Ref.No:Ex/PE/BS/B/T/212/2024/S

JADAVPUR UNIVERSITY

B.E. POWER ENGINEERING SECOND YEAR FIRST SEMESTER-2023-24
Subject: CHEMISTRY OF ENERGY SCIENCE
Time: 3 Hrs **Full Marks: 100**

General instructions: Internal Choices are provided.

Answer any 4 Questions:

1 a) Write down the names of the electron carriers involved in the electron transport of Photosynthetic system. (5)

b) Explain the formation of ATP mentioning the role of the binuclear Mn protein complex with reference to Photosystem-II. (8)

c) Why mitochondrion is considered as the powerhouse of the cell? (4)

d) Give a detailed outline of the structural and functional unit responsible for photosynthesis. (8)

OR,

e) Explain with the help of schematic diagram the mechanism of cellular respiration showing energy transfer in mitochondria considering the glycolysis pathway. (10)

f) Mention the role of P-700 Chlorophyll involved in the photosynthetic electron transfer. (10)

g) Name the different chlorophylls which are included in photosynthetic systems. (5)

2 a) Mention a few characteristics of a good fuel. What is meant by rating of fuel? Distinguish between GCV and NCV. (4+2+5)

b) Why is CNG preferred over gasoline or LPG? Mention the composition of LPG and mention its calorific value. What are antiknock compounds and how do they function? (3+3+2)

c) A sample of coal was analyzed as follows:
Exactly 2.500 g was weighed into a silica crucible. After heating for an hour at 1100C, the residue weighed 2.415 g. The crucible was then covered with a vented lid and strongly heated for exactly 7 minutes at 950 + 200C.The residue weighed 1.528 g. The crucible was then heated without the cover, until a constant weight was obtained. The last residue was found to weigh 0.245 g. calculate the percentage of moisture, volatile matter, ash and fixed carbon content in the coal sample. (6)

OR,

d) Calculate the gross and net calorific value of coal having the following composition: C=85% H=8% S=1%N=2%Ash=4%; Latent heat of steam=587cal/g (5)

e) Write short notes on the following: (Any 4) (4*5=20)

i. Aviation fuel ii. Refining of petroleum

iii. Producer gas iv. Significance of proximate analysis of coal

v. Bio-fuel and its advantages vi. Geothermal energy

3 a) Distinguish between Hot lime soda and Cold lime soda Process. (8)

b) A water works has to supply 1 m^3/s of water. Raw water contains: Mg $(HCO_3)_2$=219 ppm, Mg^{2+}=36 ppm, HCO^{3-}=18.3 ppm, H^+=1.5 ppm. Calculate the cost of treating water per day, if lime (90% pure) and soda (95% pure) cost Rs 500 per ton and Rs 7000 per ton respectively. Given: Molecular weight of Mg $(HCO_3)_2$ is 146, atomic mass of Mg is 24, HCO^{3-} is 61 and H^+ is 1. (8)

c) What is meant by hardness of water? What are the types of hardness? (2+4=6)

d) How can you prevent caustic embrittlement? (3)

OR,

e) Distinguish between BOD and COD (5)

f) Calculate the amount of lime and soda needed for softening a water sample which contains the following impurities. Given: Ca^{2+}=20 ppm SO_4^{2-}=24 ppm Mg^{2+}=18 ppm HCO^{3-}=183ppm (atomic masses of Ca=40, Mg=24, HCO^{3-}=61, SO_4^{2-}= 96) (8)

g) Explain the terms Priming and Foaming in conjunction with boiler corrosion. (6)

h) Give equations to explain the removal of hardness by Calgon process (6)

4 a) What are fuel cells? How does a fuel cell differ from a storage cell? Mention the different types of fuel cell. (3+3+4=10)

b) Write short notes on the following: (4*2=8)

i. Mercury cell ii. Ni-Cad Battery

c) What are secondary cells? Mention the composition, reactions involved in a lead acid battery. (2+5=7)

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d) Why photovoltaic cells are replaced by organic solar cells? Mention the working principle of an organic solar cell. What are the two types of organic solar cell available? Mention a few advantages of using such cells in industry. (3+3+2+2=10)

e) Give a diagrammatic representation of Hydrogen-Oxygen fuel cell. Highlight on the following points:

i. Composition of the cell

ii. Electrode reactions involved in the cell

iii. EMF generated and applications of the cell

iv. Fate of the product obtained. (5+5=10)

f) Write down the reactions taking place in an alkaline battery. What are its advantages over a dry cell? Mention its EMF and uses. (2+2+1=5)