(2) 24/11/16

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
B. TECH-M.TECH DUAL DEGREE 1st Sem (CE,ME, AE, Min, Met) EXAMINATION,2016
Chemistry (CH-1201)

Time: 3 h **Full Marks: 70**

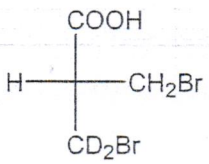
Use separate answer scripts for each half

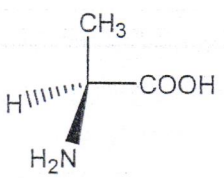
FIRST HALF
[Question No.1 and 8 are compulsory and answer *any two* from each Unit]

1. (a) Why tetramethylsilane (TMS) accepted as standard reference in the ^{1}H NMR spectra? Define Chemical Shift.
(b) Why magnitude of $\Delta_o > \Delta_t$? [3+3]

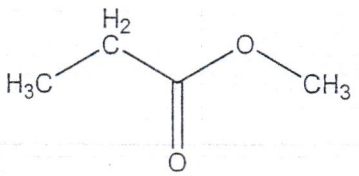
Unit –I [answer *any Two*]

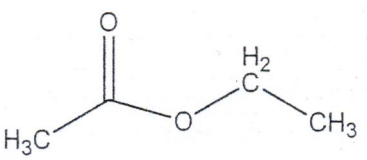
2. (a) Mycomycin, an antibiotic isolated from the bacterium *Nocardia acidophilus*, is chiral and has $[\alpha]_D = -130°$, when a 1.50 g sample was dissolved in 10 mL of alcohol in a sample tube with a 5.00 cm path length. What was the observed rotation of this sample.
(b) Find out the absolute configuration of following compounds:

i) 

ii) 

(c) Draw the ^{1}H-NMR spectra of the following two isomeric compounds and show their splitting pattern with intensity ratio.

i) 

ii) 

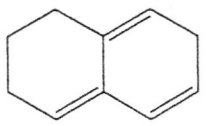
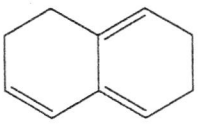
[3+3+4]

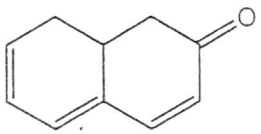
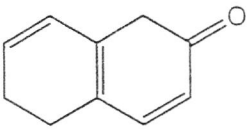
3. (a) How Nylon 6 and Nylon 66 is prepared? Give reactions.
(b) Differentiate Thermoplastic and Thermosetting polymer with examples.
(c) Calculate the number-average and weight-average molecular mass for a polymer sample containing 200 molecules of molecular weight 1000, 300 molecules of molecular weight 10000 and 500 molecules of molecular weight 100000.
(d) Give two examples of bio-polymers. [3+3+3+1]

4. (a) State Lambert- Beer's law of absorption of light and hence prove: $A = \varepsilon cl$ where A= absorbance, ε = molar extinction co-efficient, c = molar concentration, l = path length

(b) Explain why in presence trace amount of alkali colorless phenolphthalein solution shows deep pink color.

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

i)  and 

ii)  and 

[(4+2) +(2×2)]

Unit II [answer any Two]

5. (a) Hydration energy of the divalent ions of the first transition series exhibits a double humped curve when plotted against their d^n configuration though a smooth curve can be obtained considering only Ca^{2+}, Mn^{2+} and Zn^{2+}. Explain.

(b) Predict which of the following oxides will show normal spinel and inverse-spinel structure. $ZnFe_2O_4$, Mn_3O_4, Fe_3O_4 [4+6]

6. (a) $[Fe(phen)_2(NCS)_2]$ is found to be diamagnetic at low temperature and paramagnetic at high temperature – Explain the phenomenon.

(b) Ni^{2+} prefers mostly octahedral geometry whereas for Co^{2+} a large number of tetrahedral complexes are known in presence of weak field ligands – Give reason. [5+5]

7. (a) Mention the basic requirements for chelating ligands to be used as a chelating drugs.

(b) Draw the structures of Lewisite and British anti-Lewisite (BAL). Show how British anti-Lewisite removes arsenic from the body.

(c) How does ^{131}I destroys tumor cells in Thyroid glands? *Cis*-platin shows anti-cancer activity whereas its *trans* analogue does not - Explain. [(3+(1+2)+(1+3)]

SECOND HALF

8. Calculate E^0 for a system where a piece of Fe is dipped in a 0.005(M) solution of $NiSO_4$ at 25°C. Give the cell configuration and write down the cell reaction.

[Given that $E^0_{Fe^{2+}/Fe} = -0.441V$ and $E^0_{Ni^{2+}/Ni} = -0.24V$].

[4]

Unit III [answer *any Two*]

9. (a) For the reaction scheme, R→ I → P with successive first-order rate constants k_1 and k_2 derive the necessary equation describing the temporal behavior of [P]. Find the time at which the concentration "I" attains maximum value. Show that the rate of formation of P depends solely on the first-step of the reaction provided $k_1 << k_2$.
(b) What is the relationship between Arrhenius activation energy and pre-exponential factor with the parameters (E_1, m and B) appear in $k = B\,T^m \exp(-E_1/RT)$? [(4+2+1)+3]

10. (a) The Rice-Herzfeld mechanism for the thermal decomposition of acetaldehyde (CH_3CO) is

$$CH_3CHO \xrightarrow{k_1} CH_3\bullet + CHO\bullet$$

$$CH_3\bullet + CH_3CHO \xrightarrow{k_2} CH_4 + CH_2CHO\bullet$$

$$CH_2CHO\bullet \xrightarrow{k_3} CO + CH_3\bullet$$

$$CH_3\bullet + CH_3\bullet \xrightarrow{k_4} C_2H_6$$

Using the steady-state approximation, show that the rate of methane (CH_4) formation is proportional to $[CHH_3CHO]^{3/2}$. Find the chain length of the reaction.
(b) Describe electrophoretic effect. How does this effect influence the mobility of ions in solution?
(c) Illustrate the standard hydrogen electrode with half-cell reaction. [5+3+2]

11. (a) The specific conductance of 0.01(N) KCl is 0.001225 mho cm^{-1} at 18°C. In a given conductivity cell at same temperature, the resistance of 0.01(N) KCl was found to be 145 ohms and that of 0.002(N) K_2SO_4 was 712 ohms. What is the cell constant? Calculate the equivalent conductance of that K_2SO_4 solution.
(b) Give the schematic of the Stern model of the electrode-electrolyte interface.
(c) Give the configuration of a Pb-acid battery and write down the electrochemical reaction sequence during discharge.

[4+3+3]