

Enrollment No./ Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

MASTER OF ENGINEERING - SEMESTER - 1 EXAMINATION – SUMMER 2026

Subject Code: 3710812

Date: 09-06-2026

Subject Name: Computational Method for Mechanical Engineering

Time: 02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Verify that the functions $X^{1/2}$ and $X^{3/2}$ form a basis of solutions of $4x^2y'' - 3y = 0$ & Solve it when $y(1) = 3$, $y'(1) = 2.5$ **07**
- (b)** Solve $d^3y/dx^3 + 8y = \cosh(2x)$ **07**

- Q.2 (a)** Find the steady state oscillation of the mass spring system governed by the equation. $Y'' + 3Y' + 2Y = 20 \cos 2t$ **07**
- (b)** Find the Laplace transform of piecewise continuous function, **07**
- $$F(t) = t^2; 0 \leq t < 3$$
- $$= t+2; 3 \leq t < 5$$
- $$= 7; t \geq 5.$$

OR

- (b)** Find $L^{-1} \left\{ \frac{1+e^{-\frac{\pi}{2}s}}{s^2+4} \right\}$ in terms of Heaviside's unit step function. **07**

- Q.3 (a)** Find a matrix P that diagonalizes $A = \begin{bmatrix} 2 & 0 & -2 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ and determine $P^{-1}AP$. **07**

- (b)** Determine the Eigen value and Eigen vector of the matrix. **07**

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 2 & 1 \\ -1 & 1 & 2 \end{bmatrix}$$

OR

- Q.3 (a)** Find a cosine series of period 2π to represent $f(x) = \sin x$ in $0 < x < \pi$. Also graph the corresponding periodic continuation of $f(x)$. Hence deduce that $1 - 1/3 + 1/5 - 1/7 + \dots = \pi/4$ **07**

- (b)** Find Fourier cosine Integral of $f(x) = e^{-ax}$, $x > 0$, $a > 0$, Hence prove that **07**

$$\int_0^{\infty} \frac{\cos \omega x}{a^2 + \omega^2} d\omega = \frac{\pi e^{-ax}}{2a}$$

- Q.4 (a)** Find one root of $e^x - 3x = 0$, correct to two decimal places using the method of Bisection. **07**

- (b)** Develop the mathematical model for the membrane. **07**

OR

Q.4 (a) Solve the following system of equations using gauss- seidal iteration: **07**

$$x + y + 54z = 110$$

$$27x + 6y - z = 85$$

$$6x + 15y + 2z = 72$$

(b) Find the Fourier series with period 2 to represent $f(x) = X^2 + X$, in the interval $-1 < x < 1$. **07**

Q.5 (a) The function $f(x) = e^{2x} - e^x - 2$ has a zero in the interval $[0, 1]$. Find this zero correct to four significant digits using Newton's method. **07**

(b) What type of conic section the quadratic equation $7x_1^2 + 6x_1x_2 + 7x_2^2 = 200$ represents? Transform it to principal axis. **07**

OR

Q.5 (a) Find the initial acceleration (at $t = 0$ sec.) using the given the table: **07**

Time t (sec)	0	5	10	15	20
Velocity v (m/s)	0	3	14	69	228

(b) Using convolution theorem, determine $L^{-1} \left\{ \frac{1}{s^2 - s - 12} \right\}$ **07**
