

This question paper contains 3 printed pages.]

Your Roll No.

4323

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M. Tech./Sem. III
CHEMICAL SYNTHESIS AND PROCESS
TECHNOLOGIES

Paper—Module—9 : Solution Chemistry

Time : 3 Hours

Maximum Marks : 38

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

*Answer **three** questions in all including.*

Question No. 1 which is compulsory.

1. (a) What are the various ways of achieving selectivity in complexometric titration of a mixture of metal ions? Give examples for each of these. 5

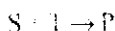
- (b) For stepwise complexation reaction between metal and ligand derive the relationship

$$\frac{d \log \alpha_C}{d \log [A]} = C - \bar{n} \text{ where } \bar{n} \text{ and } \alpha_C \text{ are the formation functions}$$

and [A] is free ligand concentration. 5

[P.T.O.]

- (c) For a spectrometric titration 4



draw the titration curves under the following conditions

- (i) $\epsilon_S = \epsilon_P$
 (ii) $\epsilon_S = \epsilon_P > 0, \epsilon_I < 0$
 (iii) $\epsilon_S = \epsilon_I < 0, \epsilon_P > 0$

2. (a) Define mean molar extinction coefficient $\bar{\epsilon}$. How this has been used by Yatsmirkü for calculation of $\beta_1, \beta_2 \dots \beta_n$ values for a complexation reaction between metal M and ligand L. 4

- (b) Using $[M]_0, [L]_0$ data describe elimination method for finding β_1 and β_2 values for 1:1 and 1:2 complexation reactions between M and L. 4

- (c) Suggest two methods for simultaneous complexometric estimations of a mixture of Cu + Zn in a solution. 4

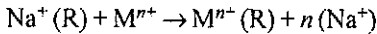
3. (a) For a back titration of M and M_0 in presence of excess EDTA, derive the following relation 6

$$P_{M_0} - P_{M_1} = \left[\log K_{M_0L} - \log K_{M_1L} + \log [M_0L] - \log [M_1L_1] \right]$$

- (b) Estimate the accuracy in estimation of 10^{-3} M Zn in presence of 10^{-4} M Mg. Given $K_{ZnY} = 16.5, \log K_{MgY} = 8.7, pZn^{trans} = 5.6$.

4. (a) For a cation exchange reaction of the type

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Show that $\frac{\lambda_0}{\lambda} = \phi$

and this ratio varies as a function of added ligand. λ_0 and λ are the distribution ratio (of metal M^{n+} between resin and solution) in the absence and presence of ligand respectively.

- (b) For complexometric titration derive the following titration error formula

$$\text{Error} = \frac{4.6 \Delta PM}{(C_M K_{ML})^{1/2}} \quad 4$$

- (c) In the pH-metric method for the determination of stability constants, show that

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$$\frac{T_L - [L]}{T_M} = \frac{\sum_{n=1}^{n=N} n \beta_n [L]^n}{\sum_{n=0}^N \beta_n [L]^n}$$

Where the terms have usual meanings.