**Methodist College of Engineering & Technology (Affiliated to Osmania University, Hyderabad) Chemistry Section, Humanities & Sciences Department**

Mr G.Mohan

**SYLLABUS**

# Unit I : ELECTOCHEMISTRY AND BATTERY CHEMISTRY

1. **Unit II : WATER CHEMISTRY AND CORROSION**
2. **Unit III : ENGINEERING MATERIALS**
3. **Unit IV : CHEMICAL FUELS**
4. **Unit V : GREEN CHEMISTRY, BIODIESEL AND COMPOSITES**

**Unit I (A): ELECTOCHEMISTRY AND BATTERY CHEMISTRY**

**PART – A**

1. Differentiate between Electrochemical cell and Electrolytic cell (May-June-2019)
2. Single electrode potential and standard electrode potential.
3. What is salt bridge? Why is Salt Bridge used in electrochemical cells? (What is its role in a galvanic cell?)
4. Write the cell reaction and cell representations of the Daniel cell.
5. What is the useful electrical energy obtained from Daniel cell under standard conditions? (Eº cell =1.1V, ∆G= -212300J).
6. Calculate the single electrode potential of Zn+2 (0.01M)| Zn at 250C given Eº Zn+2| Zn = - 0.76 V. (-0.8191).
7. What is electrochemical series? Discuss its applications. (Q17a, supply, Jan2015, 4M).
8. Electrode potential of Zinc is assigned negative value, whereas that of copper positive value. Give reasons.
9. Does the following cell work spontaneously at 25ºC? Why? Why not? Cu|cu+2

(1.0M)||Ni+2 (1.0M)|Ni Given, E0 cu+2/cu=+0.34, E0Ni+2 /Ni = -0.25v(Ecell= -ve).

1. What is a reference electrode? Give two examples with their electrode reactions.
2. The standard electrode potential of Cu+2/Cu is 0.334v.Will copper displace hydrogen from acids? Why? Why not?
3. For the cell reaction Zn+ Fe+2→Zn+2+ Fe. Calculate the relative concentration of Zn+2and

Fe+2 at which the overall cell emf becomes zero.E˚Fe+2/Fe =-0.44v and E0 Zn+2/ Zn=- 0.76v.(Ans=6.7x1010) (OU,June 2015).

1. Free energy change for a reaction involving two electrons in a cell is-125KJ/mole. Calculate emf of the cell.(-0.647Kv).
2. Why can glass electrode not be used for a solution of high alkalinity? (Answer: The glass electrode can be used in solutions only with pH range of 0 to 10. However above the pH 12 (high alkalinity), cations of the solution affect the glass and make the electrode useless. If the pH of the solution is above 9, the glass membrane of the electrode is attacked by hydroxyl ions. It leads to the alteration in the relationship between pH and glass electrode potential.
3. Mention any two applications of EMF measurement. (Answer: 1. Determination of standard free energy change and equilibrium constant. (i) The standard free energy change of a reaction can be calculated as follows − ΔG° = nFE°).
4. Represent Quinhydrone electrode and write the electrodic reaction for reduction process and mention its SRP value. (Q2 Main, June 2017, Q1, supply, Dec. 2016).
5. Represent Calomel electrode and write the electrodic reaction for reduction process and mention its S.R.P. value. (Q1, Suppl.Dec.2017),(Q3 Suppl Jan 2015,3M).
6. Define single electrode potential. How Zn/Zn2+ electrode potential is determined?(Q2,Suppl.Dec.2017).
7. Define E.M.F. and give the general expression for emf of a galvanic cell and explain the link between emf and cell reaction (Q4 Suppl Jan 2015,3M).
8. Write the expressions for ∆H and ∆S in terms of cell emf.
9. Write the cell notation and cell reaction for Zn-Ag cell.

