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Your Roll No.....

Sr. No. of Question Paper : 1058

D

Unique Paper Code : 2342011103

Name of the Paper : Mathematics for Computing

Name of the Course : **B.Sc. (H) Computer Science**

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **Section A** is compulsory. Each question is of **5** marks.
3. Attempt any **four** questions from **Section B**. Each question is of **15** marks.

Section A

1. (a) Write the following system of equations in matrix form. Reduce the augmented matrix into row echelon form. (5)

P.T.O.

$$x_1 + 3x_2 + x_3 = 1$$

$$-4x_1 - 9x_2 + 2x_3 = -1$$

$$-3x_1 - 6x_3 = -3$$

(b) Define a convex set. Show if $C = \{x_2: 2x_1 + 3x_2 = 7\} \subset \mathbb{R}^2$ is a convex set. (5)

(c) Show that the transformation defined by $T(x_1, x_2) = (2x_1 - 3x_2, x_1 + 4, 5x_2)$ is not linear. (5)

(d) Find the characteristic polynomial of the following matrix (5)

$$A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & -3 & 0 \\ 4 & -13 & 1 \end{bmatrix}$$

(e) Let $a = -2\hat{i} + 3\hat{j} + 5\hat{k}$ and $b = \hat{i} + 2\hat{j} + 3\hat{k}$ be two vectors. Find the value of the dot product of these two vectors. (5)

(f) Determine whether or not the vectors $(4, 1, -2)$, $(-3, 0, 1)$ and $(1, -2, 1)$ form a basis of \mathbb{R}^3 . (5)

Section B

2. (a) For what values of λ and μ do the following system of equations is consistent. (7)

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

- (b) Find the inverse of the following matrix using Gauss Jordan method. (8)

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

3. (a) Determine whether the system has a nonzero solution. (7)

$$x + 2y - 3z = 0$$

$$2x + 5y + 2z = 0$$

$$3x - y - 4z = 0$$

- (b) Apply Gram Schmidt orthonormalization process to obtain an orthonormal basis for the subspace of \mathbb{R}^4 generated by the vectors. $(1, 1, 0, 1)$, $(1, -2, 0, 0)$, $(1, 0, -1, -2)$. (8)

4. (a) Use the Cayley-Hamilton theorem to find

$$(A - 2I)(A - 3I) \text{ where } A = \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}. \quad (7)$$

- (b) What is a subspace? Let Y be the set of vectors in \mathbb{R}^4 of the form $[a, 0, b, 0]$. Prove that Y is a subspace of \mathbb{R}^4 . (8)

5. (a) Calculate the curl and divergence for the following vector field. (7)

$$\vec{F} = x^3y^2\hat{i} + x^2y^3z^4\hat{j} + x^2z^2\hat{k}$$

- (b) What is a positive definite matrix? Is the following matrix positive definite? (8)

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

6. (a) Let $a = [1, 1, 0]$, $b = [3, 2, 1]$ and $c = [1, 0, 2]$,
Find the angle between: a , b and b , c . (3)

- (b) If $\phi(x, y, z) = 3x^2y - y^3z^2$, find $\nabla\phi$ (grad ϕ) at the
point $(1, -2, -1)$. (4)

- (c) Diagonalize the matrix (8)

$$A = \begin{bmatrix} 2 & 0 & 0 \\ 1 & 4 & -1 \\ -2 & -4 & 4 \end{bmatrix}$$

7. (a) If V is an inner product space, then show that
 $\langle v, au + bw \rangle = a \langle v, u \rangle + b \langle v, w \rangle$ where
 a and b are scalars and v, u, w are vectors in
 V . (7)

- (b) Suppose that three banks in a certain town are
competing for investors. Currently, Bank A has
40% of the investors, Bank B has 10%, and Bank
C has the remaining 50%. Suppose the towns folk
are tempted by various promotional campaigns to
switch banks. Records show that each year Bank
A keeps half of its investors, with the remainder

switching equally to Banks B and C. However, Bank B keeps two-thirds of its investors, with the remainder switching equally to Banks A and C. Finally, Bank C keeps half of its investors, with the remainder switching equally to Banks A and B. Find the distribution of investors after two years. (8)

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