

S.E. C.M.P.N SEM III NEP June 2026

Time: 2 hours

Max Marks: 60

04/06/26.

Note: (1) Question No. 1 is Compulsory.

(2) Answer any three questions from Q.2 to Q.6.

(3) Figures to the right indicate full marks.

(4) Statistical Table to be provided

Q.1. Attempt any Five Questions from the following.

a) Find the sum and product of the eigenvalues of $A = \begin{bmatrix} -2 & -9 & 5 \\ -5 & -10 & 7 \\ -9 & -21 & 14 \end{bmatrix}$ 3

b) Construct the dual of the following LPP 3
 Maximise $Z = 5x_1 + 4x_2$
 Subject to constraint $2x_1 + 6x_2 \leq 5$
 $7x_1 + 3x_2 \leq 2$
 $x_1, x_2 \geq 0$

c) Find value of a_n in the expansion of Fourier series for $f(x) = x^2$ in $(-\pi, \pi)$ 3

d) Calculate first 2 raw moments for probability density function 3
 $f(x) = \begin{cases} xe^{-x} & x \geq 0 \\ 0 & \text{Otherwise} \end{cases}$

e) What is the remainder when 5^{11} is divided by 7 3

f) Obtain Spearman's rank correlation coefficient for following data 3

X	18	17	13	17	19	21
Y	21	22	14	17	18	13

Q.2. a) The number of traffic accidents that occur on a particular stretch of road during a month follows a Poisson distribution with a mean of 7. Find the probability of observing exactly three accidents on this stretch of road next month. 4

b) Calculate the correlation coefficient for the following heights of fathers(X) and their sons(Y) 5

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

c) Expand Fourier series for $f(x) = x^2$ in $(0, 2)$ 6

Q.3. a) Fit a straight line of the form $y=a+bx$ to the following data 4

X	1	3	5	7	8	10
Y	8	4	5	7	8	4

b) By using Chinese Remainder theorem, solve $x \equiv 3(mod 4)$, $x \equiv 5(mod 7)$ 5

c) Find eigen values and eigen vectors of $A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$ 6

Q4.

- a) A random variable X has the following probability distribution

4

X	1	2	3	4
P(X=x)	0.2	0.3	0.3	0.2

Find moment generating function about origin of x, hence find first two raw moments.

- b) The distribution of wait times at a drive-through restaurant is approximately normal with mean 185 seconds and standard deviation 15 seconds. find the percentage of wait times that are
- between 155 and 215 seconds.
 - more than 170 seconds.

5

- c) Check whether the matrix $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ is diagonalizable, if yes, find the diagonalizing matrix P and the diagonal matrix D.

6

Q5.

- a) Verify Cayley-Hamilton theorem for matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 1 & 2 & 2 \\ 3 & 2 & 1 \end{bmatrix}$

4

- b) Maximise $Z = 7x_1 + 5x_2$
 Subject to constraint $-x_1 - 2x_2 \geq -6$
 $4x_1 + 3x_2 \leq 12$
 $x_1, x_2 \geq 0$

5

- c) Perform key generation encryption and decryption for RSA Algorithm with the following parameters primes $p=3$, $q=11$ message, $M=5$

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Q6.

- a) Expand Fourier series for $f(x) = x$ in $(-\pi, \pi)$

4

- b) Obtain the equation of line of regression of X on Y

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X	21	23	25	27	28	20
Y	8	12	15	17	18	20

- c) Using the method of Lagrange's multipliers, solve the following NLPP
 Maximise $Z = x_1^2 + x_2^2 + x_3^2 - 10x_1 - 6x_2 - 4x_3$
 Subject to constraint $x_1 + x_2 + x_3 = 7$ $x_1, x_2, x_3 \geq 0$

6