# PART-B

1. Derive Nernst equation and give its applications.
2. What is a Quinhydrone electrode? Write its electrode reaction.
3. Describe the working of Glass – electrode With the help of neat-labeled diagram, explain the construction of saturated calomel electrode. Write the pertinent electrode reaction?
4. Describe with the help of suitable example, diagram and electrode reaction for each of the following types of electrodes: Metal – Metal ion electrode, Gas-ion electrode, Metal – metal insoluble salt electrode. (SCE).
5. For the following Galvanic cell, set up at 25ºC Pt | S C E || H+ (Test) | Q, QH2 |Pt pH=?
6. At what pHsolution containing Quinhydrone electrode the cell EMF would be zero volt. ESCE = 0.242 V, Eº Q / QH2=0.700V. (Ans, PH =7.7).
7. Describe Quinhydrone electrode. Derive an expression for the potential of Quinhydrone electrode. Explain how pH of a solution could be determined using this electrode. (Give the redox reactions).
8. Write the different types of electrode systems you have studied. Describe them with their electrode reactions & single electrode potential.
9. Calculate the single electrode potential of Cu+2 (0.1 M)/ Cu electrode at 25º C. Given E0 of Cu 0.34 volts. (Ans=0.31v)
10. A Hydrogen electrode was combined with a saturated calomel electrode. The emf of the combination was 0.673 volts. What is the pH of the solution if potential of SCE is 0.248 at the same temperature?(Ph=7.19)
11. The standard electrode potential for Cu+2/Cu and Cd+2/Cd are 0.337 and -0.403v. Construct a galvanic cell. Give the cell reaction, Calculate EMF of the cell and ΔGO.(Ans, emf=0.74v ,

∆G= - 142820J).

1. Calculate the EMF for the cell : Zn │ Zn +2 ││ Ag + │ Ag given EOZn+2 │Zn = - 0.762 V and EO Ag + │ Ag = 0.8 V (Ans=1.562v).
2. A cell is constructed using SCE and Hydrogen electrode with an acid having [H+]=0.05N. Calculate the ECell if ESCE=0.242. What is the cell notation and cell reaction? (emf= 0.32v).
3. Emf of combined cell using Quinhydrone and saturated calomel electrodes at 25ºC was found to be 0.380v. Calculate the pH of unknown acid solution used in the experiment. (Ph=1.319).
4. Calculate the Emf of cell at 25ºc Fe |Fe SO4 (0.05M)|| Cu SO4 (0.2M)| Cu Eº Fe+2/Fe = - 0.44v, Eº cu+2 /cu =0.34v.(Ans,emf=0.798v).
5. Calculate the EMF for the following cell at 25ºc Pb| Pb+2(0.001)||Ag+(0.01) | Ag, Eº for the cell is 0.925V.(Ans, emf=0.895v).
6. The standard reduction potential of Cu+2 / Cu and Ag+/Ag electrodes are 0.337 and 0.799

V. Construct a galvanic cell using these electrodes. For what concentration of Ag+ will the cell emf be 0, if concentration of Cu+2 is 0.01M? (Ans, [Ag+]=1.52x10-9).

1. Calculate the emf of the following cell at 250C Fe |Fe SO4 (0.01M)|| Cu SO4 (0.01M)|Cu.Given E0 of Fe &Cu as - 0.44 and 0.34V respectively.(Ans,emf=0.78v).
2. Predict whether Cu(s) can reduce Ag+ ion in an aqueous solution. Given standard reduction potentials Cu+2/Cu=0.34v Ag+/Ag=0.80v.
3. How would you represent copper, iron voltaic cell given std. reduction potentials of Cu and Fe are respectively 0.34v, -0.44v? Calculate the emf of cell.
4. In pH metric experiment using Glass – SCE combination the Emf of cell is found to be 178mv when a buffer solution of pH = 4.0 is used. Calculate the EGo of Glass electrode. State whether Glass electrode acts as anode or cathode. Justify your answer. (Key: When glass electrode is cathode,E˚glass=0.654, which is greater than E SCE, hence glass electrode acts as cathode.).
5. Write the cell reaction and calculate the emf of following cell at 25◦ C. Zn(s) I Zn+2 (0.2M)

II Ag+ (0.02M) I Ag(s) Given E◦ Zn/Zn+2 =+0.76v, E◦ Ag/Ag+ = -0.8v. (Ans, emf=1.4801).

