxygen in air is 23% by weight.	Apply	Leaner to recall the calorific value of fuel, understand the concept of theoretical calculation of calorific value (HCV) and LCV and apply the formulas of HCV and LCV to determine the gross and net calorific values of a coal.	CO5
9	The percentage composition of a sample of bituminous coal was found to be as under: C = 75.4%; H = 5.3%; O = 12.6%; N = 3.2%; S= 1.3% and Ash = rest. Calculate the minimum weight of air necessary for complete combustion of 1 Kg of coal. Oxygen in air is 23% by weight.	Apply	Learner to recall the composition of fuel, understand the concept of combustion of fuels and apply the formulas to find the amount of air required for combustion of fuels.	CO5
10	A sample of coal was found to have the following percentage composition: C=75%, S=1.2%, H=5.2%, N=3.7%, O=12.8% and ash=2.1%. Oxygen in air is 23% by weight. Calculate the minimum amount of air required for complete combustion of 1kg of coal sample.	Apply	Learner to recall the composition of fuel, understand the concept of combustion of fuels and apply the formulas to find the amount of air required for combustion of fuels.	CO5
PART B-LONG ANSWER QUESTIONS				

1	What is a fuel? Classify fuels with suitable examples.	Understand	Learner to recall the types of fuels and understand the natural fuels and artificial fuels.	CO5
2	Compare the solid, liquid and gaseous fuels with its advantages and disadvantages.	Understand	Learner to recall the types of fuels and understand the calorific values of solid, liquid and gaseous fuels.	CO5
3	Describe the moisture, volatile matter, ash content and fixed carbon in proximate analysis of coal and write its significance.	Understand	Learner to recall the solid fuels and understand the quantitative analysis of coal.	CO5
4	Explain the proximate analysis of coal. i. Moisture ii. Volatile matter iii. Ash content iv Fixed carbon.	Understand	Learner to recall the solid fuels and understand the quantitative analysis of coal.	CO5
5	Explain Ultimate analysis of coal along with its significance.	Understand	Learner to recall the formation of coal and understand the quantitative analysis of coal	CO5
6	Explain how the percentage of carbon, hydrogen, sulphur and oxygen is estimated by ultimate analysis of coal.	Understand	Learner to recall the formation of coal and understand the quantitative analysis of coal.	CO5
7	Illustrate the ultimate analysis of coal. i. Carbon and hydrogen ii. Nitrogen iii. Sulphur iv. Oxygen.	Understand	Learner to recall the formation of coal and understand the quantitative analysis of coal.	CO5
8	Discuss the significances of analysis of coal.	Understand	Learner to recall the formation of coal and understand the quantitative analysis of coal.	CO5
9	Illustrate the refining of petroleum by giving its composition, boiling ranges and uses of various fractions obtained during refining.	Understand	Learner to recall the crude oil and understand various fractions obtained during refining	CO5

10	Explain the composition of crude oil? Describe the refining of petroleum with various fractions obtained during refining and mention uses of each fraction..	Understand	Learner to recall the mining of petroleum and understand the process of fractional distillation.	CO5
11	List the various steps involved in refining of petroleum. At what temperature kerosene, diesel and gasoline are obtained. How do they differ in their composition?	Understand	Learner to recall the mining of petroleum and understand the process of fractional distillation.	CO5
12	Describe fractional distillation of petroleum mentioning the components, composition, boiling point ranges and applications.	Understand	Learner to recall the mining of petroleum and understand the process of fractional distillation.	CO5
13	Explain the composition, properties and applications of LPG and CNG.	Understand	Learner to recall the gaseous fuels, understand composition of LPG,CNG and apply LPG,CNG for industrial and domestic purpose.	CO5
14	Explain about composition, properties and applications of natural gas.	Understand	Learner to recall the gaseous fuels, understand composition of natural gas and apply natural gas for industrial and domestic purpose..	CO5
15	What kind of energy do we get from the sun? Explain how we convert solar energy in to electricity.	Understand	Learner to recall the solar energy and understand the process to convert solar energy in to electricity.	CO5
16	What is wind energy? Enumerate advantages and disadvantages associated with wind power.	Understand	Learner to recall the use of alternate energy resources and understand the production of wind energy, advantages and disadvantages of wind power	CO5

