Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER – I (New)– EXAMINATION – WINTER-2019

Subject Code: 3710812 **Date: 02-01-2020**

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)** There is a system for the unknown currents i_1, i_2 and i_3 in the electrical network. Using Kirchhoff's current and voltage laws the following equations obtained. Find the current using Gauss elimination method. **07**

$$i_1 - i_2 + i_3 = 0, -i_1 + i_2 - i_3 = 0, 10i_2 + 25i_3 = 90, 20i_1 + 10i_2 = 80$$

(b) Solve the following initial-value problem arises from a mechanical system using Laplace transform **07**

$$y'' + 3y' + 2y = e^t, y(0) = 1, y'(0) = 0$$

Q.2 **(a)** It has been claimed that in 60% of all solar-heat installations the utility bill is reduced by at least one-third. Accordingly, what are the probabilities that the utility bill will be reduced by at least one-third in **07**

(i) Four of five installations

(ii) At least four of five installations?

(b) Find the Fourier series of $f(x) = x^2$ in the interval $(0, 2\pi)$ and hence deduce that $\frac{\pi^2}{12} = \frac{1}{1^1} - \frac{1}{2^2} + \frac{1}{3^2} - \cdots$ **07**

OR

(b) Derive the governing ordinary differential equation for the damped vibration and discuss all the cases. **07**

Q.3 **(a)** If P is the pull required to lift a load W by means of a pulley block, find a linear law of the form P=mW +c connecting & W using following data, **07**

P	12	15	21	25
W	50	70	100	120

Where P and W are taken in Kgs. & compute P when W=150 Kgs.

(b) The velocity of a train which starts from rest is given by the following table, the time being reckoned in minutes from the start and speed in Km/hrs. **07**

Time (minutes)	0	3	6	9	12	15	18
Velocity(kms/hr)	0	22	29	31	20	04	00

Estimate approximately the distance covered in18 minutes by simpson's 3/8 rule

OR

Q.3 **(a)** A practical study was carried out to check the effect of parameters on various properties of sand mold collected data are as follows, **07**

Water content	Mold hardness $(Kg/(cm)^2)$	Permeability	Shear stress$(Kg/(cm)^2)$
3% (15 ml)	91	210	0.38
4% (20 ml)	86	300	0.50
5% (25 ml)	83	360	0.55
6% (30 ml)	78	380	0.88

Compute the values of mold hardness when water content is 4.5% using newton's forward interpolation.

(b) (1) Determine a 90% confidence interval foe the mean of a normal distribution with variance = 16, using a sample of n=100, with mean=8. Take corresponding value of c from below table. **03**

γ	90%	95%	99%	99.9%
c	1.645	1.960	2.576	3.291

(2) A random variable X has the following probability distribution **04**

X	0	1	2	3	4	5	6	7
P(X)	a	4a	3a	7a	8a	10a	6a	9a

(i) Find the value of a.
(ii) Find P(X<3)

Q.4 **(a)** A tightly stretched string with fixed end points at $x = 0$ and $x = 20$ is initially given the deflection $f(x) = kx(20 - x)$. If it is released from this position, then find the deflection of the string. **07**

(b) Find the dominant eigen value of $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ by Power method by choosing $x_0 = [1,1]^T$ & hence find the other eigen value also. **07**

OR

Q.4 **(a)** A rod of length l with insulated side is initially at uniform temperature 100°C . Its ends are suddenly cooled at 0°C and kept that temperature. Find the temperature $u(x,t)$. **07**

(b) If $\vec{F} = (2x^2 - 4z)\hat{\imath} - 2xy\,\hat{\jmath} - 8x^2\,\hat{k}$ then evaluate $\iiint_V div\vec{F}\,dv$, where V is bounded by the planes $x = 0, y = 0, z = 0$ and $x + y + z = 2$ **07**

Q.5 **(a)** Verify Green's theorem for $\oint_c [(x - y)dx + 3xydy]$ where c is the boundary of the region bounded by the parabolas $x^2 = 4y$ and $y^2 = 4x$. **07**

(b) Solve the differential equation using method of variation of parameter $y'' - 7y' + 6y = 2\sin 3x$. **07**

OR

Q.5 **(a)** Solve the differential equation : $y'' - y = t$; $y(0) = y'(0) = 1$. **07**

(b) Find the eigenvalues and corresponding eigenvectors of the matrix **07**

$$\begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix}$$

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