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B.M.S. COLLEGE FOR WOMEN
BENGALURU – 560004

I SEMESTER END EXAMINATION-APRIL – 2024

M.Sc. CHEMISTRY-MATHEMATICS FOR CHEMISTS (Soft Core)
(CBCS Scheme-F+R)

Course Code: MCH105S **QP Code: 11011**
Duration: 3 Hours **Max. Marks:70**

Instruction: **Answer Question No.*1* and any *FIVE* of the remaining.**

1. Answer any TEN of the following. **(10x2=20)**

a) Find the magnitude of the vector $4\vec{i} + 3\vec{j} - 2\vec{k}$.
b) Find the projection of $\vec{i} + \vec{j} + \vec{k}$ on $2\vec{i} + \vec{j} - 2\vec{k}$.
c) Define scalar matrix with an example.
d) If $A = \begin{bmatrix} 0 & -1 & 2 \\ 1 & 0 & 3 \\ -2 & -3 & 0 \end{bmatrix}$ find A^T.
e) If $3x^2 + 5xy + y^2 = 7$. Then find $\frac{dy}{dx}$.
f) If $x = a(t - \sin t), y = a(1 + \cos t)$, find $\frac{dy}{dx}$ at $t = \frac{\pi}{2}$.
g) Show that $f(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at the point $(1, 1)$.
h) Evaluate $\int x^2 sinx dx$.
i) If $z = x^y$, find $\frac{\partial^2 z}{\partial x^2}$ and $\frac{\partial^2 z}{\partial y^2}$.
j) Solve the differential equation $y' = e^{3x-2y}$
k) Find the area bounded by the curves $y = x^3$ and $y = 4x$.
l) Two A die is thrown. If E is the event 'the number appearing is a multiple of 3' and F be the event 'the number appearing is even' then find whether E and F are independent.

2. a) Prove that the triangle whose vertices are $2\vec{i} + 4\vec{j} - \vec{k}, 4\vec{i} + 5\vec{j} + \vec{k}, 3\vec{i} + 6\vec{j} + 3\vec{k}$ 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 value of x for which the matrix $\begin{bmatrix} 2 & 3 & 1 \\ x-1 & 2 & 5 \\ 1 & x & 5 \end{bmatrix}$ is singular.

b) Verify Cayley Hamilton theorem and find A^{-1} $where\ A = \begin{bmatrix} 2 & -1 & 3 \\ -1 & 4 & 2 \\ 0 & -3 & 1 \end{bmatrix}$

(5+5)

4. a) Solve the following system of equations by Cramer's rule

$$2x + 5y + z = -1,\ x + 7y - 6\,z = -18,\ 3y + 6z = 9.$$

b) Find the eigenvalues and eigenvectors for $\begin{bmatrix} 1 & 1 & 2 \\ 3 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$. **(5+5)**

5. a) If $y = e^{m\sin^{-1}x}$. Show that $(1-x^2)y_{n+2} - (2n+1)y_{n+1} - (n^2+m^2)y_n = 0$

b) If $u = log\sqrt{x^2+y^2+z^2}$ then show that

$$(x^2+y^2+z^2)\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) = 1$$ **(5+5)**

6. a) A ladder of 15 feet long leans against a smooth vertical wall. If the top slide down at the rate of 2ft/s, find how fast the lower end is moving when the lower end is 12ft away from wall?

b) Find the equation of the tangent and normal to the curve $y^2 = \frac{x^3}{2a-x}$, at (a, a). **(5+5)**

7. a) Evaluate i) $\int \frac{x^2}{(x^2+4)(x^2+4)} dt$.

b) Solve $xy\frac{dy}{dx} = 1 + x + y + xy$. **(5+5)**

8. a) Find the Fourier series of the function $f(x) = |x|$ in $(-\pi < x < \pi)$. Hence deduce that

$$\frac{\pi^2}{8} = \sum_{i=1}^{n} \frac{1}{(2n-1)^2}$$

b) Fit a parabola for the following data using least square method

X	-3	-2	-1	0	1	2	3
Y	4.63	2.11	0.67	0.09	0.63	2.15	4.58

(5+5)

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