S.E/Sem-III/NEP/Dec-25/IT Q.P. Code :- 99791

17/12/25

Duration: 2 Hours **Marks: 60** (1/2)

NB: (1) Question **no 1** is **compulsory**.
(2) Attempt any **three** questions out of the remaining **five**.
(3) Figures to the right indicate full marks.
(4) Assume suitable data, if required and state it clearly.

Q1. Attempt **any five** questions

(a) Find Laplace Transform of $f(t) = t^2e^{-3t}cosht$. [3]

(b) Find $L^{-1}\left\{\frac{s+3}{s^2+4s+5}\right\}$. [3]

(c) Find the value of the coefficient $b_n, for\ f(x) = x$ in the interval $(-\pi, \pi)$. [3]

(d) Show that $u = 3x^2y - y^3$ is harmonic function. [3]

(e) Give two regression lines $3X + 2Y = 26\ and\ 6X + Y = 31$, find correlation coefficient (r). [3]

(f) If X is continuous random variable with the probability density function $f(x) = kx, for\ 0 \le x \le 2\ and\ 0$ otherwise, find k and its mean. [3]

Q2.

(a) Find $L\left(\frac{e^{-at}-e^{-bt}}{t}\right)$. [4]

(b) Find $L^{-1}\left\{tan^{-1}\left(\frac{s+a}{b}\right)\right\}$. [5]

(c) Find the orthogonal trajectories of the family of curves $x^3y - xy^3 = c$. [6]

Q3. (a) Construct an analytic function, whose real part is $u = e^xcosy$. [4]

(b) Find Laplace Transform of $f(t) = sin^2t\ cos^3t$. [5]

(c) obtain half-range cosine series for $f(x) = x(\pi - x)\ in\ 0 \le x \le \pi$. [6]

Q4. (a) Find Inverse Laplace Transform of $F(s) = \frac{s+7}{(s^2+9)(s-1)}$. [4]

(b) Find moment generating function of the following distribution. Hence find mean and variance. [5]

X	1	2	4	5
P(X)	0.4	0.1	0.2	0.3

(c) Find $L\left\{e^{-2t}\int_0^t u\ sin(3u)du\right\}$. [6]

Q5. (a) Let X be discrete random variable with the following probability distribution [4]

x	1	2	3	4	5	6	7
P(X=x)	k	2k	3k	k^2	k^2+k	$2k^2$	$4k^2$

Find k, and P(X<5).

(b) Fit a straight line of the form $y = a + bx$ to the following data [5]

x	1	3	5	7	8	10
y	8	12	15	17	18	20

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

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Q6. (a) From the following data calculate Spearman's rank correlation coefficient R between X and Y [4]

X: 16 18 25 30 12

Y: 38 21 38 16 50

(b) Find k if $f(z) = \frac{1}{2}log(x^2 + y^2) + itan^{-1}\left(\frac{kx}{y}\right)$ is analytic. [5]

(c) Use Convolution theorem to find $L^{-1}\left\{\frac{1}{(s+3)(s-4)^2}\right\}$. [6]

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