Exam. Code : 206602
Subject Code : 8478

M.Sc. (Bioinformatics) Semester—II
BASIC MATHEMATICS
Paper—BI-523

Time Allowed—3 Hours]   [Maximum Marks—75

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

SECTION—A   1.5×10=15

1. (a) Define absolute value function. Represent it graphically in the domain [−1, 1].

   (b) Find real numbers x and y such that :

      $3x + 2iy - ix + 5y = 7 + 5i$.

   (c) If $f(x) = x^2 - 5x + 6$, find $f(A)$, where :

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

   (d) Find the vector $\overrightarrow{PQ}$ if P(1, 2, 3) and Q(2, 3, −7). Also find length of the vector $\overrightarrow{PQ}$.

   (e) Find the derivate of $f(x) = x^3 + 3x - \dfrac{1}{x} + 7$ at x = 2.

(f) The motion of a particle moving in a straight line is given by $s = t^2 + 2t + 3$. Find its velocity and acceleration at the end of 3 seconds.

(g) Evaluate $\lim\limits_{x \to 4} \dfrac{x^2 - 16}{x - 4}$.

(h) Evaluate $\int \left(\sqrt{x} + \dfrac{1}{x} + 7 \right) dx$.

(i) Find the ratio in which the join of $(-3, 2)$ and $(4, 6)$ is cut by X-axis.

(j) Find the equation of the line passing through $(1, 1)$ and parallel to the line $2x - 3y + 5 = 0$.

SECTION—B

UNIT—I

2. (a) If $A = \{1, 2, 3, 4, 5\}$, $B = \{1, 2, 3, 4\}$, $C = \{3, 4, 5\}$, determine $(A \cap B) \cup C$ and $(A \cup B) \cap C$.   4

(b) Which of the following relations are functions ? Give reasons. If it is a function, determine its domain and range :

(i) $\{(2,1), (3,1), (5,2)\}$

(ii) $\{(0, 0), (1, 1), (1, -1), (4, 2), (4, -2)\}$.   8

3. (a) Write $\dfrac{3+4i}{2-4i}$ in the form x + iy, where x and y are real. 6

   (b) Find the conjugate and modulus of $\dfrac{i\sqrt{-9}+7i}{1+\sqrt{-1}}$. 6

UNIT—II

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

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

   6

5. (a) Find the value of a for which the vectors :

   $3\vec{i}+2\vec{j}+9\vec{k}$ and $\vec{i}+a\vec{j}+3\vec{k}$ are

   (i) parallel (ii) perpendicular. 6

   (b) If $\vec{a} = \vec{i}+\vec{j}+\vec{k}, \vec{b} = \vec{i}-\vec{j}+\vec{k}, \vec{c} = \vec{i}+2\vec{j}-\vec{k}$, find $(\vec{a}\times\vec{b})\cdot\vec{c}$. 6

UNIT—III

6. (a) Find the interval in which the function f(x) = $x^2 - 2x$ is increasing. 6

   (b) The sum of two numbers is 24. Find the numbers so that their product is maximum 6

7. (a) If $z = x^4 \log\left(\dfrac{y}{x}\right)$, find $\dfrac{\partial z}{\partial x}, \dfrac{\partial z}{\partial y}$. 6

(b) Find the maximum value of $\dfrac{\log x}{x}$ in $(2, \infty)$. 6

UNIT—IV

8. (a) Find the 20th term of the series :

2×4 + 4×6 + 6×8 + ... 6

(b) Evaluate $\displaystyle\int_0^{\frac{\pi}{4}} \tan^2 x \, dx$. 6

9. (a) Find $\displaystyle\int \dfrac{2x^2 + x}{x-1} dx$. 6

(b) Find the area of the region bounded by the curves $y^2 = 4x$ and $y = 8x$. 6

UNIT—V

10. (a) Find the centroid of the triangle whose vertices are $(0, 0)$, $(3, 0)$ and $(0, 4)$. 6

(b) Find the equation of the diameter of the circle $x^2 + y^2 - 6x + 2y = 0$ which passes through the origin. 6

11. (a) Find the equation of the parabola whose focus is $(5, 2)$ and directrix is $x - 1 = 0$. 6

(b) Find the equation of the sphere with centre $(1, -1, 1)$ and radius equal to radius of the sphere $2x^2 + 2y^2 + 2z^2 - 2x + 4y - 6z = 1$. 6