Total No. of Questions : 12]

SEAT No. :

P2927

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[5669]-516

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 = 1.5m and 1 = 2.5 if error in the measurement of diameter is ± 0.010m and length is ± 0.020m. **[6]**

OR

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

$$T = 314 \times V^{0.42} \times f^{1.5}$$

where, T-Average chip-tool interface temperature (ºC), 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 ºC 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 $x_1 = 0$, $x_2 = 0$, $x_3 = 0$.

P.T.O.

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]**

Minimize $Z = 5X_1 + 6X_2$

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

$3X_1 + X_2 \geq 1200$

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 increament in t as 0.01. Find all values of u for $t = 0$ to $t = 0.03$.

OR

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

$$\frac{dT}{dx} = -\frac{q}{A} \times \frac{1}{0.5*(1+0.01*T)}$$ (T 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 deg.C. Use R-K 4th order method.

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 $Nu = a.Re^b$, 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 $y = a_0 + a_1 x + a_2 x^2$ 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 $I = \int_{-1}^{1} e^x dx$. **[6]**

OR

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

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

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

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