

Gujarat Technological University
Model Question Paper
M.E. Semester- I Examination

Subject code: 2710002**Total Marks: 70****Subject Name: Computational Methods for Mechanical Engineering****Instructions:**

1. All questions are compulsory.
2. Assume suitable data if necessary.
3. Figure to the right indicate full marks.

- Q.1 (a) The tank as shown in figure 1 contains 1000 litres of water in which 200 grams of sugar is dissolved. 50 litres mixture of water and sugar, each containing $(1+\cos t)$ grams of dissolved sugar, run into the tank per minute. The mixture, kept uniform by stirring, running out at the same rate. Find the amount of sugar $y(t)$ in the tank at any time t . 07
- (b) A damping force having magnitude $2\cos(2\pi t - \pi/4)$ N, gives $5\cos 2\pi t$ m displacement. Calculate 07
- (a) The energy dissipated during first 5 seconds.
 - (b) The energy dissipated during the first $\frac{3}{4}$ sec.
- Q.2 (a) Show that Laplace equation given by $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0$, is an elliptic equation. 07
- (b) With the help of Cramer's rule method, prove that the second order wave equation 07
- $$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$
- is a hyperbolic equation.
- OR
- (b) The decrease of volume $y[\%]$ of leather for certain fixed values of high pressure x [atmosphere] was measured. The results are shown in the table. Find the regression line of y on x . 07

Given Values		Auxiliary Values	
X_j	Y_j	X_j^2	$X_j Y_j$
4,000	2.3	16,000,000	9,200
6,000	4.1	36,000,000	24,600
8,000	5.7	64,000,000	45,600
10,000	6.9	100,000,000	69,000
28,000	19.0	216,000,000	148,400

- Q.3 (a) Verify Green's theorem in the plane using $F_1 = y^2 - 7y$, $F_2 = 2xy + 2x$ and Circle $x^2 + y^2 = 1$ 07
- (b) (1) Find v such that $p=[2,3,0]$, $q=[0,6,1]$, $u[2,0,-4]$ and v are in equilibrium. 03
- (2) Three blocks are connected by a weightless cord and rest on inclined plane. After analysis following simultaneous equations are found. 04
- $$100 a + T = 519.72$$
- $$50 a - T + R = 216.55$$
- $$25 a - R = 108.27$$
- Solve above equation for acceleration a and tensions T and R in the rope.
- OR

- Q.3 (a) Find out what type of conic section the following quadratic form represents and transform it to principal axes: $17X_1^2 - 30X_1X_2 + 17X_2^2 = 128$ 07

- (b) Spring Mass system using linear algebraic equation. Idealized spring mass system play an important role in mechanical and other engineering problem. Figure 2 shows such a system. After they are released the masses are pulled downward by the force of gravity. Notice that the resulting displacement of each spring in fig 2(b) is measured along local coordinates refer to its initial position in fig 2 (a) 07

Q.4 (a) Determine the Fourier series representation for the excitation of given figure 3. 07

- (b) Lines L_1 and L_2 are given by following parametric equations respectively. 07
 $x = 1+6t, y = 2-4t, z = -1 + 3t; x = 4 - 3p, y = 2p, z = -5 + 4t$ where parameters p and t takes all real values. Find point of intersection and angle between two lines.

OR

Q.4 (a) Thermometer reading 5°C , is brought into a room whose temperature is 22°C . One minute later the thermometer reading is 12°C . How long does it take until the reading is practically 22°C , say, 21.9°C ? 07

- (b) Expand the Fourier series for $f(x) = \begin{cases} x & 0 < x \leq \pi \\ 2\pi - x & \pi < x < 2\pi \end{cases}$ 07

Q.5 (a) A jet fighter's position on an aircraft carrier's runway was timed during landing. Where x is the distance from the end of carrier. Estimate the velocity and acceleration using numerical differentiation. 07

t (s)	0	0.52	1.04	1.75	2.37	3.25	3.83
X (m)	153	185	210	249	261	271	273

- (b) A die is loaded in such a way that an even number is twice as likely to occur as an odd number. If E is the event that a number less than 4 occurs on a single toss of the die, find $P(E)$. 07

OR

Q.5 (a) Determine inverse of following matrix using Gauss-Jordan method: 07

$$\begin{bmatrix} -1 & 1 & 2 \\ 3 & -1 & 1 \\ -1 & 3 & 4 \end{bmatrix}$$

- (b) Result obtained for x and y in a practical performed is shown in table. Fit the straight line to the x and y values. Find the equation for a line and draw them on graph. 07

X_i	Y_i
1	0.5
2	2.5
3	2.0



Figure 1

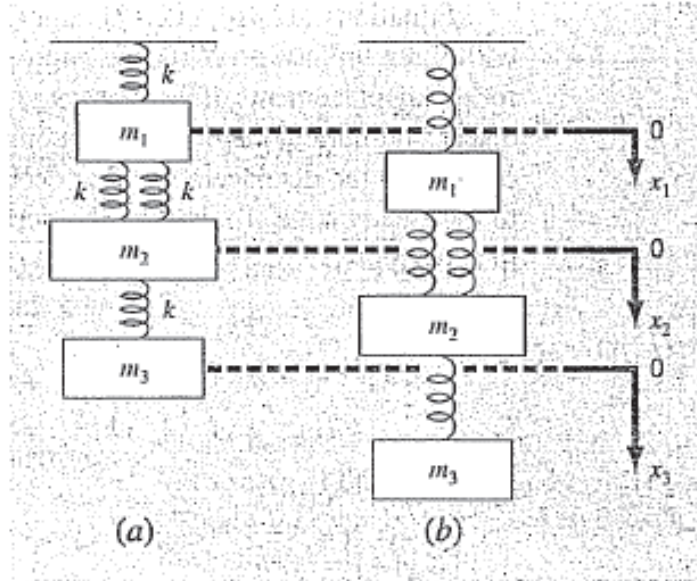


Figure 2

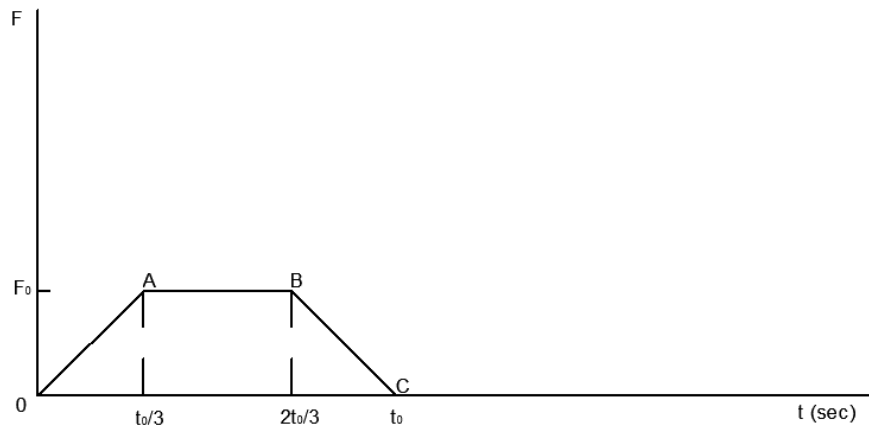


Figure 3

