

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 $3\hat{i} - \hat{j} + 2\hat{k}$ and $\hat{i} - \hat{j} + 3\hat{k}$.

(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 value 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

$$y' = e^{3x-2y}.$$

(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 $\begin{bmatrix} 2 & 3 & 1 \\ x-1 & 2 & 5 \\ 1 & x & 5 \end{bmatrix}$ 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

$$\begin{aligned} 3x + y + 2z &= 3 \\ 2x - 3y - z &= -3 \\ x + 2y + z &= 4 \end{aligned}$$

(b) Find the inverse of the matrix $\begin{bmatrix} 1 & -2 & 3 \\ 0 & 2 & 1 \\ -4 & 5 & 2 \end{bmatrix}$. (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 4π c.c per second. How fast the radius and surface area are increasing when the volume is 288π 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)

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

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