ME/Sem I/CBCGS/MECH THERMAL/ND-18/5-12-2018

Paper / Subject Code: 61003 / Numerical Methods and Computational Techniques.

Total Marks:80

(3hours)

N.B.: 1. Answer any **four** questions.
2. Figures to the right indicate full marks.
3. Use of **scientific calculator** is permitted.
4. Assume **suitable data** if necessary with justification.

1. a) Find the real root of the equation $\cos x - xe^x = 0$ by Bisection method correct up to four decimal places. 10

b) Use Relaxation method to solve the following system, 10

$$-5x + 12z = 80; \quad 4x - y - z = -2; \quad 6x + 8y - 2z = 45.$$

If necessary, make sure to rearrange the equations to achieve convergence.

2. a) Determine the linear spline valid in the interval $[x_{i-1}, x_i]$ for the following data,

x	6.2	6.5	7.1	8.5
$y(x) = xln(x)$	11.3122	12.1667	13.9167	18.1905

Also find $y(6.3)$, $y(7.0)$ *and* $y(7.6)$. 10

b) Using R-K method of 4th order, solve the differential eq.

$$\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2, \quad y(0) = 1, \quad y'(0) = 0$$

for $x = 0.2$ with step size $h = 0.2$. 10

3. a) Using Shooting method, solve the boundary value problem,

$$\frac{d^2y}{dx^2} = 2y^2, \quad y(0) = 1, \qquad y(1) = 2$$

with the step size $h = 0.5$ 10

b) The velocity v of a particle at distance S from a point on its path is given by the table below: 10

S in metre	0	10	20	30	40	50	60	70	80
$v(m/sec)$	40	55	60	65	70	63	58	45	35

Estimate the time taken to travel 80 meters . Justify for the method used.

[TURN OVER]

4. a) The population of a town is as follows: 10

Year (x)	1941	1951	1961	1971	1981	1991	2001
Population (y) in lakhs	5	7	10	15	21	28	40

Estimate the population increase during the period 1946 to 2000.

b) The latent heat of vaporization of steam l, is given in the following table at different temperatures t: 10

t	40	50	60	70	80	90	100	110
l	1069	1063	1058	1052	1049	1041	1036	1030

For this range temperature, a relation of the form $l = a + bt$ is known to fit the data, Find the values of a and b by the method of least square.

5. a) Using predictor-corrector method, find $y(0.2) and\ y(0.4)$ 10

$$\frac{dy}{dx} = 2y + e^x, y(0) = 0$$

b) Using Bendre-Schmidt method, solve the equation $u_t = 4u_{xx}$

under the conditions $u(0,t), u(8,t) = 0,\ u(x,0) = 8x - x^2,\ 0 \le x \le 8$

up to $t = 1min$, taking $h = 1$. 10

6. a) Using finite-difference scheme, solve the boundary value problem,

$$\frac{d^2y}{dx^2} = 2x + 3y$$

with the boundary conditions $y(0) = y(1) = 0$ and step size $h = 0.25$. 10

b) Classify the equation $u_{xx} + u_{yy} = x^3 + y^3$. Write the finite difference scheme, corresponding algebraic equations and solve it over the rectangular region

$0 < x < 3, 0 < y < 2$. Given that,

$u(x,0) = u(x,2) = 0, u(0,y) = u(3,y) = 0$ taking $h = k = 1$. 10
