



II Semester M.Sc. Examination, June 2015
(CBCS)
CHEMISTRY

C 205 : (SC) : Mathematics for Chemistry

Time : 3 Hours

Max. Marks : 70

Instruction : Answer question no. 1 and **any five** of the remaining.

1. Answer **any ten** of the following : **(2×10=20)**

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

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

c) If $A = \begin{bmatrix} -2 \\ 4 \\ 5 \end{bmatrix}$, $B = [1 \ 3 \ -6]$ verify that $(AB)' = B'A'$.

d) Find the n^{th} derivative of $y = e^{ax}$.

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

f) Find $\int x \cos x \, dx$.

g) Solve $\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = 0$.

h) Solve the equation $y'' - 6y' + 13y = 0$.

i) 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.

j) Evaluate $\int x \cos x \, dx$.

k) Evaluate $\int \frac{dx}{(x+1)(x+2)}$.

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



2. a) Find the inverse of the matrix $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$.

b) Solve : $x + y + z = 11$

$$2x - 6y - z = 0$$

$$3x + 4y + 2z = 0$$

by Cramer's rule.

(5+5)

3. a) Given that $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$, $\vec{b} = 3\hat{i} - 6\hat{j} + 2\hat{k}$, $\vec{c} = 6\hat{i} + 2\hat{j} - 3\hat{k}$. Show that $\vec{a} \times \vec{b} = 7\vec{c}$. Show also that \vec{a} , \vec{b} , \vec{c} are each of modulus 7 and are mutually perpendicular.

- b) Find the volume of parallelepiped whose edges are represented by

$$\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}, \vec{b} = \hat{i} + 2\hat{j} - \hat{k}, \vec{c} = 3\hat{i} - \hat{j} + 2\hat{k}.$$

(5+5)

4. a) Find the derivative of the following :

i) $y = \cos(ax + b)$

ii) $y = \frac{1}{3x+2}$.

b) If $y = x^n \log x$. Show that $y_{n+1} = \frac{n!}{x}$.

(5+5)

5. a) Find the maximum and minimum values of $f(x, y) = x^2y^2 - 5x^2 - 8xy - 5y^2$

b) Write the general solution of the differential equation : $\frac{dy}{dx} = \frac{x+1}{2-y}$, $y \neq 2$. (7+3)

6. a) Find $\int \frac{x^2}{(x^2+1)(x^2+4)} dx$.

b) Evaluate i) $\int x e^x dx$ ii) $\int \frac{x \sin^{-1} x}{\sqrt{1-x^2}} dx$.

(5+5)



7. a) Solve $\frac{dy}{dx} = \sin(x+y) + \cos(x+y)$.

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

8. a) Solve $\frac{d^2y}{dx^2} - 18\frac{dy}{dx} + 81y = 0$.

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

deduce that $\frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$ (4+6)

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