2 pm 25/4/17

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
B. TECH-M.TECH DUAL DEGREE 2nd SEM (EE, CST, ETC, IT) EXAMINATION, 2017
Chemistry (CH-1201)

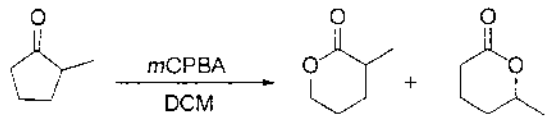
FULL MARKS : 70 TIME : 3 Hrs

Use separate answer scripts for each half

FIRST HALF

[Question No. 1 compulsory and from Unit-1 (*answer any two*) and Unit-II (*answer any two*)]

1. (a) Write down the structure of N,N'-dicyclohexylcarbodiimide and mention it's one use in organic synthesis.
(b) Identify the major product and explain why it forms in major proportion.



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

[(½+½)+2+3]

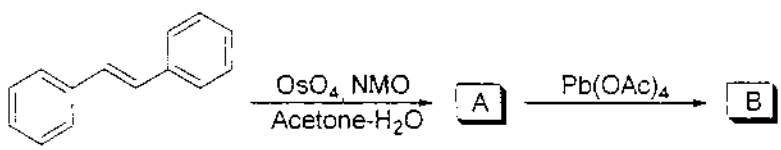
Unit –I [*answer any Two*]

2. (a) What are *atactic* and *syndiotactic* polymer? Give examples.
(b) How would you prepare Nylon 6, 6 from 1,3–butadiene?
(c) Write mechanistic details of Ziegler-Natta catalyst.
(d) Write an example of block co-polymer.
(e) In a polymer, there are 100 molecules of molecular weight 100, 200 molecules of molecular weight 1000 and 300 molecules of molecular weight 10000. Find out the number average and weight average molecular weight of the polymer. What is the polydispersity index in this case?

[2+2+2+1+3]

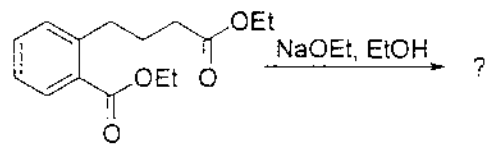
3. (a) Explain with reasons:
(i) *p*-Nitrophenol shows red shift in alkaline medium.
(ii) Aniline shows Blue shift in acid medium.

(b) Identify the products and provide appropriate mechanism for each step.



(c) Find the predominant product and write down plausible mechanism for the corresponding reaction:

(i)



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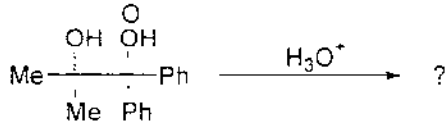
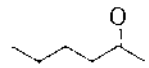
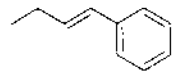
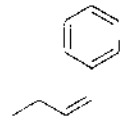
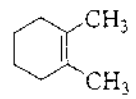
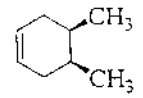


[(1½× 2)+4+(1½× 2)]

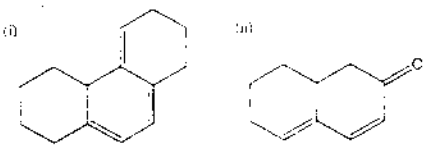
4. (a) How could you distinguish the following pairs with the help of proton NMR spectroscopy? (**any two**)

(i)  and 

(ii)  and 

(iii)  and 

(b) Calculate the λ_{max} (nm) of each of the following compounds:



(c) What type of electronic transitions do you expect from each of the following compounds?
(i) Acetaldehyde and (ii) aniline

[4+4+2]

Unit –II [*answer any Two*]

5. (a) What are the basic requirements of a chelating ligand for its fruitful application in 'Chelation therapy'?
(b) What is Wilson's disease? Which metal ion is responsible for this disease? Which chelating agent is best suited to remove this metal ion?
(c) What is an MRI contrast reagent? Give example.

[3+4+3]

6. (a) Explain why 10 Dq increases in the order:

$$[CrCl_6]^{3-} < [Cr(NH_3)_6]^{3+} < [Cr(CN)_6]^{3-}$$

(b) Explain why OH^- is a weaker field ligand than H_2O.
(c) What is tetragonal distortion? Explain with an example.

[3–4+3]

7. (a) Six metal-ligand bonds in $[Co(H_2O)_6]^{3+}$ are uniform but these are not uniform in $[Cu(H_2O)_6]^{2+}$ -explain.
(b) Define 'normal' and 'inverse' spinels with examples.
(c) Ni(II), Pd(II) and Pt(II) have the same number of d electrons but Pd(II) and Pt(II) form square planar complexes almost exclusively while only a few complexes of Ni(II) are square planar-explain.

[3+4+3]

SECOND HALF

(Answer Question No. 11 and <u>any two</u> from the rests)

8. (a) Derive the Michaelis-Menten rate law based on the following scheme with rate constants k_1, k_{-1} and k_2 for reactions (i), (ii) and (iii), respectively.
(i) $E + S \rightarrow ES$, (ii) $ES \rightarrow E + S$ and (iii) $ES \rightarrow E + P$
(b) What is the effect of substrate concentration on the order of the above reaction ?
(c) How will you estimate the value of turnover number (k_2) and Michaelis constant (K_M) of an enzyme from the Lineweaver-Burk plot ?

[4+2+4]

9. (a) Lindeman model for a unimolecular reaction is as follows:

$$A + A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} A^* + A \qquad \text{(in rapid equilibrium)}$$

$$A^* \xrightarrow{k_2} product \qquad \text{(slow)}$$

It leads to a rate equation as follows,

$$\frac{d(product)}{dt} = \frac{k_2 k_1 [A]^2}{k_{-1}[A] + k_2}$$

Show that the Lindeman model has the ability to follow the experimentally observed change from the first-order to second order kinetics with decreasing concentration of A.

(b) Give examples of different categories of batteries. What are the electrode components of Pb acid battery? Write down the half cell reactions.

(c) Give a schematic of H_2-O_2 PEM fuel cell.

[5+3+2]

10. (a) Give account of the 'Stern Model' of electrified interface and show the different capacity regions.

(b) Express half cell reaction of a calomel electrode.

(c) Consider the following reaction in an electrochemical cell operating at 25 °C:

$$Sn + Pb^{2+} \rightarrow Sn^{2+} + Pb$$

where the activities of the Sn^{2+} and Pb^{2+} are 0.6 and 0.3 respectively. The standard cell potential is 0.014 volt. Calculate the free energy change and configure the cell.

(d) At 18°C molar conductivity of a dilute $AgNO_3$ solution is 115.8 ohm^{-1} cm^2 and transport numbers of Ag^+ and NO_3^- ions are 0.466 and 0.534 respectively. Calculate ion conductances and mobilities of the two ions.

[2+2+3+3]

11. Give account of the characteristic features of a Li ion battery and show the overall charging-discharging reactions.

[4]