

## INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

B. TECH-M.TECH DUAL DEGREE 1<sup>st</sup> Sem (CE, ME, MET, AE, MIN) EXAMINATION, 2017

## Chemistry (CH-1201)

Time : 3 hours

Full Marks : 70

Use separate answer scripts for each half

## FIRST HALF

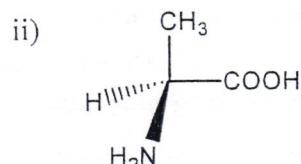
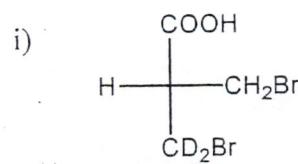
[Question No.1 is compulsory. Answer any two from Unit-I and any two from Unit-II]

1. (a) Why tetramethylsilane (TMS) accepted as standard reference in the  $^1\text{H}$  NMR spectra? Name two deuterated NMR solvents.  
 (b) Tetrahedral complexes show only high spin configuration-explain.

[3 + 3]

Unit -I [Answer any Two]

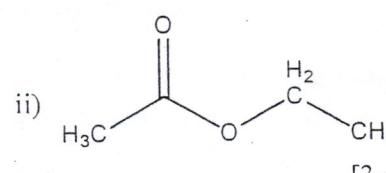
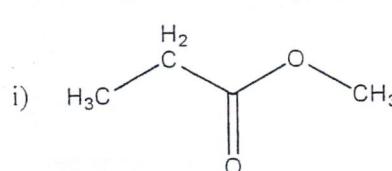
2. (a) Coniine, the toxic extract of poison *Hemlock*, is chiral and has  $[\alpha]_D = +15.7^0$ , when a 1.50 g sample was dissolve in 10 mL of alcohol in a sample tube with a 5.00 cm path length. What was the observed rotation of this sample?  
 (b) Find out the absolute configuration of following compounds:



- (c) Write down the product(s) of the reaction and give mechanism when (S)-1-phenylethanol is allowed to react separately with thionyl chloride in the presence and absence of pyridine.  
 (d) Methoxychloromethane,  $\text{ClCH}_2\text{OCH}_3$ , undergoes ready  $\text{SN}^1$  solvolysis reactions, even though it is primary substrate- Explain.

[3+2+3+2]

3. (a) Draw Pascal's triangle by mentioning intensity and naming of the peaks up to six adjacent protons.  
 (b) Define Chemical shift. How does electronegativity affect chemical shift.  
 (c) Draw the  $^1\text{H}$ -NMR spectra of the following two isomeric compound and show their splitting pattern with intensity ratio



[3 + 3 + 4]

4. (a) How Nylon 6 and Nylon 66 are prepared? Give reactions.  
 (b) Differentiate Thermoplastic and Thermosetting polymers with examples.

- (c) Calculate the number-average and weight-average molecular mass for a polymer sample containing 200 molecules of molecular weight 1000, 300 molecules of molecular weight 10000 and 500 molecules of molecular weight 100000  
(d) Classify polymer on the basis of *Tacticity*.

[3 + 2 + 3 + 2]

### Unit II [Answer any Two]

5. Answer any two of the following:
- (a) What diseases are likely to occur for the deficiency of sodium and zinc in the body and what would happen if excess copper and calcium accumulate in the body?
- (b) What are the essential criteria that a chelating agent must satisfy for being considered for chelation therapy? Suggest chelating agents for treatment of any two of the following:  
i) Pb(II), ii) Pu(IV), iii) As (III) toxicities.
- (c) Give appropriate reasons to explain why very few second and third transition elements are chosen as essential elements while majority of the first transition elements are essential elements. Name four bulk essential metal ions required in biological system.

[5 + 5]

6. Answer any two of the following:
- (a) Give structures of two platinum complexes which may be used for cancer chemotherapy. Why is *cis*-platin effective in treating cancer while *trans*-platin is not?
- (b) Suggest a radioisotope whose complex can be used as an excellent radio-imaging agent for heart tissues. What are MRI contrast agents? Write structure of a MRI contrast agent.
- (c) Illustrate the term 'Neutron Capture Therapy'.

[5 + 5]

7. (a) What is spectrochemical series?  
(b) F<sup>-</sup> is weak field ligand whereas CO is strong field ligand – explain with the help of simple MO diagram.  
(c) [NiCl<sub>4</sub>]<sup>2-</sup> is yellow whereas [PdCl<sub>4</sub>]<sup>2-</sup> is colorless – explain.

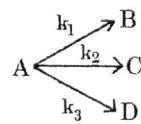
[2 + 5 + 3]

### SECOND HALF

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

8. (a) Although Arrhenius equation is used extensively to determine the activation energy of chemical reaction, many modern theories of reaction rates predict that the rate constant behaves like :  $k = a T^m e^{-\frac{E}{RT}}$  . Where a, E and m are temperature independent constants. What is the relationship between Arrhenius activation energy  $E_a$  and pre-exponential factor A and the constant m, a, and E in the above equation?

(b) Prove that the activation energy for the disappearance of A according to the following reactions:



is given by  $E_a = \frac{k_1 E_1 + k_2 E_2 + k_3 E_3}{k_1 + k_2 + k_3}$ , where  $E_i$  is the activation energy for the  $i$ th reaction.

[5 + 5]

9. (a) A proposed mechanism for the reaction  $H_2 + Br_2 \rightarrow 2HBr$  is

- (i)  $Br_2 \rightarrow Br + Br$
- (ii)  $Br + H_2 \rightarrow HBr + H$
- (iii)  $H + Br_2 \rightarrow HBr + Br$
- (iv)  $H + HBr \rightarrow H_2 + Br$
- (v)  $Br + Br \rightarrow Br_2$

Is this reaction a chain reaction? If so, then identify the initiation, propagation, inhibition and termination steps(s). If you assume the steady state approximation for the intermediate species, find out the rate law for HBr formation. Show that the order of the reaction is 1.5 in the initial state of reaction when  $[HBr]$  is negligibly small.

(b) Illustrate the Stern model for the electrode-electrolyte interface and show that for dilute solution the capacity of the electrified interface is represented by that of the Guoy – Chapman region.

[5 + 5]

10. (a) Consider the galvanic cell  $Cd | Cd^{2+} \parallel KCl | Hg_2Cl_2 - Hg$  and answer the following:

- (i) Write down the cell reaction and express the Nernst equation for the cell.
- (ii) Which are the types of the electrodes (both anode and cathode) in the cell?
- (iii) Find out  $\Delta G^0$  for the reaction involved (given,  $E^0_{\text{anode}}: 0.402\text{V}$  and  $E^0_{\text{cathode}}: -0.268\text{V}$ ).

(b) Give the schematic representation of charging – discharging behavior of Li-ion battery and write down the reversible reactions.

[(2 + 1 + 2) + 5]

11. (a) Show that the enzyme catalytic reaction is first order and zero-order with respect to the substrate, S at low and high concentration of S, respectively.

[4]

Or

(b) What are the different components in a  $H_2 - O_2$  fuel cell? What are the functions of each of these components?

[4]