Seat No.: ________ *Enrolment No.*___________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2710002 **Date: 06-01-2015**

Subject Name: Computational Method for Mechanical Engineering

Time: 02:30 pm - 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)** Find the steady state oscillation of the mass spring system governed by the equation **07**

$$y'' + 3y' + 2y = 20\, cos2t.$$

(b) The model of “sealed container with atomic waste dumped into the ocean” is $m\frac{dv}{dt} = W - B - kv,\ v(0) = 0$ where W is the weight of the container, B the buoyancy force of the water and $-kv$ is the drag. Solve the equation to obtain $v(t)$ and integrate to get $y(t)$ such that $y(0) = 0$ **07**

Q.2 **(a)** Using Laplace Transform solve: $y'' - y = t\,;\quad y(0) = y'(0) = 1.$ **07**

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

OR

(b) 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**

Q.3 **(a)** Find a matrix P that diagonalizes the matrix A $= \begin{bmatrix} -1 & 4 & -2 \\ -3 & 4 & 0 \\ -3 & 1 & 3 \end{bmatrix}$ and determine $P^{-1}AP$. **07**

(b) Verify dimension theorem for the linear transformation T: $R^4 \rightarrow R^3$ given by the formula **07**

$$T(x, y, z, w) = (4x + y - 2z - 3w, 2x + y + z - 4w, 6x - 9z + 9w).$$

OR

Q.3 **(a)** Solve the following equation using Gauss-Jordan method. **07**

$10x + y + z = 12$

$2x + 10y + z = 13$

$x + y + 5z = 7$

(b) Compute the flux of water through $S: |x| \leq 1, |y| \leq 3, |z| \leq 2$ if the velocity vector is $V = F = [x^2, 0, z^2]$ (As $F=\rho V$ and density $\rho = 1$ for water). **07**

Q.4 **(a)** Lines L_1 and L_2 are given by following parametric equations respectively. **07**

$x = 1 + 6t,\quad y = 2 - 4t,\quad z = -1 + 3t;$

$x = 4 - 3p,\quad y = 2p,\quad z = -5 + 4t,$

where parameters p and t takes all real values.

Find point of intersection and angle between two lines.

(b) A periodic motion observed on the oscilloscope is illustrated in figure 1. **07**

Represent this motion by harmonic series (Fourier series).

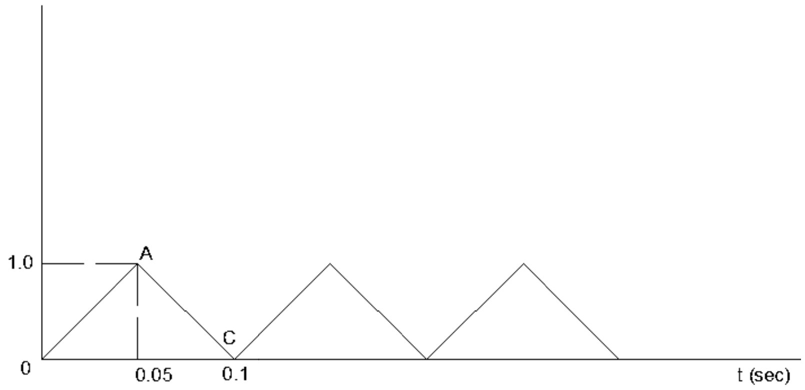

Figure 1

OR

Q.4 **(a)** The following table gives the marks secured by students. **07**

Range of marks	30-40	40-50	50-60	60-70	70-80
No. of students	32	45	54	31	34

Find the number of students who got marks between 50 and 55.

(b) A body executes damped forced vibrations given by the equation. **07**

$$\frac{d^2x}{dt^2} + 2k\frac{dx}{dt} + b^2x = e^{-kt}\sin\omega t$$

Solve the equation when $\omega^2 \neq b^2 - k^2$

Q.5 **(a)** By method of least squares, find the curve y = ax + bx^2 that best fit the following data: **07**

X	1	2	3	4	5
Y	1.9	5.4	9.3	14.6	18.8

(b) 1. Using Poisson distribution, find the probability that the ace of spades will be drawn from a pack of well-shuffled cards at least once in 104 consecutive trials. **04**

2. If on an average one ship in every fifteen is wrecked, find the probability that out of seven ships expected to arrive, four at least will arrive safely. **03**

OR

Q.5 **(a)** Determine the largest Eigen value and corresponding eigenvector of the matrix **07**

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

(b) A 20kg mass is resting on a spring of 4700 N/m and dashpot of 147 N-Sec/m in parallel. If a velocity of 0.10 m/sec is applied to the mass at the rest position, what will be the displacement from the equilibrium position at the end of first second? **07**

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