

MCA Sem.-1 Examination
Mathematical Foundations

Time : 3-00 Hours]

January-2025

[Max. Marks : 50

Instructions:

- Write both the Sections in the separate answer book.
- Both Sections having equal weightage.
- Draw Diagrams wherever necessary.
- Make Assumptions wherever necessary.

SECTION – I

- Q-1 The survey of a housing society of 250 residents in Ahmedabad provides the following information. [7]
- Every resident can speak Gujarati or Hindi.
 - 148 residents speak Gujarati.
 - 175 residents speak Hindi.
- Then determine how many residents of this society speak both languages and how many speak only Gujarati.

- Q-2 (a) Using definition of differentiation, calculate the derivative [5]
- $$f(x) = 4 - x^2$$
- Also find the values of the derivatives of $f'(-3)$ and $f'(0)$.
- (b) Find dot product and angle between given vectors u and v : [5]
- $$u = i + j - k, \quad v = 3i - j + k$$

OR

- Q-2 (a) [5]

Find all indegree and outdegree of the vertices of the graph. Give all elementary cycles.

- (b) Integrate: $\int_0^4 \left(3x - \frac{x^3}{4}\right) dx$ [5]

- Q-3 Use the Gram-Schmidt process to transform the basis vectors: $\{(1,1,1), (1,1,0), (1,0,0)\}$ into an orthonormal basis. [8]

OR

- Q-3 (a) Examine the continuity of the function at mentioned point: [4]

$$f(x) = \begin{cases} x - 3, & \text{if } x \leq 2 \\ 8, & \text{if } x > 2 \end{cases} \text{ at } x = 2$$

- (b) Find derivative: $f(x) = \frac{2x+5}{3x-2}$ [4]

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SECTION - II

Q-4 Perform Newton-Raphson method to find the root of $x^4 - x^3 + 10x + 7 = 0$, correct up to three decimal places with $x_0 = -2$ and $x_1 = -1$. [7]

Q-5 (a) Find inverse of the matrix [5]

$$A = \begin{bmatrix} 1 & -2 & 1 \\ 4 & -7 & 3 \\ -2 & 6 & -4 \end{bmatrix}$$

(b) Perform the five iterations of the bisection method to obtain a root of the equation $f(x) = x^3 - x - 1 = 0$. [5]

OR

Q-5 (a) Perform False Position Method to obtain a root of the equation $f(x) = x^3 - 4x + 1 = 0$, correct up to three decimal places with $x_0 = 0$ and $x_1 = 1$. [5]

(b) Solve the following systems of equations by Cramer's rule. [5]

$$\begin{aligned} 4x + 3y &= 12 \\ 2x + 5y &= -8 \end{aligned}$$

Q-6 Solve the following systems of equations by the Gauss Jordan method: [8]

$$\begin{aligned} x + 3y + 2z &= 17 \\ x + 2y + 3z &= 16 \\ 2x - y + 4z &= 13 \end{aligned}$$

OR

Q-6 (a) Compute $B - 2A$ and $A + 2B$. [4]

$$A = \begin{bmatrix} 2 & 0 & -1 \\ 4 & -5 & 2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 7 & -5 & 1 \\ 1 & -4 & -3 \end{bmatrix}$$

(b) Define: [4]

- (i) Determinant of a Matrix
- (ii) Row Echelon Form