

Q.P. Code : 60765

Second Semester M.Sc. Degree Examination, July 2019

(CBCS Scheme)

Chemistry

Paper C 205 (Soft Core) - MATHEMATICS FOR CHEMISTS

Time : 3 Hours

[Max. Marks : 70]

Instructions to Candidates : Answer Question No. 1 and any FIVE in the remaining.

1. Answer any TEN of the following : [10 × 2 = 20]

(a) Find a unit vector perpendicular to the vectors  $3\vec{i} - \vec{j} + 2\vec{k}$  and  $\vec{i} - \vec{j} + 3\vec{k}$ .

(b) Find the angle between vectors  $\vec{a} = (1, 2, 1)$  and  $\vec{b} = (1, 3, 2)$ .

(c) If  $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 5 & 6 & 7 \end{bmatrix}$ , find  $A^T A$ .

(d) Find the eigen values of the matrix  $A = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$ .

(e) If  $y = \sin^3(x^2)$ , find  $\frac{dy}{dx}$ .

(f) If  $x = a(t - \sin t)$ ,  $y = a(1 - \cos t)$ , find  $\frac{dy}{dx}$  at  $t = \pi/2$ .

(g) Find the critical points of the function  $f(x) = x^4 - 4x^3 + 10$ .

(h) Find the integral  $\int x^2 \sin(x) dx$ .

(i) If  $Z = x^2 y^2 + 3xy$ , find  $\frac{\partial^2 Z}{\partial x^2}$  and  $\frac{\partial^2 Z}{\partial y^2}$ .

(j) Solve the differential equation

$$x \frac{dy}{dx} + y = 0.$$

(k) Solve the differential equation

$$y = e^{1/x} dy.$$

(l) Three coins are tossed simultaneously, find the sample space.

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2. (a) Prove that the triangle whose vertices are  $3\hat{i} + 6\hat{j} - 3\hat{k}$ ,  $2\hat{i} + 4\hat{j} - \hat{k}$  and  $4\hat{i} - 5\hat{j} + \hat{k}$  is an isosceles right angled triangle

(b) Find the volume of the tetrahedron whose vertices are given by  $(1, 1, 1)$ ,  $(2, 1, 3)$ ,  $(3, 2, 2)$  and  $(3, 3, 4)$ . (5 + 5)

3. (a) Find the values of  $x$  for which the matrix  $\begin{bmatrix} 2 & 3 & 1 \\ x-1 & 2 & 3 \\ 1 & x & 5 \end{bmatrix}$  is singular.

(b) Find the eigen values and eigen vectors of the matrix  $\begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$ . (5 + 5)

4. (a) Solve by matrix method the system of equations

$$3x + y + 2z = 3$$

$$2x - 3y - z = -3$$

$$x + 2y + z = 4$$

(b) Find the inverse of the matrix  $\begin{bmatrix} -2 & 3 \\ 0 & 2 & 1 \\ -4 & 5 & 2 \end{bmatrix}$  (5 + 5)

5. (a) If  $xy + 4y = 3x$  : prove that  $\frac{d^2y}{dx^2} = \frac{24}{(x+4)^3}$

(b) If  $x = at^2$ ,  $y = 2at$ , find  $\frac{d^2y}{dx^2}$  (5 + 5)

6. (a) The volume of a sphere is increasing at the rate of  $4\pi$  c.c per second. How fast the radius and surface area are increasing when the volume is  $288\pi$  c.c?

(b) Find the equation of tangent and normal to the curve  $(1+x^2)y = 2-x$  where it crosses the x-axis. (5 + 5)

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7. (a) Evaluate

(i)  $\int \frac{8-3t}{10t^2+13t-3} dt$

(ii)  $\int x e^x dx$

(b) Solve:  $\frac{d^2y}{dx^2} - 18\frac{dy}{dx} + 81y = 0$ . (5 + 5)

8. (a) Find the Fourier series of the function  $f(x) = x^2$  ( $-\pi < x < \pi$ ).

(b) Fit a straight line for the following data (5 + 5)

$x: 1 \quad 2 \quad 3 \quad 4 \quad 5$

$y: 8 \quad 6 \quad 5 \quad 3 \quad 1$

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