

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
 DUAL DEGREE B. TECH-M.TECH 2nd Sem (EE, ETC, CST&IT) EXAMINATION, April 2016

Chemistry (CH-1201)

Time : 3 hours

Full Marks : 70

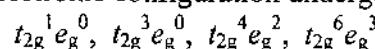
Use separate answer scripts for each half

FIRST HALF

(Question No.1 compulsory and answer any FOUR from the rest)

1. (a) PVC is soft and flexible; whereas Bakelite is hard and brittle. Give reasons? Write down the structure of PAN as Ladder polymer form.

(b) Which of the following electronic configuration undergoes Jahn-Teller distortion?



[3+3]

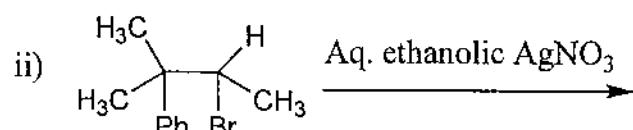
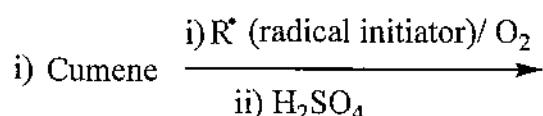
2. (a) Differentiate between Thermoplastic and Thermosetting polymers with proper example.

(b) What is copolymerization? Classify the homopolymer on the basis of *Tacticity*?

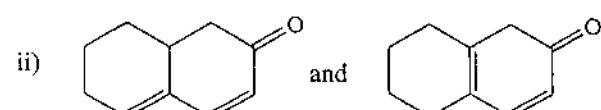
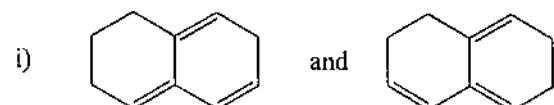
(c) In a polypropylene polymer, there are 200 molecules of molecular weight 10^3 , 300 molecules of molecular weight 10^4 and 400 molecules of molecular weight 10^5 . Find out $\overline{M_n}$, $\overline{M_w}$ and $\overline{DP_n}$.

[3+3+4]

3. (a) Predict the product(s) and suggest a mechanism for each of the following reactions:



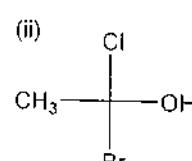
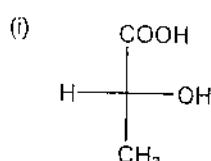
(b) Calculate the λ_{\max} value in nm for the following isomeric compounds.



$[(2 \times 2) + (3 \times 2)]$

4.(a) Draw energy profile diagram of n-butane by mentioning all possible conformational isomers.

(b) Designate R-S of the following chiral molecules:



(c) Write notes on (any two)

(i) Energy profile diagram of S_N¹ and S_N² reactions. (ii) Bathochromic and Hypsochromic shift and (iii) Hofmann and Saytzeff elimination.

5. (a) Write down criterions of radioelement for using as radiodiagnostic agent and radiotherapeutic agent. Give examples of radionucleotides used as radiodiagnostic agent and radiotherapeutic agent.

(b) Write name and structure of a lanthanide complex and a vanadium complex used in diagnostic application and as insulin mimetic, respectively.

6. (a) What is meant by spectrochemical series? Arrange the halide ions according to their field strength with proper reasoning.

(b) What is meant by Spinel and Inverse Spinel structure of minerals. Comment on the possible structure of any one of the following two minerals: (i) NiFe₂O₄ (ii) Co₃O₄.

[(2+3)+(2+3)]

7. (a) Draw the diagrams for high spin and low spin crystal field splitting for a d⁷ metal complex and then calculate their Crystal Field Stabilization Energies (CFSE).

(b) Define octahedral site stabilization energy (OSSE) and then calculate the OSSE between high spin octahedral and tetrahedral configurations for a d⁸ metal complex.

(c) 'Tetrahedral complexes always prefer high spin state' - justify.

[4+4+2]

SECOND HALF

(Answer Question No. II and any TWO from the rests)

8. (a) For the hydrogen- bromine (chain) reaction to produce hydrogen bromide: H₂ + Br₂ = 2HBr establish the following rate law:

$$\frac{d[HBr]}{dt} = \frac{k[H_2][Br_2]^{1/2}}{1 + \frac{m[HBr]}{[Br_2]}}$$

(b) Show that the initial rate of formation of HBr is three-halves (3/2) order.

(c) What is the chain length of the above reaction?

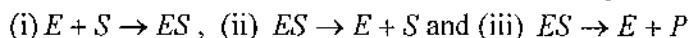
[6+2+2]

9. (a) Write down the spontaneous reactions for the cell configuration
 $\text{Cd}/\text{Cd}^{+2} // \text{KCl}/\text{Hg}_2\text{Cl}_2, \text{Hg}(\text{s})$
If $E_{\text{Cd}/\text{Cd}^{+2}}^0 = 0.402$ and $E_{\text{calomel}}^0 = 0.2680$ V, calculate the free energy change under standard condition.

- (b) Illustrate the following
- (i) Double layer structure at the electrode solution interface.
 - (ii) Redox electrode.
- (c) What is the function of Polymer electrolyte membrane (PEM) in a H₂-O₂ fuel cell?
- (d) What are the intercalated host structures in Li-ion battery?

[3+3+2+2]

10. (a) Derive the Michaelis-Menten rate law based on the following scheme with rate constants k₁, k₋₁ and k₂ for reactions (i), (ii) and (iii), respectively.



How will you estimate the value of turnover number (k₂) and Michaelis constant (K_M) of an enzyme?

(b) What are the components of a Pb-acid battery? Write down the charging-discharging reaction of such battery.

[(4+1) + 5]

11. If reactant A undergoes two simultaneous reactions to produce B and C according to $A \xrightarrow{k_1} B, A \xrightarrow{k_2} C$, then show that the required activation energy for the disappearance of total A can be expressed by $E_a = \frac{k_1 E_1 + k_2 E_2}{k_1 + k_2}$. Symbols have their usual significance.

[4]