Roll No...........................

Name of the Course : **B.Tech.(Mechanical Engineering)**
Semester : Third
Name of the Paper : Engineering Mathematics-III
Paper Code : TMA-303

Time : 3 Hours                                    Maximum Marks : 100

Note : (i) All the questions are compulsory.
(ii) Answer any two sub questions from (a), (b) and (c) in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

1. (a) Solve the partial differential equation $x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2)$. (CO1)
(10 Marks)

(b) Solve $(mz - ny)\dfrac{\partial z}{\partial x} + (nx - lz)\dfrac{\partial z}{\partial y} = (ly - mx)$. (CO1)
(10 Marks)

(c) Solve the wave-equation $\dfrac{\partial^2 y}{\partial t^2} = c^2 \dfrac{\partial^2 y}{\partial x^2}$ by D'Alembert's Method. (CO1)
(10 Marks)

2. (a) Using iterative method, find a positive root of the equation $e^{-x} - \sin x$. (CO2)
(10 Marks)

(b) Apply $4_{th}$ order Runge-Kutta method, solve the boundary value problem :
$5\dfrac{dy}{dx} = x^2 + y^2$; $y(0) = 0$ for finding the value of $y$ in the interval $0 \leq x \leq 0.2$. Use step length $h = 0.2$. (CO2)
(10 Marks)

(c) Evaluate $\displaystyle\int_0^1 e^{-x^2} dx$ using Simpson's one-third rule by taking step length $h = 0.1$. (CO2)
(10 Marks)

3. (a) Show that $\displaystyle\int_0^\infty \dfrac{e^{-t} - e^{-3t}}{t} dt = \log 3$. (CO3)
(10 Marks)

(b) Find the Laplace Transforms of the function: (CO3)

$$f(z) = \begin{cases} t/T & \text{for } 0 < t < T, \\ 1 & \text{for } t > T. \end{cases}$$

(10 Marks)

(c) Use Laplace Transforms to solve the following differential equations:
$\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + 2y = 0$, with initial condition $y = \dfrac{dy}{dx} = 0$ at $x = 0$. (CO3)
(10 Marks)

P.T.O.

## End Term (Odd) Semester Examination : November 2025

4. (a) Suppose 3% of bolts made by a machine are defective, the defects occurring at random during production. If bolts are packaged 50 per box. find :
(i) exact probability, and
(ii) Poisson approximation to it, that a given box will contain 5 defectives. (CO4)
**(10 Marks)**

(b) Students of a class were given an aptitude test. Their marks were found to be normally distributed with mean 60 and standard deviation 5. What percentage of students scored more than 60 marks? (CO4)
**(10 Marks)**

(c) Find the mean and standard deviation of Binomial distribution. (CO4)
**(10 Marks)**

5. (a) Describe Skewness and Kurtosis for any data set. If the first four moments of a distribution are 0, 2.5, 0.7, and 18.75. Examine the skewness and kurtosis of the distribution. (CO5)
**(10 Marks)**

(b) The demand for a particular spare part in a factory was found to vary from day-to-day. In a sample study, the following information was obtained : (CO5)

| Days | Mon | Tues | Wed | Thurs | Frid | Sat |
|------|-----|------|-----|-------|------|-----|
| No. of parts demanded | 1124 | 1125 | 1110 | 1120 | 1125 | 1116 |

Use $\chi^2$-Test to test the hypothesis that the number of parts demanded does not depend on the day of the week at 5% level of significance. **(10 Marks)**

(c) To assess the significance of possible variation in the performance of an antibiotic after its administration to TB patients of different hospitals of a city, a common test was performed on a number of patients taken at random from each of the four hospitals. The results are as follows: (CO5)

| | Hospitals | | | |
|-------|-----|-----|-----|-----|
| S.No. | A | B | C | D |
| 1 | 20 | 25 | 24 | 23 |
| 2 | 19 | 23 | 20 | 20 |
| 3 | 21 | 21 | 22 | 20 |

Make an analysis of variance (ANOVA) of the data and given $F_{0.05}(3,8) = 8.83$.
**(10 Marks)**