Sem 3 NEP Reg Winter 2025 – CMPN 17·12·2025

Time: 2 hours **Marks: 60**

Note: 1. Question No. 1 is Compulsory.
2. Attempt any 3 **(Three)** Questions from the remaining questions.
3. **Statistical Table** is allowed.

Que. 1 Attempt **any Five** questions of the following

a. $If A = \begin{bmatrix} 3 & 2 & 1 \\ 0 & -1 & 4 \\ 0 & 0 & -2 \end{bmatrix}$, find Eigen values of $A^{-1} + 6I$ — 3

b. Transform the LPP to standard form — 3
Maximise $Z = 2x_1 + x_2 + 4x_3$
$x_1 - x_2 + 2x_3 \le 5$
$3x_1 + x_2 + 5x_3 \ge 14$ $x_1,\ x_2 \ge 0$

c. Find the value of a_n in the expansion of Fourier Series for $f(x) = 4 - x^2$ in $(0,\ 2\pi)$ — 3

d. A random variable x defines the possible outcomes of tossing of a fair die, find moment generating function of x about origin — 3

e. What is the remainder when 13^{70} is divided by 21 — 3

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

X	24	24	24	55	25
Y	24	31	51	40	38

Que. 2 a. It is known that the probability of an item produced by a certain machine will be defective is 0.001. If the produced items are sent to the market in packets of 100, find the number of packets containing at least 2 are defective in the consignment of 2000 Packets. — 4

b. Five students got the following percentage of marks in mathematics and statistics — 5

Maths	28	34	18	25	75	23	24	33	37	43
Stats	24	31	11	34	65	24	23	53	53	42

Calculate the coefficient of correlation.

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

Que. 3 a. Obtain equations of line of regression of x on y for following data. — 4

X	31	44	65	49	41
Y	48	32	21	66	43

b. By using Chinese Remainder theorem, Solve 5

$x \equiv 1(mod\ 3),\ \ x \equiv 2(mod\ 4),\ \ x \equiv 3(mod\ 5)$

c. Find Eigen values and Eigen vectors of the matrix 6

$$A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$$

Que. 4 a. A random variable X has probability density function 4

$f(x) = x^2 e^{-x} \qquad x \geq 0$

Find 2 moments about origin and mean.

b. Show that the matrix A= $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ is diagonalisable, hence find it's diagonalisable matrix. 5

c. In RSA System the public key (E, N) of user A is defined as (7,187). Calculate φ(N) and private key 'D". What is the cipher text for M=10 using the public key. 6

Que.5 a. Verify Cayley- Hamilton theorem for matrix 4

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

b. The height of school children of one school is normally distributed with mean of 54 inches and standard deviation 12 inches. What proportion of students have height between i. 46 and 56 inches ii. More than 56 5

c. Applying Simplex method, Solve the following LPP 6

Maximise $Z = 3x_1 + 2x_2$

Subject to constraint $x_1 + x_2 \leq 4$

$x_1 - x_3 \leq 2 \qquad x_1, x_2 \geq 0$

Que.6 a. Fit a straight line of the form y=a+bx to the following data 4

X	1	4	7	9	8	10
Y	18	14	19	27	18	28

b. Find Fourier series for the function f(x) = x ,$0 < x < 2\pi$ 5

c. Using the method of Lagrange's multipliers solve the following NLPP 6

Optimize $z = -x_1{}^2 - x_2{}^2 + 4x_1 + 8x_2$

Subject to: $x_1 + x_2 = 4 \quad x_1,\ x_2 \geq 0$

****