Q.P. Code : 61905

First Semester M.Sc. Degree Examination, January/February 2020

(CBCS – New Scheme – Freshers)

Chemistry

MATHEMATICS FOR CHEMISTS (Soft Core)

Time : 3 Hours] *[Max. Marks : 70*

*Instructions to Candidates : Answer Q. No. 1 and any **FIVE** of the remaining.*

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

   (a) Find the value of λ, if the vectors $\vec{a} = (1-\lambda)\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{b} = 5\hat{i} - \lambda\hat{j} + 6\hat{k}$ are orthogonal.

   (b) Find the acute angle between the vectors $\hat{i} + \hat{j} + \hat{k}$ and $2\hat{i} + \hat{j} - 2\hat{k}$.

   (c) Find the inverse of the matrix $A = \begin{bmatrix} 2 & 3 \\ 1 & 5 \end{bmatrix}$.

   (d) If $A = \begin{bmatrix} 2 & 1 & -3 \\ 0 & 2 & 6 \end{bmatrix}$ find AA'.

   (e) Find the nth derivative of $y = \sin x$.

   (f) Find for what values of x, the function $x^3 - 9x^2 + 24x + 7$ is (i) increasing (ii) decreasing.

   (g) The radius of a circle is increasing uniformly at the rate of 3 cm/sec. Find the rate at which the area of the circle is increasing when the radius is 10 cm.

   (h) Find $\int x \cos x \cdot dx$.

   (i) Form a differential equation from the equation $y^2 = 4ax$.

   (j) Solve $x - y \cdot \frac{dy}{dx} = 2$.

   (k) If $f(x,y) = x^y + y^x$, then show that $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$.

   (l) Three coins are tossed, find the probability of getting all heads and no heads.

2. (a) Find the area of the triangle with the vertices $A(1,2,3)$, $B=(2,-1,1)$ $C(0,2,-4)$.

(b) Find the volume of the parallelopiped whose co-terminal edges are represented by $\hat{i}+3\hat{j}+2\hat{k}$, $2\hat{i}-\hat{j}+3\hat{k}$ and $\hat{i}+\hat{j}+\hat{k}$. (5 + 5)

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

(b) Solve the following system of equations by matrix method.

$$2x+3y+3z=5$$
$$x-2y+z=-4$$
$$3x-y-2z=3$$

(5 + 5)

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

(b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. (5 + 5)

5. (a) If $x\sqrt{1+y}+y\sqrt{1+x}=0$, where $x \neq y$ then show that $\frac{dy}{dx}=\frac{-1}{(1+x)^2}$.

(b) Find the maximum and minimum values of the function $2x^3-3x^2-6x+10$.

(5 + 5)

6. (a) If $u=x^2y+y^2z+z^2x$, then show that $U_x+U_y+U_z=(x+y+z)^2$.

(b) Solve $(x^2-yx^2)\cdot\frac{dy}{dx}+y^2+x^2y^2=0$ when $x=1$, $y=1$. (5 + 5)

7. (a) Evaluate $\int \frac{e^x \cdot dx}{(1+e^x)(2+e^x)}$.

(b) Show that $\int_0^{\pi/2} x \cdot \sin x \cdot dx = 1$. (5 + 5)

8. (a) Obtain the Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$, Hence deduce that

$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots = \frac{\pi}{4}$.

(b) Fit a parabola for the following data using least squares method. (5 + 5)

x	1	2	3	4	5
y	14	13	9	5	2
