M-64/2110

MATHEMATICS FOR CHEMISTS-104 (A)

SEMESTER-I, SYLLABUS DECEMBER-2019

(FOR STUDENTS WITHOUT MATHEMATICS IN B.Sc)

TIME ALLOWED 3 Hrs MM 55

SECTION A

1. (a) Find the divergence of vector $F = (-x^2 + yz)\hat{\imath} + (4y - z^2x)\hat{\jmath} + (2xz - 4z)\hat{k}$.

(b) Find the value of λ, so that $\vec{a}.(\vec{b} \times \vec{c}) = 0$, where

$$\vec{a} = 2\hat{\imath} - 4\hat{\jmath} + 5\hat{k}, \quad \vec{b} = \hat{\imath} - \lambda\hat{\jmath} + \hat{k}, \quad \vec{c} = 3\hat{\imath} + 2\hat{\jmath} - 5\hat{k}$$

2. Determine λ and μ so that the system of equations

$$x + y + z = 6, \quad x + 2y + 3z = 10, \quad x + 2y + \lambda z = \mu$$

have a) No solution b) infinite number of solution c) a unique solution

3. Find all the eigen values and the eigen vectors of the matrix A over real R, where

$$A = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 1 & -1 \\ 0 & 2 & 4 \end{bmatrix}$$

4. Find the vector equation of the plane which is at a distance of 7 units from the origin and is norm to the vector $3\hat{\imath} + 5\hat{\jmath} - 6\hat{k}$.

SECTION B

5. If $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$.

6. (a) Find $\frac{dy}{dx}$, if $x^3 + y^3 = 3axy$

(b) If the function $f(x) = \begin{cases} 3ax + b & ; \ x > 1 \\ 11 & ; \ x = 1 \\ 5ax - 2b & ; \ x < 1 \end{cases}$ is continuous at $x = 1$ find the values of a and b.

7. Solve in series the equation using:

$$\frac{d^2y}{dx^2} + xy = 0$$

8. Find a Fourier series to represent $f(x) = x - x^2$ from $x = -\pi$ to $x = \pi$.

SECTION C

9. Do briefly

a) Find the value of $\vec{a}.(\vec{b} \times \vec{c})$, where

$$\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}, \quad \vec{b} = \hat{\imath} - 2\hat{\jmath} + 3\hat{k}, \vec{c} = 3\hat{\imath} - \hat{\jmath} - \hat{k}$$

b) Evaluate divergence of the function $= x^2yz\,\hat{\imath} + xy^2z\,\hat{\jmath} + xyz^2\,\hat{k}$.

c) Define Symmetric and Hermitian matrices.

d) If $A = \begin{bmatrix} 2 & -1 \\ 4 & 2 \end{bmatrix}, B = \begin{bmatrix} 4 & 3 \\ -2 & 1 \end{bmatrix}$. Find $3A - B$

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

f) State Cayley Hamilton theorem.

g) State the conditions for finding the maximum and minimum of functions of two variables.

h) Write the trigonometric functions of sum and differences of angles.

i) Evaluate: $\int x \sin x \;\; dx$

j) Check whether the equation

$$(1 + 2xy\cos x^2 - 2xy)dx + (\sin x^2 - x^2)\,dy = 0$$

is exact or not?

k) Find the equation of the line which passes through the point (1, 2, 3) and is parallel to the vector $3\hat{\imath} + 2\hat{\jmath} - 2\hat{k}$