

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

P.G. SECOND YEAR

M.A./M.SC. THIRD SEMESTER (July – December), 2012

Mid-Semester Examination, September 2012

Date : 10/09/2012

APPLIED CHEMISTRY

Time : 11 am – 1 pm

Paper – XI & XII

Full Marks : 50

[Use separate Answer Scripts for each Group]

Paper – XI

Group – A (S. M.)

1. Answer either (a) or (b) :

a) i) If $-1, 1, 2$ be the eigen values of a square matrix A of order 3, find the eigen values of $A^2 - 12A + 7I_3$, where I_3 is the identity matrix of order 3. [2]

ii) Is the matrix $\begin{pmatrix} 1 & 3 & 5 \\ 0 & -7 & 2 \\ 0 & 0 & 4 \end{pmatrix}$ diagonalisable? Justify your answer. [3]

b) i) Examine whether the following system of equations has non-trivial solution : $x + 2y + 3z = 0$, $2x + 3y + 4z = 0$, $3x + 4y + 5z = 0$. [2]

ii) Find the values of p, q and r so that the matrix $\begin{pmatrix} 0 & 2q & r \\ p & q & -r \\ p & -q & r \end{pmatrix}$ is orthogonal. [3]

2. Answer either (a) or (b) :

a) i) Test for convergence of the series $\frac{\alpha}{\beta} + \frac{1+\alpha}{1+\beta} + \frac{(1+\alpha)(2+\alpha)}{(1+\beta)(2+\beta)} + \dots$ where $\alpha, \beta > 0$ and $\beta - \alpha \neq 1$. [3]

ii) Evaluate $\lim_{x \rightarrow 0} \frac{x - \log(1+x)}{1 - \cos x}$. [2]

b) i) Find the extremum of the function $xy(a - x - y)$, $a > 0$. [3]

ii) Let $u(x, y) = \tan \{xy(x+y)\}$. Evaluate $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$. [2]

3. Answer either (a) or (b) :

a) i) Evaluate $\int_{-\frac{1}{3}}^{\frac{1}{3}} \cos x \cdot \log \frac{1+x}{1-x} dx$. [2]

ii) Evaluate $\int_0^\infty e^{-x^2} \cdot \sqrt{x} dx \times \int_0^\infty e^{-x^2} \cdot \frac{1}{\sqrt{x}} dx$. [3]

b) i) If $f(x) = f(a+x)$, show that $\int_a^{3a} f(x) dx = 2 \int_0^a f(x) dx$. [2]

ii) Show that $\int_0^{\pi/2} \sin^p x dx \times \int_0^{\pi/2} \sin^{p+1} x dx = \frac{\pi}{2(p+1)}$, $p > -1$. [3]

4. Answer either (a) or (b) :

a) i) Examine the differentiability of $f(z)$ at $z = 0$: $f(z) = \begin{cases} \frac{(\bar{z})^2}{z}, & z \neq 0 \\ 0, & z = 0 \end{cases}$. [2]

- ii) Find the residue of $f(z) = \frac{1}{(z^2 + a^2)^2}$ at $z = ai$. [3]
- b) i) If $f(z) = z \operatorname{Re} z$, does it satisfy CR equations at $z = 0$? [2]
 ii) Prove or disprove : $f(z) = e^y \cos x + i.2e^y \sin x$ is nowhere analytic. [3]

Group – B (K.P)

5. Answer **any one** :

- a) State the axioms of probability. Show that the conditional probabilities satisfy all the three axioms. [2+3]
 b) When are two events said to be mutually exclusive?
 When are two events said to be independent?
 Show that two proper events cannot be mutually exclusive and independent. [1+1+3]
 c) Define Bernoullian sequence of trials. If A_i be the event of i successes in a Bernoullian sequence of n trials, show that $P(A_i) = \binom{n}{i} p^i (1-p)^{n-i}$, where p is the probability of success in each trial. [2+3]

Paper – XII

Group – C (J. N.)

(Answer **any one** question)

6. a) Compare and contrast between LSV and CV. [3]
 b) Mention the merits and demerits of DME as used in polarography. [3]
 c) What is the potential window of DME? [1]
 d) Write down the Ilkovic equation and mention the units of the various parameters involved in it. [2]
7. a) Define ' E_{Y_2} ' in polarography. What is its physical significance? [1+1]
 b) What do you mean by 'Polarographic Maxima'? Name a maximum suppressor. [½+½]
 c) What do you mean by 'Cathodic depolariser' and 'Anodic depolariser' as used in electrogravimetry? Cite at least one example for each kind of your choice. [1½×2]
 d) "EPR spectrometers nearly always operate in the derivative mode" —Justify the statement. [1]
 e) Give one example for each of the following types of molecules so far as rotational microwave spectroscopy is concerned :
 i) Prolate symmetric top
 ii) Oblate symmetric top
 iii) Spherical top
 iv) Asymmetric tops [4×½]

Group – D (U. G.)

(Answer **any one** question)

8. a) Derive the expression for $E_{\text{equivalence}}$ of the quantitative reaction between the solutions of Fe^{2+} salt and dichromate in sulfuric acid medium. [4]
 b) What is gravimetric factor? Calculate the gravimetric factor of phosphorus if the weighable precipitate is $\text{Mg}_2\text{P}_2\text{O}_7$. [1+1]
 c) Depict the steps involved in gravimetric analysis of an analyte. [2]
9. a) Calculate the concentration ratios of ferric-ferrous and ceric-cerous at equivalence point when Ce^{4+} - salt solution is titrated with Mohr's salt solution in sulfuric acid medium.
 (Given $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 = +0.76 \text{ V}$ and $E_{\text{Ce}^{4+}/\text{Ce}^{3+}}^0 = +1.44 \text{ V}$) [2+2]
 b) Discuss the advantages on the use of organic precipitating reagent over the inorganic precipitating reagent in the gravimetric estimation of an analyte. [4]

Group – E (S. G.)

(Answer **any one** question)

10. a) Distinguish between ‘accuracy’ and ‘precision’. [2]
b) How will you detect and estimate arsenic in water sample? [3]
c) Analysis of a sample of iron gave the following percent values for the iron content — 7·08, 7·21, 7·12, 7·09, 7·16, 7·14, 7·07, 7·14, 7·18 and 7·11. Calculate standard deviation for the values. [3]
11. a) What do you mean by BOD of a water sample? Describe one method of determination of BOD of a water sample. What should be the permissible value of this parameter for drinking water? [1+3+1]
b) Give the outline of the analytical procedure for estimation of SO₂ in air sample. [3]