1. Explain the principle involved in the potentiometric acid base titrations (strong acid Vs strong base) using a calomel and Quinhydrone electrode [Hint- Galvanic cell construction, Description, Cell notation, Cell reaction, Emf of Cell reaction].
2. Represent the cell, write electrode reactions and Ecell,for potentiometric redox titration.
3. Explain the principle involved in Potentiometric titration using quinhydrone and calomel electrode.
4. Differentiate between Potentiometric and PH metric titrations for HCl vs NaOH.
5. Write the cell reaction for the cell Pt,H2 l HCl l AgCl l Ag . Eo for this cell is 0.222V. If measured emf of the cell is 0.385valcula. C te the pH of the HCl solution (Pressure of Hydrogen = 1 atm ). (Ans,Ph=2.758).
6. The 'Tins' used for containing food stuffs are actually tin coated steel, known as 'tin plate'. Explain why tin coatings are preferred to zinc in the environment inside the tin of a canned fruit. ( ANS : The aqueousenvironment inside the tins might be quite acidic (in fruits), Tin is much less reactive towards acids than zinc. Zinc produces poisonous substance when reacted with acids of foodstuff. Due to this tin coating is preferred over zinccoating in food industry.)
7. Explain various types of potentiometric titrations and draw the suitable graphs6M(Q11a, Main, June 2017).
8. Calculate the e.m.f. of the following cell at 250C Zn/ZnSO4(0.1M)//CdSO4(0.01M)/Cd The standard reduction potential of Zn and Cd electrodes at 298K are -0.76V and - 0.40Vrespectively. (Ans 1.13v) 5M (Q16a,Main, June 2017)
9. The e.m.f. of a cell consisting of quinhydrone electrode and a saturated calomel electrode is 0.2640 Volts at 300K. What will be PH of a solution? Given E0SCE = +0.242V and E0(CH,Q,QH2) = + 0.6996V (Ans,PH=3.27)
10. Consider the cell Ag/AgBr, (M=0.32)//Cu2+(M=0.42)/Cu(s).The emf of the cell at 250˚C is 0.565v.Write the cell reaction and calculate standard emf of the cell (Q12b suppl, Jan2015, 3M) (Ans, E˚ cell=0.5468v)
11. Calculate the equilibrium constant for the following reaction at 298K. Sn + CuSO4 →Cu

+ SnSO4, Given E˚Cu+2/Cu=0.337v, E˚Sn+2/Sn=-0.136v. (Ans- E˚cell=0.473v, Keq=9.98 x 10 15 ) (June-2019).

# Unit I (B): BATTERY CHEMISTRY

1. What is the difference between a cell and a battery?

# Explain construction, working and applications of Zinc-Carbon battery.

1. What are the advantages and applications of Lithium ion cells?
2. Explain Lead-Acid battery with suitable reactions**. (Q12a, Main, June2017, 5M) (Q17a, Main, May2007, 4M).**
3. What are advantages and applications of fuel cells?
4. Describe in detail the working of Methanol– Oxygen Fuel Cells.
5. Differentiate primary battery from secondary battery.**(Q9, Suppl.,Jan. 2015,2M)(Q3,Main, June2017, 2M)(Q1, Main, May2007, 2M)**
6. Write the charging and discharging reactions in Lead-acid battery.**(Q3,Suppl.. Dec.2017, 2M)**
7. Write advantages of fuel cells **(Q4, Suppl., Dec. 2017,2M)**
8. What are fuel cells?
9. Write a note on Lithium ion batteries. **(Q16b, Suppl., Dec. 2017, 5M),**and their advantages and applications**(Q12b, Main, June 2017,5M)**
10. Write characteristics of fuel cells**(Q4, Main, June 2017,2M)**

