Exam. Code : 206602
Subject Code : 5211

M.Sc. Bioinformatics 2nd Semester

BASIC MATHEMATICS

Paper–BI-523

Time Allowed—3 Hours] [Maximum Marks—75

Note :– Question No. **1** from Section A is compulsory. Attempt **five** questions from Section B, selecting **one** question from each unit.

SECTION–A

1. (a) If A = {1, 2}, B = {3, 4}, C = {4, 5}, find A × (B ∪ C) and show that : (A ~ B) × C = (A × C) ~ (B × C).

(b) Find the conjugate of $\frac{(1-i)^2}{5+i}$.

(c) If $A = \begin{bmatrix} 2 & 5 \\ 1 & 4 \end{bmatrix}$ then A (Adj A) =

(d) If $\vec{a}$ and $\vec{b}$ are unit vectors perpendicular to each other then find the value of $|\vec{a} - 2\vec{b}|$.

(e) Find $\lim_{x \to 0} \frac{\sin 4x}{\sin 5x}$.

(f) If $f(x, y) = x^2y + e^{xy}$, find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$.

(g) Find the derivative of $(x + 1)^{4/3} (2x - 1)$.

(h) Evaluate $\int \left(x^2 + \frac{1}{x} + e^{3x} \right) dx$.

(i) Find the equation of line passing through (2, 3) and perpendicular to the line $3x + 2y + 7 = 0$.

(j) Find the equation of circle whose center is same as center of $x^2 + y^2 - 2x + 4y + 7 = 0$ and is of radius 4.

$1.5 \times 10 = 15$

SECTION–B

UNIT–I

2. (a) If $f : \mathbb{R} \to \mathbb{R}$ and $g : \mathbb{R} \to \mathbb{R}$ are defined by :

$$f(x) = x^2 + 3x + 1, \; g(x) = 2x - 3$$

Find fog and gof (the composite of f, g and composite of g, f). 6

(b) Define and give an example of a periodic function. 2

(c) Show that $A \cup B = A \cap B \Leftrightarrow A = B$. 4

3. (a) Express $\frac{2 - \sqrt{3}\,i}{1 + i}$ is the form a + ib. 4

(b) Find the multiplicative inverse of $-1 + 2\sqrt{3}\,i$. 4

(c) Find the square root of $11 + 2\sqrt{30}$. 4

UNIT–II

4. (a) Prove that

$$\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right). \quad 6$$

(b) If $A = \begin{bmatrix} 3 & 1 \\ 4 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 0 \\ 2 & 5 \end{bmatrix}$, find $(AB)^{-1}$. 6

5. (a) Find the angle between the vectors $\vec{a} = 2\vec{i} - \vec{j} + 3\vec{k}$ and $\vec{b} = 6\vec{i} - 3\vec{j} + 6\vec{k}$. 4

(b) Show that if $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ then vectors $\vec{a}$ and $\vec{b}$ are perpendicular. 4

(c) Find the value of t such that the vectors : $2\vec{i} - \vec{j} + \vec{k}$, $\vec{i} + 2\vec{j} - 3\vec{k}$ and $3\vec{i} + \vec{j}t + 5\vec{k}$ are coplanar. 4

UNIT–III

6. (a) If $y = \sqrt{x} + \frac{1}{\sqrt{x}}$, show that $2x\frac{dy}{dx} + y - 2\sqrt{x} = 0$. 4

(b) A point moves in a fixed straight line so that $s = \sqrt{t}$, show that the acceleration is proportional to the cube of the velocity. 4

(c) If $x = \log t + \sin t$, $y = e^t + \cos t$, find $\frac{dy}{dx}$. 4

7. (a) Prove that the function $f(x) = x^3 - 3x^2 + 3x - 100$ is increasing for all real values of x. 4

(b) Divide 16 into two parts such that the sum of their squares is minimum. 4

(c) If $f(x) = \sec x + \tan x$, prove that $f'(x) = f(x) \sec x$. 4

UNIT–IV

8. (a) Find the sum of the series $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} + \ldots$ to 9 terms. 4

(b) If $3 + 3\alpha + 3\alpha^2 + \ldots \infty$ is equal to $\frac{45}{8}$, $\alpha > 0$ then find α. 4

(c) Evaluate $\int \frac{2x^2 + x}{x - 1}\, dx$. 4

9. (a) Evaluate :

(i) $\int_0^2 |x - 1|\, dx$ 4

(ii) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos x\, dx$. 2

(b) Find the area of the region bounded by the curves $x^2 = 4y$, the line $x = 2$ and the x-axis. 6

UNIT–V

10. (a) Find the equation of the straight line passing through (2, 3) which makes equal intercepts on the axes. 4

    (b) Find the center of the sphere which passes through (a, 0, 0), (0, b, 0), (0, 0, c) and (0, 0, 0). 8

11. (a) Find the equation of the circle passing through the point (4, 5) and having center at (2, 2). 4

    (b) Find the equation of the parabola whose focus is (5, 2) and directrix is $x - 1 = 0$. Find also vertex and latus rectum of this parabola. 8