Tribhuvan University

Institute of Science and Technology

2078

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Bachelor Level / Second Year/ Third Semester/ Science

Computer Science and Information Technology (CSc. 207)

(Numerical Method)

(NEW COURSE)

Full Marks: 60
Pass Marks: 24
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The figures in the margin indicate full marks.

Section A

Attempt any TWO questions: (2×10=20)

1. How can Horner's rule be used to evaluate the $f(x)$ and $f(x)$ of a polynomial at given point? Explain. Write an algorithm and program to calculate a real root of a polynomial using Horner's rule.

2. What is matrix factorization? How can it be used to solve system of linear equations? Factorize the given matrix A and solve the system of equations $Ax = b$ for given b using L and U matrices.

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 8 & 11 \\ 3 & 22 & 36 \end{bmatrix} \text{ and } b = \begin{matrix} 4 \\ 12 \\ 28 \end{matrix}$$

3. What is higher order differential equation? How can you solve the higher order differential equation? Explain. Solve the following differential equation for $1 \le x \le 2$, taking $h = 0.25$.

$$\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 5y = 0, \text{ with } y(1) = 1 \text{ and } y'(1) = 2$$

Section B

Attempt any EIGHT questions: (8×5=40)

4. How the half-interval method can estimate a root of non-linear equation? Find a real root of following equation using half-interval method correct up to two decimal places.

$$x^2 - e^{-x} - x = 1$$

5. Calculate a real root of the given equation using fixed point iteration correct up to 3 significant figures.

$$2x^3 - 2x = 5$$

6. What is Newton's interpolation? Obtain the divided difference table from the following data set and estimate the $f(x)$ at $x = 2$ and $x = 5$.

x	3.2	2.7	1.0	4.8	5.6
$f(x)$	22.0	17.8	14.2	38.3	51.7

7. What is linear regression? Fit the linear function to the following data

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
$f(x)$	2.0	2.6	3.9	6.0	9.3	15	20.6	30.4

8. What are the problems with polynomial interpolation for large number of data set? How such problems are addressed? Explain with example.

9. Evaluate the following integration using Romberg integration.

$$\int_0^1 \frac{\sin^2 x}{x} dx$$

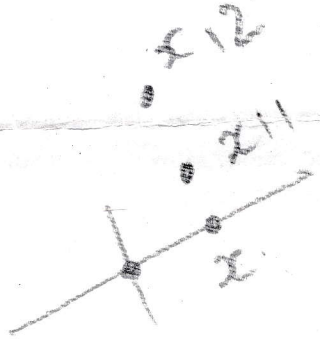
10. Solve the following set of linear equations using Gauss Jordan method.

$$x_2 + 2x_3 + 3x_4 = 9$$
$$7x_1 + 6x_2 + 5x_3 + 4x_4 = 33$$
$$8x_1 + 9x_2 + x_4 = 27$$
$$2x_1 + 5x_2 + 4x_3 + 3x_4 = 23$$

11. Solve the following differential equation for $1 \le x \le 2$, taking h = 0.25 using Heun's method.

$$y'(x) + x^2 y = 3x, \text{ with } y(1) = 1$$

12. Consider a metallic plate of size 90 cm by 90 cm. The two adjacent sides of the plate are maintained at temperature of 100°C and remaining two adjacnt sides are held at 200°C. Calculate the steady state temperature at interior points assuming a grid size of 30 cm by 30 cm.



$$A = \frac{200 + B + D}{4}$$

$$B = \frac{A + C + 300}{4}$$

$$C = \frac{D + B + 400}{4}$$

$$D = \frac{300 + C + A}{4}$$