

SE SEM-IV NEP 2020 May 2026

ECS

Date: 12/05/2026

Max. Time: 2 hrs.

Max. Marks: 60.

- N.B. (1) Attempt any three out of the five questions.
 (2) Figures to the right indicate full marks.
 (3) Assume suitable data if necessary

Q.1 (a)

Find eigen values & eigen vectors of a matrix $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. [6]

(b) Construct an orthonormal basis of $\mathbb{R}^2$ using Gram-Schmidt process to $S = \{ (3, 1), (2, 3) \}$. [6]

(c) If a continuous random variable X has the p.d.f.
 $f(x) = kx^2(1 - x^3) \quad 0 \leq x \leq 1$ [8]
 $= 0$ otherwise. Find k , mean & variance X .

Q.2 (a) Calculate the Karl Pearson's coefficient of correlation of the following data. [6]

$x : 12 \quad 17 \quad 22 \quad 27 \quad 32$

$y : 113 \quad 119 \quad 117 \quad 115 \quad 121$

(b) A hospital switch board receives an average of 4 emergency calls in a 10 minutes interval. Determine the probability that [6]

(i) there are at least 2 emergency calls, (ii) there are exactly 3 emergency calls, in an interval of 10 minutes.

(c) Reduce the quadratic form $6x^2 + 3y^2 + 14z^2 + 4xy + 4yz + 18xz$ to a diagonal form using congruent transformations. Find the index and class value. [8]

Q.3 (a) Check whether following are subspaces of $\mathbb{R}^3$. [6]

i) $W = \{(a, 0, 0) / a \in \mathbb{R}\}$

ii) $W = \{(x, y, z) / x = 1, z = 1\}$

- (b) Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ [6]

- (c) Calculate Spearman's rank correlation coefficient from the following data. [8]

X : 40 42 45 35 36 39

Y : 46 43 44 39 40 43

- Q.4 (a) Use normal equations to fit a straight line of the form $y = a + bx$ to the following data. [6]

x : 0 5 10 15 20 25

y : 12 15 17 22 24 30

- (b) Reduce the quadratic form $5x^2 + 5y^2 + 2z^2 - 4xy + 4yz - 4xz$ to canonical form using an orthogonal transformation. Also find the transformation matrix. [6]

- (c) A sample of 400 students was taken to study the level of study and their preference for online learning. [8]
Test whether preference for online learning is independent of the level of Study at 5% level of significance.

Level of Study	Prefer Online	Do Not Prefer Online	Total
Undergraduate	120	80	200
Postgraduate	140	60	200
Total	260	140	400

- Q.5 (a) A sample of 10 students has an average score of 68 marks in a test. The population mean is assumed to be 70 marks, and the sample standard deviation is 5 marks. [6]
Test whether the sample mean differs significantly from the population mean at 5% level of significance.

- (b) A manufacturer knows from his experience that the resistance of resistor he produces is normal with $\mu = 100$ ohms and standard deviation $\sigma = 2$ ohms. [6]
What percentage of resistors will have resistance between 98 ohms and 102 ohms?

- (c) i) Find the usual inner product between the two vectors $(2, -2, 1, 3)$ [8]
and $(1, -2, 1, 0)$ and verify the Cauchy Schwarz inequality.
(ii) Show that the set $B = \{(2, 1, 1), (1, 3, 1), (1, 2, -1)\}$ is a basis of the vector space $\mathbb{R}^3$.