Shirpur Education Society's

# R. C. PATEL INSTITUTE OF TECHNOLOGY, SHIRPUR

An Autonomous Institute

[ Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere ]

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(स्वायत्त महाविद्यालय)

**Academic Year (2024-25)**

**Year: Second Semester: III**

**Program: SY B.Tech. (CIVIL ENGG.)** **Max. Marks: 60**

**Subject:** Mathematics for Civil Engineering (RCP23VCPC301) **Time: 2030 To 4.30 pm**

**Date: 21/03/2025** **Duration: 2 Hours**

**RE END SEM EXAMINATION –ODD SEM- III (MARCH 2025)**

**Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.**

**(1)** This question paper contains_02 pages.

**(2) All Questions are Compulsory.**

(3) All questions carry equal marks.

**(4) Answer to each new question is to be started on a fresh page.**

**(5) Figures in the brackets on the right indicate full marks.**

**(6) Assume suitable data wherever required, but justify it.**

(7) Draw the neat labelled diagrams, wherever necessary.

| Question No. | | Max. Marks |
|---|---|---|
| Q1 (a) | i) Find the Eigen values of $A^4, A^{-1}, 2A^2 and\ Adj(A)$, Where $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$. | [07] |
| | **OR** | |
| | ii) Verify the Caley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ and hence, find $A^4\ and\ A^{-1}$. | [07] |
| Q1 (b) | If $A = \begin{bmatrix} 1 & 5 \\ 4 & 2 \end{bmatrix}$, $find\ e^A\ and\ 5^A$. | [05] |
| Q2 (a) | (i)Find the Eigenvalues and Eigenvectors of the following matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$. | [08] |
| | **OR** | |
| | (ii) Show that the matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ is diagonalizable. | [08] |

| | | |
|---|---|---|
| Q2 (b) | Obtain Laplace transform of each of the following function.<br>$f(t) = \begin{cases} sin2t, & 0 < t < \pi \\ 0, & t > \pi. \end{cases}$ | [04] |
| Q3 (a) | (i) Evaluate $\int_0^\infty t\, e^{-3t} cos4t\, dt$ .<br>**OR**<br>(ii) Use convolution theorem to find $L^{-1}\left[\frac{1}{(s-1)(s-2)}\right]$ | [07]<br>[07] |
| Q3 (b) | Solve $y'' + y = t, \quad y(0) = 1, y'(0) = -2.$ | [05] |
| Q4 (a) | i) Find the Fourier series of $f(x) = \frac{\pi - x}{2}$ in the interval $0 \le x \le 2\pi$.<br>Hence, deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + - - -$ .<br>**OR**<br>ii) Find the half range cosine series of $f(x) = x(\pi - x)$ in the interval $(0, \pi)$. and hence deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} - - - -$ . | [07]<br>[07] |
| Q4 (b) | Using partial fraction, find $L^{-1}\left[\frac{1}{(s+3)(s-1)}\right]$ | [05] |
| Q5 (a) | i) In a certain factory turning out blades, there is a small chance of $\frac{1}{500}$ for any blade to be defective. The blades are supplied in packets of 10. Use the Poisson distribution to calculate the approximate number of packets containing no defective, one defective, and two defective blades in a consignment of 10000 packets.<br>**OR**<br>ii) Find the constant k such that the function $f(x) = \begin{cases} kx^2, 0 < x < 3 \\ 0, \text{otherwise.} \end{cases}$ is Probability density function and compute (i) P(1<X< 2),<br>(ii) P(X<2),<br>(iii) P(X≥ 2). | [07]<br>[07] |
| Q5 (b) | The probability of a man hitting a target is $\frac{1}{3}$. (i)If he fires 5 times, what is the probability of his hitting the target at least twice? (ii)How many times must he fire so that the probability of his hitting the target at least once is more than 90% ? | [05] |