17	Explain the advantages of hydropower? How energy is generated in hydroelectric power plant.	Understand	Learner to recall the energy resources and understand the production of electric energy advantages of hydropower.	CO5
18	Compare the following i. HCV and LCV ii. CNG and LPG	Understand	Learner to recall the calorific value of gaseous fuels and understand HCV and LCV, CNG and LPG.	CO5
19	What is calorific value of a fuel. Define the terms Calorific value, High calorific value (HCV) and Low calorific value(LCV) and explain their relation between HCV and LCV	Understand	Learner to recall the calorific value of fuels. and understand HCV and LCV by theoretical calculation of dulong's formula.	CO5
20	Describe about alternate energy sources with example.	Apply	Learner to recall the energy resources and understand the production of electric energy advantages of alternate energy sources.	CO5
PART C-SHORT ANSWER QUESTIONS				
1	Define a fuel?	Remember	-	CO5
2	Write the classification of fuels with suitable examples.	Remember	-	CO5
3	Why a good fuel should possess low oxygen and high carbon percentage?	Understand	Learner to recall the analysis of and understand the calorific value of coal.	CO5
4	Why a good fuel must have low ash content?.	Understand	Learner to recall the analysis of and understand the quality of coal.	CO5
5	Why is net calorific value less than gross calorific value?	Understand	Learner to recall the calorific value of coal and understand the difference between GCV and NCV.	CO5
6	Write the significance of moisture and volatile matter in coal.	Remember	-	CO5

7	What is CNG? Give the composition CNG.	Remember	-	CO5
8	Compare solid fuels and liquid fuels.	Understand	Learner to recall the types of fuels and understand the solid fuel and liquid fuel	CO5
9	Write the significance of fixed carbon and ash content in coal.	Remember	-	CO5
10	What is meant by calorific value of a fuel? Mention its units.	Remember	-	CO5
11	What is LPG? Give its composition and applications.	Understand	Learner to recall the calorific value of gaseous fuels and understand the uses of LPG.	CO5
12	List the alternative energy sources?	Remember	-	CO5
13	What is wind energy?	Remember	-	CO5
14	Mention the advantages and disadvantages of hydropower?	Understand	Learner to recall the hydropower energy and understand the uses of renewable energy sources	CO5
15	What is solar energy?	Remember	-	CO5
16	What is hydropwer energy?	Remember	-	CO5
17	Mention the advantages and disadvantages of solar energy?	Remember	Learner to recall the hydropower energy and understand the uses of renewable energy sources	CO5
18	Mention the advantages and disadvantages of wind energy?	Understand	Learner to recall the wind energy and understand the uses of renewable energy sources	CO5
19	Compare gross calorific value and net calorific value of fuel.	Understand	Learner to recall the calorific value of a fuel and understand gross and net calorific value of a fuel.	CO5

20	What are renewable and non-renewable resources? Give examples.	Remember	-	CO5
MODULE V				
ENGINEERING MATERIALS				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	What do you mean by nanomaterials? Explain different methods to prepare nanomaterials.	Understand	Learner to recall the nanomaterials and understand to synthesize the nanoparticles.	CO6
2	How is nanotechnology in modern medicine.	Apply	Learner to recall the nanomaterials, understand to synthesize the nanoparticles and use of nanomaterials in medicine.	CO6
3	Explain the sol gel process for manufacture of nanomaterials.	Understand	Learner to recall the nanomaterials and understand to synthesize the nanoparticles.	CO6
4	Discuss the applications of nanotechnology.	Apply	Learner to recall the nanomaterials, understand to synthesize the nanoparticles and use the nanomaterials in various sectors.	CO6
5	Explain the term setting and hardening of cement. What are the compounds, which contribute to the hardening?	Understand	Learner to recall the composition of cement and understand about chemical reactions in cement.	CO6
6	Discuss the composition, setting and hardening reactions of Portland cement?	Understand	Learner to recall the composition of cement and understand about chemical reactions in cement.	CO6
7	Describe the mechanism of lubrication that is applied to delicate instruments.	Understand	Learner to recall the composition of cement and understand about chemical reactions in cement..	CO6

8	List the physical, physiological and psychological effects of noise. Describe the adverse health effects due to industrial noise. What should be the cloud and pour point of a good lubricant?	Understand	Learner to recall the properties of lubricants and understand the importance of cloud and pour point to avoid friction between two moving surfaces.	CO6
9	What should be the flash and fire point of a good lubricant?	Understand	Learner to recall the properties of lubricants and understand the importance of flash and fire point to avoid explosions.	CO6
10	What are the medical applications of smart materials?	Understand	Learner to recall the properties of lubricants and understand the importance of pour point where liquids phase changes to solid phase. CO6 PART B-LONG ANSWER QUESTIONS	CO6
PART B-LONG ANSWER QUESTIONS				
1	What are nanomaterials? Explain the sol-gel method.	Understand	Learner to recall the nanoscale and understand to synthesize the nanoparticles.	CO6
2	Describe CVD technique for the preparation of carbon nanotubes.	Understand	Learner to recall the nanomaterials and understand to synthesize the nanoparticles.	CO6
3	Discuss the applications of nanomaterials.	Apply	Learner to recall the nanomaterials, understand to synthesize the nanoparticles and use the nanomaterials in various sectors.	CO6

