

Total No. of Questions :12]

SEAT No. :

P3920

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[Total No. of Pages :5

T.E. (Mechanical / Automobile)

NUMERICAL METHODS AND OPTIMIZATION

(2012 Course) (End Semester) (Semester - II) (302047)

Time : 2½ Hours]

[Max. Marks :70

Instructions to the candidates:

- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of programmable calculator is not permitted.
- 5) Assume suitable data, if necessary.

Q1) Volume of cylinder is calculated after measuring its diameter as (2.5 ± 0.02) m and its height as (4.8 ± 0.05) m respectively. Estimate the absolute error in calculation of volume. [6]

OR

Q2) Determine the real root of the equation $e^x = 5x$ using method of successive approximation. Assume initial guess $x = 0.15$ and solve upto 5 iterations. [6]

Q3) Draw a flowchart for Gauss elimination method. [6]

OR

Q4) Using Gauss Seidal method, solve the following set of equations up to 3 decimal places. [6]

$$3x + y - z = 0,$$

$$x + 2y + z = 0,$$

$$x - y + 4z = 3$$

Q5) A company is manufacturing two different types of products A and B. Each product has to be processed on two machines M1 and M1. Product A requires 2 hours on machine M1 and 1 hour on machine M2. Product B

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requires 1 hour on machine M1 and 2 hours on machine M2. The available capacity of machine M1 is 104 hours and that of machine M2 is 76 hours Profit per unit for product A is Rs.6 and that for product B is Rs. 11. [8]

- i) Formulate the problem.
- ii) Find the optimal solution by simplex method.

OR

Q6) a) Determine the maximum value of root of equation. [5]

$$0.51(x) - \sin(x)$$

by Newton's method. Take initial guess as 2 and do 4 iterations.

b) Write a short note on Genetic Algorithm. [3]

Q7) a) Fit the exponential curve $y = ae^{bx}$ to the following data: [8]

x	2	4	6	8
y	25	38	56	84

b) The values of x, Y and y' are given below. Use Hermit interpolation to find the value of y at x = 0.25. [8]

x	Y	y'
0	0	0
1	1	1

OR

Q8) a) Using least square technique, fit the following curve $Nu = a \cdot Re^b$ to the below mentioned data. Find the values of 'a' and 'b.' [8]

Re [x]	900	1500	2700	3000
Nu [y]	89	110	120	125

- b) Using suitable interpolation formula to find a polynomial which passes the points (0,-12), (1,0), (3, 6), (4, 12) [8]

- Q9) a) The total mass of the variable density rod is given by. [8]

$$m = \int_0^L \rho(x) \cdot A_c(x) \cdot dx$$

Where m is mass, $\rho(x)$ is density, $A_c(x)$ is cross-sectional area, x is distance along the rod and L is the total length of the rod. The following data is measured for a 10m length rod. Determine the mass in kg using trapezoidal rule to best possible accuracy.

x, m	0	2	3	4	6	8	10
$\rho, \text{g/cm}^3$	4.00	3.95	3.89	3.80	3.60	3.41	3.30
A_c, cm^2	100	103	106	110	120	133	150

- b) Draw the flowchart to find integral. [8]

$$I = \int_{x_1}^{x_n} \int_{y_1}^{y_n} f(x, y) \cdot dx dy$$

Using Trapezoidal rule.

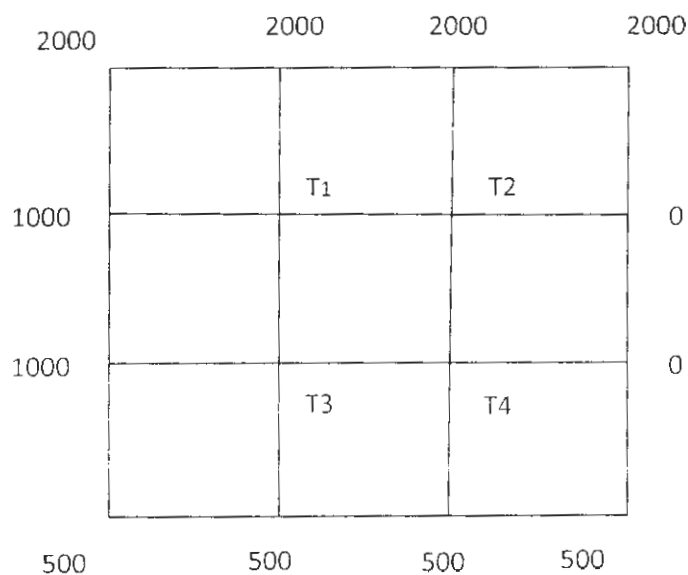
OR

Q10)a) Use three point Gauss-Legendre formula to solve. $\int_0^3 \left(\frac{e^x}{2+x^2} \right) dx$ [8]

b) Using the following data to calculate the work done by stretching the spring that has a spring constant of $k = 300 \text{ N/m}$ to $x = 0.30 \text{ m}$. Use Simpson's 1/3rd and 3/8th rule. [8]

$F (10^3\text{N})$	0	0.01	0.028	0.046	0.063	0.082	0.11
x, m	0	0.05	0.10	0.15	0.20	0.25	0.30

Q11)a) The edges of a steel plate of $750 \times 750 \text{ mm}$ has maintained at temperatures as shown in fig. What will be steady state temperatures at the interior points? [12]



b) Draw the flowchart for Runge-Kutta fourth order method. [6]

OR

- Q12)a)** Solve the following set of differential equations using Runge-Kutta fourth order method for $x = 1$. Take $x_0 = 0$, $y_0 = 4$ and $z_0 = 6$. Use step size of 0.5. **[10]**

$$\frac{dy}{dx} = -0.5y$$
$$\frac{dz}{dx} = 4 - 0.3z - 0.1y$$

- b) Use Euler's method with $h = 0.5$ to solve the initial value problem over the interval $x = 0$ to 2. **[8]**

$$\frac{dy}{dx} = yx^2 - 1.1y \quad \text{Where } y(0) = 1.$$

