

Ans

DEPARTMENT OF MATHEMATICS, IIT KHARAGPUR
MID-SEMESTER EXAMINATION: AUTUMN, 2016

Sub: MA 30110 ADVANCED NUMERICAL TECHNIQUES
3rd / 4th yr. M.Sc. & B.Tech. Time: 2hrs. Maximum Marks: 30

Answer ALL the Questions

Marks are indicated within the parenthesis

1(a) Derive second-order accurate forward and backward difference formulas for first order derivative.

(b) Write the Thomas algorithm for solving a tri-diagonal system of linear algebraic equations.

(c) Solve the BVP $\frac{d^2 y}{dx^2} - 2y = 0$, $y(0) = 1$; $\frac{dy(1)}{dx} = 0$.

through a second-order accurate finite difference scheme by choose $h=0.2$.

(3+3+4)

2a. Solve the following boundary value problem using a finite difference scheme

$$\frac{d^4 y}{dx^4} + 81y = 81x^2$$

$$y(0) = y(1) = y''(0) = y''(1) = 0$$

Choose step size $h=1/3$.

2b. Construct the resulting algebraic equations to solve the following BVP by a second-order accurate finite difference scheme

$$\frac{d^3 y}{dx^3} + 4\frac{d^2 y}{dx^2} + \frac{dy}{dx} - 6y = 1, \quad y(0) = 1; \quad \frac{dy(0)}{dx} = 0; \quad \frac{dy(1)}{dx} = 1.$$

Choose step size $h=0.2$. Solutions are not required to obtain.

(5+5)

3. Discuss the Newton's method of linearization for solving the following non-linear BVP through finite difference scheme

$$f''' + f f'' + 1 - (f')^2 = 0$$

$$f(0) = 0, f'(0) = 0, f'(4) = 1.$$

Construct the ensuing block tri-diagonal system at each iteration. (6+4)