# Unit II (A): WATER CHEMISTRY

**PART – A**

1. Define hardness of water? Why do we express hardness in terms of CaCO3 equivalents?
2. Name the salts responsible for the temporary and permanent hardness of water.
3. What is EDTA? Write its structure and uses.
4. Explain the principle behind the color change from wine red to blue of the indicator in the EDTA titration of hardness estimation of water.
5. Give the principle of determination of hardness of water by EDTA method.
6. Give the chemical reactions involved in determination of hardness of water by EDTA titration.
7. Distinguish between temporary and permanent hardness?( may-jun-suppl2019)
8. What are the units of hardness of water? Give the relationship between various units.
9. What is the method to remove temporary hardness? Write the chemical reaction involved.
10. What are the disadvantages of hard water when used for domestic purposes and industrial purposes?
11. Specifications of domestic and industrial water are different. Explain.
12. Distinguish between i) softening and demineralization ii) desalination and deionization of water.
13. What are the chief sources of water?
14. Which is the purest form of water? Why?
15. how are exhausted ion exchange resins regenerated?( may-jun-2019)

# PART-B

1. Describe ion exchange process of softening of water. What are its advantages over other methods?( dec2019)
2. Give the chemical reactions involved during i) softening of water by ion exchange resins and

ii) Regeneration of exhausted ion exchange resin.

1. What is reverse osmosis process of desalination of brackish water? What are its advantages? ( may-jun-2019&supply2019)
2. What is meant by alkalinity in water? What are the different types? ?( may-jun-2019)
3. How the carbonate and bicarbonate alkalinity is determined experimentally in a water sample? ( may-jun-supp2019)
4. What are the specifications of potable water?
5. What is disinfection of water? Mention the methods of disinfection of water by Chlorination (dec2019)
6. What is ‘breakpoint chlorination’? What are its advantages?
7. Explain the determination of hardness of water by EDTA method. ?( may-jun-2019)

# Numerical problems

1. A 100 ml sample of water contains 12 mg of MgSO4 (Mol. Wt. = 120) and 22.2 mg of CaCl2 (Mol.Wt. = 111). Calculate the hardness in ppm units.(Ans=30ppm)
2. A sample of water contains 21.9 mg of Magnesium bicarbonate, 19.0 mg of MgCl2 33mg CaCl2 and 18 mg of MgS04 per liter. Calculate the temporary and permanent hardness of this sample (At. Wt Mg = 24, Ca = 40, S = 32, Cl = 35.5) (Ans=150ppm and 65ppm)
3. A sample of water contains the following impurities :Mg(HCO3)2=29.2 mg/l, Ca(HCO3)2

=32.4,CaCl2=22.2 mg/l, MgSO4=120 mg/l and NaCl =40 mg/L. Calculate temporary hardness and permanent hardness in ppm. (Ans=40ppm and 120ppm)

1. 60 ml of standard hardness containing 1 mg of pure CaCO3 per ml consumed 22 ml of EDTA. 40 ml of water sample consumed 20 ml of EDTA solution using EBT indicator. 40 ml of water sample after boiling, filtering consumed 15 ml of EDTA. Calculate the temporary and permanent hardness of water sample. (Ans=338ppm and 1022ppm)
2. 100 ml of a sample of hard water required 15 ml of 0.01 M EDTA for titration using EBT indicator. 100 ml of sample was boiled and filtered. The filtrate is made up to 100 ml with distilled water. This made up solution required 8 ml of 0.01 M EDTA solution for titration. Calculate the total, permanent and temporary hardness of the sample of hard water in terms of ppm units. (Ans=150ppm,80ppm and 70ppm)
3. 50 ml of a sample of water consumed 20 ml of 0.01 M EDTA. The same water after boiling consumed 12 ml of same EDTA. Calculate the total, temporary and permanent hardness of water. (Ans= 400ppm,160ppm and 240ppm)
4. A 100 ml of sample hard water neutralizes exactly 12 ml of 0.12N HCl using Methyl orange as indicator. Determine the type of alkalinity. (Ans= HCO3- =720ppm)
5. 100 ml of water sample on titration with N/50 HCl requires 8 ml of acid upto (P) end point and 9 ml of acid upto (M) end point. Calculate the type of alkalinity present. (Ans=CO3-2 = 160ppm,HCO3-=10ppm)
6. 100 ml of water sample required 30 ml of N/50 H2SO4 for neutralization upto (P) end point. After this methyl orange was added to this and further acid required was again 30 ml calculate alkalinity of water.(Ans= CO3-2 =60ppm)
7. 100ml of sample required 4 ml of N/50 H2SO4 for neutralization upto (P) end point. Another 16 ml of same acid was needed for further titration upto (M) end point. Determine the type of alkalinity.(Ans= CO3-2 =80ppm, HCO3- =80ppm)

