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(2063)

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M.Tech 2nd Semester Examination

Computational Techniques

EC-203

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary continuation sheet will be issued.

Note : Attempt any five questions from the following questions. Mark of each question are indicated on right hand side.

1. (a) Find the iterative formula for Newton Raphson method to find root of non-linear equation. Hence find the condition of convergence of Newton Raphson method. **(7)**

   (b) Using Bisection method find the smallest positive root of equation $x^4 - x - 10 = 0$ correct to two decimal places. **(7)**

   (c) Solve the following system of equation using Elimination method

$$5x_1 - x_2 = 8$$
$$-x_1 + 5x_2 - x_3 = -5$$
$$-x_2 + 5x_3 = -6$$
(6)

2. (a) Solve the following system of equations by using LU-decomposition method

$$2x_1 + 4x_2 + 2x_3 = 15$$
$$2x_1 + x_2 + 2x_3 = -5$$
$$4x_1 + x_2 - 2x_3 = 0$$

(7)

(b) A slider in a Machine moves along fixed straight rod. Its distances 'x' in cm along rod for different values of time 't' in seconds are given below. Find velocity and acceleration at t = 0.1 and t = 0.05.

t	0	0.1	0.2	0.3	0.4	0.5	0.6
X	30.13	31.62	32.87	33.64	33.95	33.81	33.24

(7)

(c) Define divided differences. Prove that they are symmetrical and also find the Newton's general interpolation formula. **(6)**

3. (a) Find the value of y(0.3) using Adam Bash forth's Predictor corrector method, given

$\frac{dy}{dx} = (x + ye^{-x}, (y - 0.1) = 0.9053,$ y(0) = 1, y(0.1) = 1.1046, y(0.2)=1.2173. **(10)**

(b) Given u(x, y) satisfies the equation $\nabla^2 u = 0$ and boundary condition (x,0) = 0, u(x, 4) = 8 + 2x, u(0, y) $= \frac{1}{2}y^2$ and (4, y) = y^2. Find value of u(, j), i, u = 1, 2, 3 correct to one decimal places. **(10)**

4. (a) Explain what do you understand by Spline function. Find whether function

$$f(x) = \begin{cases} -2x^3 - x^2 & -1 \le x \le 0 \\ 2x^3 - x^2 & 0 \le x \le 1 \end{cases}$$ is cubic spline or not. **(4+6)**

(b) Write a note on Eigen values and Eigen vectors. Find all the Eigen values and Eigen vector of

$$A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$$ using Jacobi method. **(3+2+5)**

5. (a) Find the finite difference equation used to solve $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial x^2}$ by Dufort and Frankel method. Hence justify that this method is 3-level explicit method. **(7)**

(b) Using formula obtained in part (a), find the solution of $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subjected to conditions u(x, 0) = sinπx ,0 < x < 1, u(x, t) = 0 = u(1, t), $\left[\text{Take } h = \frac{1}{3}, k = \frac{1}{36}\right]$. Carry out computation for two levels. **(7)**

(c) Explain Dirichlet and Neumann problems. **(6)**

6. (a) Solve the boundary value Problem $\frac{\partial^4 y}{\partial x^4} - 16y = x$, for y(0.25), y(0.5) and y(0.75). Given that dx y(0) = 0 , y" (0) = 0 y(1) = 0, y'(1) = 0. **(10)**

(b) Solve the equation $\frac{\partial^2 u}{\partial t^2} = 16\frac{\partial^2 u}{\partial x^2}$, taking $\Delta x = 1$ up to $t = 1.25$ given that

$u(0, t) = u(5, t) = \frac{\partial}{\partial t}u\ (x,0)$ and $u(x, 0) = x^2(5 - x)$. **(10)**

7. (a) Using Newton Raphson-method find solution of $\sin(xy) + x - y = 0$, $\cos(xy) + 1 = 0$ taking $x_0 = 1$, $y_0 = 2$. **(7)**

(b) Find the value of $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's $\frac{1}{3}$ and $\frac{3}{8}$ rule. **(7)**

(c) Find the expression for error in Trapezoidal rule of integration. **(6)**

8. (a) Explain "Quadratic shape function". **(7)**

(b) Using three point Gaussian quadrature formula evaluates $\int_0^1 \frac{dx}{1+x}$. **(7)**

(c) Write a note on ill conditioned system of linear equations and method to solve it. **(6)**