1129
B.Sc. (Hons.) Bio-Informatics
First Semester
BIN-1005: Mathematics

Time allowed: 3 Hours   **Max. Marks: 60**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

I. (a) Write the set S = $\{\frac{1}{3}, \frac{2}{3}, \frac{7}{9}, \frac{5}{6}, \frac{13}{15}, \frac{8}{9}, ...\}$ in the set-builder form.   (2)

(b) Write the relation R = $\{(x, x^3) : x$ is a prime number less than 10$\}$ in roster form.   (2)

(c) Evaluate $\lim_{x \to 0} \frac{\sqrt{x+1} - 1}{x}$ (2)

(d) A committee of 3 persons is to be constituted from a group of 2 men and 3 women. In how many ways can this be done?   (3)

(e) Evaluate the Integral $\int \frac{\sqrt{x+1} - \sqrt{x-1}}{\sqrt{x+1} + \sqrt{x-1}} \, dx$ (3)

Unit – I

II. (a) Out of 80 students in a class, 25 are studying German, 15 French and 13 Spanish. 3 are studying German and French; 4 are studying French and Spanish; 2 are studying German and Spanish; and none is studying all the 3 languages. How many students are not studying any of the three languages?   (4)

(b) Find domain and range of the function $f(x) = \sqrt{1 - x^2}$ and draw its graph.   (4)

(c) Write 3 rational and 3 irrational numbers in the set S = $\{ x : 0 < x < 1\}$. (4)

III. (a) How many words, with or without meaning, each consisting of 3 vowels and 2 consonants can be formed from the letters of the word INVOLUTE ?   (6)

(b) Find value of the expression $C_0^7 + C_1^7 + C_2^7 + C_3^7 + C_4^7 + C_5^7$; here C_r^7 represents, the number of ways of selecting r objects out of 7 objects.   (6)

IV. (*a*) Find middle term of the expression $(\frac{x}{3} + 9y)^{10}$. (4)

(b) Which term of the expression $(2x + \frac{1}{x^2})^6$ will be independent of x? Write this term. (4)

(c) Find the coefficient of $x^6 y^3$ in the expansion of $(x + 2y)^9$. (4)

Unit – II

V. (*a*) Evaluate $\lim_{x \to 0} \frac{\sin^3 x \cos 2x}{\sin 2x}$ (4)

(b) If $f(x) = \begin{cases} a + bx, & x < 1 \\ 4, & x = 1 \\ b - ax, & x > 1 \end{cases}$ is continuous at $x = 1$ then what are possible values of a and b? (4)

(c) Find $\frac{dy}{dx}$ if $y = \frac{1 - \sin x}{1 + \sin x} + (\frac{1 - \cos 4x}{8x^2})^2$ (4)

VI. (a) A balloon, which always remains spherical, has a variable diameter $\frac{3}{2}x(2x + 1)$. Find the rate of change of its volume with respect to x. (6)

(b) Find the interval in which the function $f(x) = x^3 + 2x - 5$ is strictly increasing. (6)

VII. (*a*) Find the area of the region

R = {$(x, y) : 0 \le y \le x^2 + 1, 0 \le y \le x + 1, 0 \le x \le 2$}. (6)

(*b*) Show that $\int \sec x \, dx = \log |\sec x + \tan x| + C$ (6)

x-x-x