

2125  
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. 1 which is compulsory and selecting two questions from each Unit.

x-x-x

- Q1. (a) If  $A = \{1, 2, 3\}$  and  $B = \{a, b\}$  are two sets, how many relations are there from A to B.
- (b) Plot graph of the trigonometric function  $y = \sin(x) - 1$  for  $0 \leq x \leq 4\pi$ .
- (c) A student has 4 shirts, 3 trousers, and 2 pairs of shoes. How many different outfits can the student wear?
- (d) Evaluate  $\lim_{x \rightarrow 2} \frac{x^2 - 4}{x - 2}$ .
- (e) For what value of  $\lambda$  is the function  $f(x) = \begin{cases} x \sin \frac{1}{x} & \text{if } x \neq 0 \\ \lambda & \text{if } x = 0 \end{cases}$  continuous at  $x = 0$ ?
- (f) Evaluate the integral  $\int (6x^2 - 4x + 7) dx$ . Verify your answer by differentiating the result. (6×2)

UNIT - I

- Q 2. (a) In a group of 80 people, 37 like coffee, 52 like tea and 10 like both tea and coffee. How many people neither like coffee nor tea?
- (b) Let  $A = \{1, 2, 3\}$  be a set and a relation on A is defined as  $R = \{(1,2), (2,3), (1,3)\}$ . Find domain and range of R, and check whether R is a function or not. Explain why every function is a relation but not every relation is a function. (2×6)
- Q 3. (a) For the following functions find the domain and range. Also sketch their graphs.  
(i)  $f(x) = x^2 - 4x + 3$   
(ii)  $f(x) = |x - 2|$
- (b) Prove that the statement  $P(n): 1 + 2^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$  is true for all  $n \in \mathbb{N}$ . (2×6)

- Q 4. From a class of 12 students, in how many ways can  
(a) a president, vice-president and secretary be chosen?  
(b) a committee of 3 students be formed? Justify calculations. (2×6)

P.T.O.

(2)

- Q 5. (a) Find the general term in the expansion of  $(x^2 - 1)^n$ . Hence find the coefficient of  $x^{10}$  in the expansion.
- (b) Using binomial theorem, prove that  $\sum_{k=0}^n C_k^n = 2^n$  and  $\sum_{k=0}^n (-1)^k C_k^n = 0$ .
- (2×6)

UNIT - II

- Q 6. (a) Evaluate the following limits.

(i)  $\lim_{x \rightarrow 2} \frac{x^3 - 4x^2 + 4x}{x^2 - 4}$  and (ii)  $\lim_{x \rightarrow 1} \frac{x^{\frac{1}{3}} - 1}{x^{\frac{1}{6}} - 1}$

- (b) Discuss the continuity of the function  $f(x) = \begin{cases} x^2 - 4x + 3, & x < 2, \\ 3, & x = 2, \\ x + 1 & x > 2. \end{cases}$
- (2×6)

- Q7. (a) If  $x = t^2 + 1$  and  $y = t^3 - t$ , find  $\frac{dy}{dx}$ .
- (b) Find the intervals on which the function  $f(x) = x^3 - 6x^2 + 9x + 1$  is increasing and decreasing.
- (2×6)
- Q8. (a) The radius of an air bubble is increasing at the rate of 2 cm/s. At what rate is the volume of the bubble increasing when the radius is 15 cm?
- (b) Evaluate the integrals  $\int \frac{2x}{x^2+1} dx$  and  $\int_0^1 x(3x+2) dx$ .
- (2×6)
- Q9. (a) State Fundamental Theorem of Calculus and evaluate the integral  $\int_0^2 x\sqrt{2-x} dx$ .
- (b) Find the area bounded by the curve  $y = x^2$ , the  $x$ -axis, and the lines  $x = 1$ ,  $x = 3$ .
- (2×6)