# Unit II (B): CORROSION PART-A

* 1. Define the term ‘corrosion’ of a metal. (may/jun-suppl2019)
  2. Though aluminum is above iron in the galvanic series. Yet aluminum corrodes to a small extent. Explain why?
  3. A pure metal rod immersed vertically in water starts corroding at bottom. Give reasons.
  4. Why should Nickel plated steel articles be free from pores and pin holes?
  5. What happens when cathodic coatings breaks?
  6. Why does corrosion occur in steel pipe connected to copper tank?
  7. A copper equipment should not possess small steel bolt .why ?
  8. Account for the following:
     1. A nail hammered in a block of wood gets its stem rusted but not head.
     2. In Cathodic coating parent metal gets severely corroded when crack appears compared to anodic coating.
     3. A plumber fixes a copper bolt in Iron structure. Which part gets corroded? Explain. Which type of oxide film is most protective against corrosion?
  9. Most of the metals undergo severe corrosion in acidic environment than in alkaline/neutral environment. Why?
  10. What is pitting corrosion? Explain? (may-jun-2019)
  11. Explain waterline corrosion (may –jun-supp-2019)

# PART-B

1. Write a note on galvanic series.
2. Explain the rusting of iron metal with the help of electrochemical theory of corrosion. (Dec 19)
3. Corrosion of water filled steel tanks occurs below the waterline. Explain.
4. **Discuss the factors that affect the rate of corrosion of a metal.** (may –jun-supp-2019)
5. Explain how rate of corrosion of a metal is affected by the following factors a) Position of metal in galvanic series b) Ratio of anodic & cathodic areas .c) influence of PH.
6. Write a note on a) water-line, b) pitting corrosions.

# Write a brief note on cathodic protection.

1. **What is sacrificial anode? Discuss its role in the control of corrosion of a metal**.
2. What are anodic and cathodic metallic coatings? Explain with suitable examples.

# What is a metallic coating? How are metallic coatings classified? Give examples.

1. Explain hot dipping methods for galvanizing .

# Write a brief note on cathodic protection by impressed current method (may-jun- 2019)

1. **Explain the mechanism of corrosion inmetals by 1. Hydrogen evolution &2. Oxygen absorption type**

**Unit III: ENGINEERING MATERIALS**

**PART- A Short Question (2 Marks)**

1. Define functionality of the monomer? Explain with examples.
2. What are the basic requirements of a monomer(s) to take part in Addition polymerization and Condensation polymerization?

# What is Co-polymerization? Give an example. [AICTE Supply June 2019]

1. Can methane (CH4) undergo polymerization? Explain why?
2. What are natural and synthetic polymers? Give two examples for each.

# Define Homo, Hetero and Co-polymers with examples. [AICTE Main Dec 2018]

1. Define Vulcanization and why raw rubber needs vulcanization?
2. Write the name and chemical structure of monomer of natural rubber.
3. What are the advantageous properties of polymers over metals?
4. What is plasticity and elasticity?

# What are conducting polymers? Why do they conduct electricity? [AICTE Supply June 2019]

1. Write any three important properties of conducting polymers.
2. Why is Bakelite used in electrical appliances?

# Write the structures of Nylon 6:6 and Buna-S rubber. [AICTE Main June 2019]

1. PVC is soft and flexible, whereas Bakelite is hard and brittle. Why?
2. Why is Kevlar much less flexible than nylons?

# Write a note on bio-degradable polymers. [AICTE Main Dec 2018]

**Part – B (5 Marks)**

1. **Explain Addition, Condensation polymerization reactions with examples. [AICTE Supply June 2019]**
2. Give the important properties of Plastics, Fibers and Elastomers, with examples.