4	What are smart materials? How these materials are used in medical field.	Apply	Learner to recall the importance of materials and understand the preparation and use of these materials in medicine.	CO6
5	Explain the synthesis, properties and uses of poly L- lactic acid.	Understand	medicine. CO6 5 Explain the synthesis, properties and uses of poly L- lactic acid. Understand Learner to recall the synthesis of materials and understand the properties and use of these materials.	CO6
6	Explain the preparation, properties and uses of Polyacryl amides	Understand	Learner to recall the synthesis of materials and understand the properties and use of these materials.	CO6
7	Explain the preparation, properties of and uses of Polyacryl amides.	Understand	Learner to recall the synthesis of materials and understand the properties and use of these materials.	CO6
8	What are thermoresponse materials? Explain the preparation, properties and uses of Poly vinyl amides	Understand	Learner to recall the thermal stability of materials and understand the properties and use of these materials.	CO6
9	Describe briefly applications of smart materials and thermoresponse materials.	Apply	Learner to recall the importance of materials and understand the preparation and use of these materials in various sectors.	CO6
10	Explain the significance of smart materials and thermoresponse materials.	Understand	Learner to recall the synthesis of materials and understand the significance of these materials	CO6
11	Explain the setting and hardening of Portland cement with chemical reactions involved in it.	Understand	Learner to recall the composition of cement and understand about hardening process in cement.	CO6

12	What is the composition of Portland cement? Describe the setting and hardening of cement.	Understand	Learner to recall the composition of cement and understand about strength of cement.	CO6
13	What are the constituents of cement? Summarize the chemical reactions take place during setting and hardening of cement.	Understand	Learner to recall the composition of cement and understand about chemical reactions in cement.	CO6
14	Explain the theories for the mechanism of the lubricants.	Understand	Learner to recall the substances used as lubricants and understand about lubrication process.	CO6
15	What are lubricants ? Explain the following properties of lubricants giving their significance. i) Flash point and Fire point ii) Cloud point and Pour point	Understand	Learner to recall the substances used as lubricants and understand about lubrication process.	CO6
16	What are the characteristics of lubricants?	Understand	Learner to recall the substances used as lubricants and understand about lubrication process.	CO6
17	What is lubrication? Explain about thin film, thick film and extreme pressure lubrication.	Understand	Learn to recall the importance of lubricants and understand the process of lubrication.	CO6
18	Describe about mechanism of lubrication with example.	Understand	Learner to recall the different types of lubricants, understand the lubrication mechanism and to use in different equipments.	CO6
19	Explain the properties of a lubricant with a neat diagram.	Understand	Learner to recall the lubrication process and understand the importance of properties to use at different temperature.	CO6

20	Explain the following properties of lubricants i. Flash point and fire point ii. cloud and pour point	Understand	Learner to recall the lubrication process and understand the importance of different properties of lubricants.	CO6
PART C-SHORT ANSWER QUESTIONS				
1	What are nanomaterials?	Remember	-	CO6
2	Mention the applications of nanomaterials.	Remember	-	CO6
3	Write the preparation of sol-gel method.	Remember	-	CO6
4	What is chemical vapour deposition method?	Remember	-	CO6
5	What are smartmaterials?	Remember	-	CO6
6	Define thermoresponse materials	Remember	-	CO6
7	Write preparation of polyacryl amides.	Remember	-	CO6
8	Expalin the properties of polylactic acid	Remember	Learner to recall the thermal stability of materials and understand the properties and use of these materials.	CO6
9	Describe the applications of smart materials in medicine.	Remember	Learner to recall the importance of materials and understand the preparation and use of these materials in medicine.	CO6
10	Expalin the properties of polyvinyl amide.	Remember	Learner to recall the thermal stability of materials and understand the properties and use of these materials.	CO6
11	Write applications of thermoresponse materials in industries	Remember	-	CO6
12	What is the composition of cement	Remember	-	CO6

13	Explain the chemical reactions occurring during initial setting of cement.	Remember	Learner to recall the composition of cement and understand about chemical reactions in cement.	CO6
14	Relate the chemical reactions during setting and hardening of cement.	understand	Learner to recall the composition of cement and understand about chemical reactions in cement.	CO6
15	What is a lubricant?	Remember	-	CO6
16	What is viscosity of lubricant oil?	Remember	-	CO6
17	What are the characteristics of a good lubricant?	Remember	-	CO6
18	Define flash and fire point of a lubricant by Penskey Marten's method.	Remember	-	CO6
19	Define cloud and pour point of a lubricant.	Remember	-	CO6
20	What is thick film and thin film lubrication?	Remember	-	CO6

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