

30/4/18

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR  
B. TECH-M.TECH DUAL DEGREE 1<sup>st</sup> SEMESTER (AE&AM, CE, ME, Met, Min) EXAMINATION, 2018  
Chemistry (CH-1201)

FULL MARKS : 70

TIME : 3 Hrs

*Use separate answer scripts for each half*  
*Answer for all parts of a question (e.g. a,b,c----) must be written at one place*

## FIRST HALF

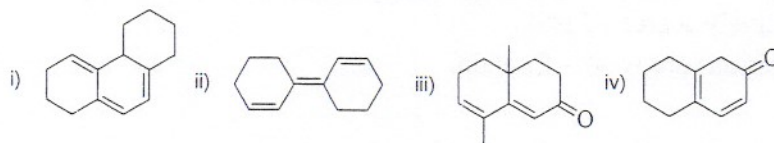
[Answer Question No. 1 and any two from Unit-1 and any two from Unit-II]

- (a) Distinguish between the possibilities when a transition metal ion with  $d^n$  configuration has zero crystal field splitting ( $\Delta = 0$ ) and when the CFSE = 0. Give an example of each.  
(b) Define the terms with suitable example: (i) Chromophore (ii) Auxochrome

[3 + (1½×2)]

Unit -I [answer any Two]

- (a) Benzene and acidic solution of aniline show similar UV spectra- Explain  
(b) Describe the difference between 1,3-butadiene and ethane in terms of  $\lambda_{\max}$ .  
(c) Calculate  $\lambda_{\max}$  for the following compounds:

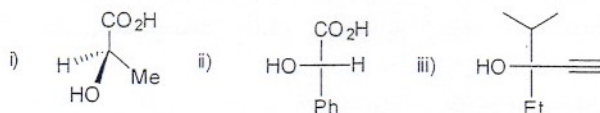


[2+2+(1½×4)]

- (a) What is bio-polymer? Discuss briefly with examples.  
(b) Describe the method and mechanism for amino acid detection.  
(c) In a polymer, there are 750 molecules of molecular weight 100, 500 molecules with molecular weight 1000 and 250 molecules with molecular weight 10,000. Calculate  $M_n$ ,  $M_w$  and PDI.  
(d) Write a short note on tacticity of PVC polymer.

[(1+1) + 2+3+3]

- (a) Draw all possible conformations of n-butane in Newmann projection formula and show the position in energy diagram with dihedral angle.  
(b) Find out the absolute configuration of following compounds



- (c) A solution prepared by mixing 20 ml of 0.1 M solution of the *R* enantiomer and 60 ml of 0.1M solution of *S* enantiomer was found to have an observed rotation of  $+10.5^\circ$ . What is the specific rotation of each enantiomer?

(d) The substitution reaction of optically active 2-iodooctane with radioactive sodium iodide  $[NaI^*]$  in acetone leads to racemisation- Explain.

[3+3+2+2]

### Unit –II [answer any Two]

5. (a) What diseases are likely to occur for the deficiency of Na and Ca in the body and what would happen if excess of them accumulate in the body?  
 (b) What are the basic requirements of a chelating agent?  
 (c) Explain how does British anti-Lewisite effectively remove As from living systems.

[3+3+4]

6. (a) Discuss the mechanism by which *cis*-platin acts as an anti-cancerous agent. Why *trans*-platin is inactive.  
 (b) What is Neutron capture therapy?

[(5+2)+3]

7. (a) In  $CrF_2$  the Cr-F bonds are unequal but in  $MnF_2$  the Mn-F bonds are equal. - Explain.  
 (b) With weak field ligands tetrahedral  $Co^{2+}$  complexes are not uncommon whereas tetrahedral  $Ni^{2+}$  complexes are relatively scarce - Justify.  
 (c) Intensity of d-d transitions are weak - Explain.

[3+3½+3½]

### SECOND HALF

(Answer Question No. 11 and any two from the rest)

8. (a) The rate constant of thermal decomposition of ethane is given as,  $K = \left( \frac{k_1 k_3 k_4}{k_5} \right)^{\frac{1}{2}}$

Following Arrhenius equation, show that the activation energy of the decomposition is,

$$E_a = \frac{1}{2} [E_{a1} + E_{a3} + E_{a4} - E_{a5}]. \text{ Notations have usual significance.}$$

- (b) Identify name of reaction steps involved in the dehydrogenation of ethane and using steady-state approximation show that the rate of formation of ethylene ( $C_2H_4$ ) is proportional to  $[CH_3CH_3]$ . What is the chain length of the reaction?

[3+(2+4+1)]

9. (a) Michaelis-Menten model generally used to explain enzyme-catalyzed reaction kinetics. Show that enzyme catalytic reaction can be first order and zero-order, depending upon the substrate (S) concentration.  
 (b) Describe the electrode – electrolyte interface structure with variation of potential from the electrode surface to the bulk of the solution.  
 (c) What do you understand by primary reference electrode?

[5+3+2]

10. (a) Illustrate the differences between reversible and irreversible cells.  
(b) Write down the charging – discharging reaction schemes of Li-ion battery.  
(c) The mobility of  $\text{Na}^+$  ion is  $7.623 \times 10^{-8} \text{ m}^2 \text{ V}^{-1} \text{ sec}^{-1}$ . (i) calculate the ion conductance of  $\text{Na}^+$  ion. (ii) the velocity of the ion if 15 Volts are applied across the electrodes 25 cm apart. (iii) the transport no. of the ions in NaCl if the mobility of  $\text{Cl}^-$  ion is  $4.239 \times 10^{-8} \text{ m}^2 \text{ V}^{-1} \text{ sec}^{-1}$ .

[3+3+4]

11. Calculate  $E^0$ ,  $\Delta G^0$  and K (equilibrium constant) for a system where a piece of Fe is dipped in a 0.005(M) solution of  $\text{NiSO}_4$  at  $25^\circ\text{C}$ . Also write down the cell and cell reaction for the system. Given that  $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.441 \text{ V}$  and  $E^0_{\text{Ni}^{2+}/\text{Ni}} = -0.24 \text{ V}$

[4]