# Differentiate between thermoplastics and thermosetting resins. [AICTE Main Dec 2018 & June 2019]

1. **Write the preparation, properties and applications of Bakelite & Nylon 6:6. [AICTE Main Dec 2018]**
2. What are the drawbacks of natural rubber? Describe the chemistry of vulcanization (With structure, reaction). Give its significance.
3. Give equations for preparation, properties and uses of (i) Buna S, (ii) Butyl rubber.

# Write the preparation, properties and uses of Nylon6, 6 and Kevlar. [AICTE Supply June 2019]

1. What are intrinsic conducting polymers? Give examples.

# What is the mechanism of conduction in polymers by considering polyacetylene as example? Write the applications of conducting polymers. [AICTE Main Dec 2018 & June 2019]

1. **Explain with reactions the degradation of Polylactic acid polymer. [AICTE Supply June 2019]**
2. **Write preparation, properties and uses of Silicone rubber. [AICTE Main June 2019]**

**MCQ’s (1 Mark)**

|  |  |
| --- | --- |
| **1. The number of repeating units in a polymer is known as**  a) monomer  b) degree of polymerization c) molecule  d) chain  **2. Which of the following is not a property of** thermoplastics?  a) Recyclable b) Soft and weak c) Easy to mold  d) Can be used at high temperatures  **3. A polymer made of identical monomer units is called**  a) Homopolymer  b) Linear polymer c) Copolymer d) Branched polymer  **4. Liquid or gas polymers having short chains and low molecular weights are known as**  a) High-polymers b) Homopolymers c) Copolymers d) Oligo-polymers  **5. Addition of different types of monomers to form polymer chains is known as**  a) Chain reaction polymerization b) Copolymerization  c) Combination d) Disproportionation  **6. What does the numbered suffix used in nylon polymers mean?** a) Molecular weight  b) Number of carbon atoms c) Coefficient of thermal expansion d) Number of monomer chains  **7. Thermosetting plastics are formed by** a) addition polymerization  b) copolymerization c) condensation polymerization d) isomerism  **8. Conducting polymers having conjugation is a type of intrinsically conducting polymers.**  a) True b) False | 1. **How much sulfur must be added to rubber for vulcanization?**   a) 1-5%  b) 7-20%  c) 25-35%  d) > 40%   1. **Silicones are called inorganic polymers due to absence of**   **in the main backbone chain.**   1. Nitrogen atom b) Oxygen atom c) Carbon atom d) Hydrogen atom    1. **The catalyst used in the preparation of poly-siloxanes is** a) Benzoyl peroxide b) Grignard reagent c) Cumene hydroperoxide d) Lewis acid    2. **Which of the following is tri- functional?** 2. Dimethyl silicon chloride b) Trimethyl silicon chloride c) Tetramethyl silicon chloride d) Momethyl silicon chloride    1. **Which of the following gives linear chain silicones on polymerisation by controlled hydrolysis?** a) Dimethyl silicon chloride b) Trimethyl silicon chloride c) Tetramethyl silicon chloride d) Momethyl silicon chloride    2. **Which of the following is mono- functional?**   a) Dimethyl silicon chloride b) Trimethyl silicon chloride c) Tetramethyl silicon chloride d) Momethyl silicon chloride  **15. The advantage of using conducting polymers in place metals is their**  **.** a) Cost b) Light-weight  c) Thermal conductivity d) Solubility |

**Unit IV: CHEMICAL FUELS**

**Part – A**

1. Define the term Fuel. What are the requirements of a good fuel?

# What are chemical fuels? Give their classification with example.

1. Define calorific value of fuel.What are the units of calorific value for gaseous fuels?
2. What are the advantages of gaseous fuels over solid and liquid fuels?
3. Write Dulongs formula for calculation of calorific value of fuel, write its usefulness.

# Define calorific value of a fuel. What is HCV & LCV?

1. Gross calorific value of a fuel is 3500 cal/gm. If it contains 6.5%H2, Calculate its net calorific value.
2. Calculate the weight of air (23% oxygen by weight) required for complete combustion of 16Kg of methane.
3. Calculate the minimum weight of air required for complete combustion of 1kg of fuel containing c=90%, H=3.5%, O=3% and rest is ash.
4. Sulfur is a poison to fuel. Justify the statement.
5. What is meant by knocking? How to improve anti knocking of fuel.

