

Total No. of Questions : 12]

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SEAT No. :
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T.E. (Mechanical/Auto. Engg./Sandwich/Automobile)

NUMERICAL METHODS AND OPTIMIZATION

(2015 Pattern) (Semester - II)

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, and Q.11 or Q.12.
- 2) Neat diagrams must be drawn whenever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Use of scientific calculator is allowed.
- 5) Assume suitable data if necessary.

Q1) Evaluate the error in the volume of a tank $V = \frac{\pi}{4} d^2 l$ at $d = 1.5\text{m}$ and $l = 2.5$ if error in the measurement of diameter is $\pm 0.010\text{m}$ and length is $\pm 0.020\text{m}$. [6]

OR

Q2) A chip-tool interface temperature model is expressed as below : [6]

$$T = 314 \times V^{0.42} f^{0.53}$$

where, T-Average chip-tool interface temperature ($^{\circ}\text{C}$), V-cutting speed (m/min) and f - feed (mm/rev).

Find maximum feed (f) in mm/rev to which temperature of tool will not increase above 900°C for cutting speed of 340 m/min. Take initial guesses as [0, 0.5]. Solve for 5 iteration.

Q3) Use the Jacobi method to approximate the solution of the following system of linear equations [6]

$$5x_1 - 2x_2 + 3x_3 = -1$$

$$-3x_1 + 9x_2 + x_3 = 2$$

$$2x_1 - x_2 - 7x_3 = 3$$

Continue the iterations until two successive approximations are identical when rounded to two significant digits. Take initial approximation as $x_1 = 0, x_2 = 0, x_3 = 0$.

OR

Q4) Solve following set of equations using Thomas Algorithm [6]

$$2.04 X_1 - X_2 = 48.8$$

$$-X_1 + 2.04 X_2 - X_3 = 0.8$$

$$-X_2 + 2.04 X_3 = 0.8$$

Q5) a) Write a note on following with example [4]

i) Slack Variable

ii) Surplus Variable

b) Write a note on simulated annealing. [4]

OR

Q6) a) Solve following LP problem using graphical method : [5]

$$\text{Minimize } Z = 5X_1 + 6X_2$$

$$\text{Subject to } 2X_1 + 5X_2 \geq 1500;$$

$$3X_1 + X_2 \geq 1200$$

$$\text{Where } X_1, X_2 \geq 0.$$

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

Q7) a) Draw a flowchart for Runge-Kutta 4th order method. [6]

b) Solve, $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ for the following condition. [12]

At $x = 0$ and $x = 0.5, u = 1$ for all values of t . At $t = 0, u = 2x + 1$ for $0 < x < 0.5$. Take increment in x as 0.1 and increment in t as 0.01. Find all values of u for $t = 0$ to $t = 0.03$.

OR

Q8) a) Given that $dy/dx = yz, dz/dx = xy, y(0) = 1, z(0) = 1, y = 0.1$ [8]

Use R-K 2nd order method to find value of y and z at $x = 0.1$

b) The temperature inside a slab of thickness 16 cm is given by [10]

$$\frac{dT}{dx} = -\frac{q}{A} \times \frac{1}{0.5 * (1 \pm 0.01 * T)} \quad (T \text{ is in deg C deg C})$$

Find the temperature of other surface by taking step size = 4cm, if heat flux (q/A) is 1000 W/m^2 and temperature at one surface 500°C . Use R-K 4th order method.

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P.T.O.

- Q9) a) A set of x values and respective y values are given below. Using appropriate interpolation method, find the value of y at $x = 11.5$. [8]

x	2	5	10	12	15
y	45	68	75	90	98

- b) The values of Nusselt numbers (Nu) and Reynold numbers (Re) found experimentally are given below. If the relation between Nu and Re is of the type $Nu = aRe^b$, find the values of a and b for the given values of Nu and Re. [8]

	2000	2400	2800	3200	3600	4000
	13.0102	13.5091	14.0789	14.4192	15.1297	16.7535

OR

- Q10) a) A set of x values and respective y values are given below. Using Lagrange inverse interpolation method, find the value of x at $y = 0.42$ [8]

x	10	20	30	40	50
y	0.1105	0.1985	0.2727	0.4101	0.5123

- b) Fit a quadratic equation of the form $y = a_0 + a_1x + a_2x^2$ for a set of given values : [8]

x	2	5	8	10	15	20
y	0.2841	2.8631	12.082	23.2612	11.6725	1.2792

- Q11) a) The Velocity v (m/min) of moped which start from rests is given at fixed interval of time t (min) as follows : [10]

t (min)	0	2	4	6	8	10	12	14	16	18	20
v (m/min)	0	10	18	25	29	32	20	11	5	2	0

Estimate approximately the distance covered in 20 minutes. Use Simpson's 1/3 and Trapezoidal rule.

- b) Use Gauss-Legendre three-point formula to evaluate $\int_{-1}^1 e^x dx$ [6]

OR

- Q12) a) Draw a combined flowchart for Simpson's 1/3 rule and Simpson's 3/8 rule. [8]

- b) Evaluate $I = \int_0^1 \int_0^{(x+y)} dx dy$ [8]

using trapezoidal rule. Take strip size for x and y axis as 0.5.

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