B.M.S. COLLEGE FOR WOMEN AUTONOMOUS
BENGALURU-560004

SEMESTER END EXAMINATION-APRIL/MAY- 2023

M.Sc. in Chemistry-I Semester

MCHE-105 Mathematics for Chemists (Soft Core)

Course code: MCH105S **QP Code: 11011**

Time: 3 hrs **Max.Marks:70**

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

1. Answer any ***TEN*** questions **(2×10 =20)**

a) Find the projection of vector $\vec{a} = 5\hat{\imath} + 2\hat{\jmath} - 3\hat{k}$ on $\vec{b} = 4\hat{\imath} + 2\hat{\jmath} + 5\hat{k}$.

b) Find the acute angle between $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{b} = 2\hat{\imath} + \hat{\jmath} - 2\hat{k}$.

c) If $A = \begin{bmatrix} 3 & 2 & 3 \\ 0 & 6 & 0 \\ 0 & 2 & -7 \end{bmatrix}$ then find trace of A.

d) If $A = \begin{bmatrix} 1 & 2 \\ 2 & 4 \\ 5 & 6 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 2 & 5 \\ 2 & 4 & 6 \end{bmatrix}$, Find AB .

e) Write the characteristic equation for A=$\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$

f) Find the n^{th} derivative of $y = a^{mx}$.

g) Show that $f(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at the point $(1, 1)$.

h) Solve $y\,dx + x\,dy = 0$.

i) Three coins are thrown simultaneously. Find the Sample space.

j) If $P(A) = \frac{5}{7}$ and $P(A \cap B) = \frac{15}{28}$. Find $P(\frac{B}{A})$

k) Evaluate $\int xe^x dx$.

l) Find a_0 in the Fourier series of e^x in $-\pi < x < \pi$.

2. a) Find the position vector of two vertices and the centroid of a triangle are $3\hat{\imath} - 2\hat{\jmath} + \hat{k}$, $\hat{\imath} + \hat{\jmath} - 5\hat{k}$ and $2\hat{\imath} + 2\hat{\jmath} - 2\hat{k}$. Find the position vector of the third vertex of the triangle.

b) Find the area of triangle with vertices $A = (1,2,3), B = (2,-1,1)$ and $C = (1,2,-4)$.

(5+5=10)

3. a) Prove that $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$.

b) Find the eigenvalues and eigenvectors for the matrix $A=\begin{bmatrix} 4 & -1 \\ 2 & 1 \end{bmatrix}$. **(5+5=10)**

4. a) Find the inverse of the matrix A= $\begin{bmatrix} 1 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$.

b) Solve : $x + y + z = 7,\ \ 2x + 3y + 2z = 17,\ \ 4x + 9y + z = 37$ by Cramer's rule.

(5+5=10)

P.T.O

5. a) If $y^{\frac{1}{m}} + y^{\frac{-1}{m}} = 2x$ then show that $(x^2-1)y_{n+2} + (2n+1)xy_{n+1} + 2\text{n}^2 y_n = 0$.

b) If $= f(r)$, where $r^2 = x^2 + y^2 + z^2$ then show that

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = f''(r) + \frac{1}{r} f'(r).$$

(6+4=10)

6. a) Sand is being dropped at the rate of 10 m^3/s into a conical pile. If the height of the pile is twice the radius of the base. What is the rate at which the height of the pile is increasing when the sand in the pile is 8 m high ?

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

(5+5=10)

7. a) Solve (i) $\int \frac{x^2+1}{x^2-5x+6} dx$.

(ii) Find the area bounded by the curves $x^2 = y$ and $y^2 = x$.

b) Solve $(D^2 - 18D + 81)y = 0$.

(6+4=10)

8. a) Fit a parabola for the following data using least square method:

x	1	2	3	4	5
y	4	5	3	6	3

b) Find the Fourier series of the function $f(x) = x^2$, $0 < x < 2\pi$.

(4+6=10)