# Explain octane and cetane numbers of a fuel. What is their significance.

1. What is unleaded Petrol? How is its Octane number improved? Discuss its advantages.
2. What is the approximate composition & calorific value of LPG?
3. What is the composition of CNG?
4. Give the uses and composition of diesel and petrol.

# PART-B

1. A sample of coal contains 80% of carbon, 15% hydrogen, and rest oxygen. Calculate the weight and volume of air needed for complete combustion of 5 Kg of coal. Air contains 21% of oxygen by volume, 23% by weight. Calculate its HCV and LCV.
2. A Producer Gas has following composition by volume CO2=8%; CO=27.6%; CH4=1.2%;N2= 52.6%; H2 = 10%; O2 = 0.6%. Calculate the gross Calorific Value of the Gas. (CV of H2 = 3100 Kcal/m3 , CO = 2970 Kcal/m3, CH4 = 9260 Kcal/m3).
3. A sample on analysis by weight, is as follows,-C=90%, H=8%, S=0.5%, O=1%, ash=0.5%.Calculate a) the minimum quantity of air required for Complete combustion of 1Kg of fuel. (b) Calculate the air fuel ratio and volumetric analysis of dry products of combustion if 20% excess air is used. (Given the% of Oxygen in air = 23 by weight & 21% by volume).
4. Write the principle of fractional distillation of crude oil. What are composition and uses of important fractions obtained i.e. Gasoline, diesel and kerosene.
5. What is cracking? What is its significance?
6. Explain moving bed catalytic cracking of heavy oil.

# Unit V : GREEN CHEMISTRY, BIODIESEL AND COMPOSITES

**V (A) GREEN CHEMISTRY**

1. What is green chemistry?
2. Explain how Green Chemistry is different from Environmental Chemistry.
3. What are the principles of green chemistry? Give examples relating to atom economy and catalysis.
4. Explain Atom economy in Green Chemistry by taking suitable example. [B.E. I-Sem (Group-B)(Main) Examination, December 2018]
5. What is the concept of Green Chemistry? [B.E. I-Sem AICTE) (Supple.) Examination, May/June2019]
6. What are green catalysts? Give two examples. What is Atom economy? [B.E. II-Sem (AICTE)(Main) Examination, May/June2019]
7. Explain any six important principles of Green Chemistry. [B.E. I-Sem (Group-B)(Main) Examination, December 2018]
8. Write any six important principles of Green Chemistry and explain their importance. [B.E. I-Sem (AICTE)(Supple.) Examination, May/June2019]
9. What is the requirement of Green Chemistry in today’s scientific world? Illustrate with examples.

# V (B): BIODIESEL

1. What is Biodiesel? What are its advantages over petro diesel?
2. Write the properties of Biodiesel. [B.E.II-Sem(AICTE)(Main) Examination, May/June2019]
3. Write a note on Trans-esterification in Biodiesel formation. [B.E. I-Sem (Group- B)(Main) Examination, December 2018].
4. Explain the concept of Trans-esterification in Biodiesel formation. [B.E. I-Sem (AICTE)(Supple.) Examination, May/June2019]
5. Explain Transesterification in the preparation of Biodiesel?
6. What are advantages of biodiesel over petro-diesel

# V (C): COMPOSITE MATERIALS

1. What are composite materials? What are their advantages? Give examples. [B.E. I-Sem (AICTE)(Supple.)Examination, May/June2019]
2. Differentiate between Matrix and Reinforcement in a composite. [B.E. I-Sem (Group- B)(Main) Examination, December 2018]
3. Write a note on Fiber reinforced composites.
4. Describe the constituents of composite materials.
5. What are Composite materials? Give their classification with examples. [B.E. I-Sem (Group-B)(Main) Examination, December 2018]
6. Discuss the applications of Composites. [B.E. II-Sem (AICTE)(Supple) Examination, May

/June2019]