

## MID SEMESTER EXAMINATION

COURSE NAME: B. Tech.  
BRANCH NAME: ALL

SEMESTER: 3<sup>rd</sup>  
SPECIALIZATION:

SUBJECT NAME: Mathematics-III

FULL MARKS: 30

TIME: 1.30 Hours

Answer All Questions.

The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

Q1. Answer all Questions. [2×3]

- a) Find the Laplace transform of the function  $f(t) = t \sin t$ .
- b) Write two assumptions for one dimensional heat equation.
- c) The probability density function of a continuous random variable  $X$  is  $f(x) = kx^2, 0 \leq x \leq 1$ . Determine  $k$ .

Q2. a) Find the inverse Laplace transform of the function  $F(s) = \ln\left(1 + \frac{w^2}{s^2}\right)$ . [4]

b) Solve the integral equation  $y = 1 - \sinh t + \int_0^t (1 + \tau)y(t - \tau) d\tau$ . [4]

OR

a) Solve the initial value problem  $y'' + y = \delta(t - 1) + \delta(t - 2)$ ,  $y(0) = 1, y'(0) = 1$ . [4]

b) Find the Laplace transform of  $f(t) = t^2 u(t - 1)$ . [4]

Q3. a) Find the Fourier series of the function  $f(x) = \begin{cases} -x - \pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ , which is assumed to be periodic of period  $2\pi$ . [4]

b) Solve the initial boundary value problem:  $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}, 0 < x < 1, t > 0$ ; [4]  
 $u(x, 0) = x(1 - x), \frac{\partial u}{\partial t}|_{(x,0)} = x - \tan\left(\frac{\pi}{4}x\right), 0 \leq x \leq 1; u(0, t) = 0, u(1, t) = 0, t > 0.$

OR

a) Find the Fourier series of the periodic function  $f(x)$  of period  $p = 2$ , where  $f(x) = x^2, -1 < x < 1$ . Hence, prove that  $\frac{\pi^2}{16} = 1 - \frac{1}{4} + \frac{1}{9} - \frac{1}{16} + \dots$  [4]

b) Find the temperature distribution in a rod of length  $l$ . The faces are insulated and the initial temperature distribution is given by  $x(l - x)$ . [4]

Q4. a) A die is rolled. If the outcome is an odd number. What is the probability that it composite? [4]

b) Solve the initial boundary value problem:  $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}, 0 < x < \pi, t > 0$ ; [4]  
 $u(x, 0) = 0, \frac{\partial u}{\partial t}|_{(x,0)} = 8 \sin^2 x, 0 \leq x \leq \pi; u(0, t) = 0, u(\pi, t) = 0, t > 0.$

OR

a) Two similar urns, A B contain 2 white and 3 red balls, 4 white and 5 red balls, respectively. If a ball is selected at random from one of the Urns, then find the probability that the Urn is A, when the ball is white. [4]

b) State second shifting theorem. Find the Laplace transform of  $f(t) = t^2 u(t - 1)$ . [4]