

Tribhuvan University
Institute of Science and Technology
 2083
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Bachelor Level / Second Year/ Third Semester/ Science
Computer Science and Information Technology (CSC 212)
 (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 far as practicable.
 The figures in the margin indicate full marks.

Section A

Attempt any TWO questions:

(2 × 10 = 20)

1. Define rate of convergence in numerical methods. Derive the secant method for solving non-linear equations and using this method solve $\sin x - 0.4x = 0$ correct up to four decimal places. [1+4+5]
2. How does pivoting improve accuracy of solution in Gauss elimination? Explain how Gauss elimination method differs from Gauss Jordan method. Solve the following system of linear equations using Gauss elimination with partial pivoting: [2+3+5]

$$\begin{aligned} 2x + 3y - z &= 5 \\ 4x - y + 3z &= 11 \\ x + 2y + 2z &= 8 \end{aligned}$$
3. Why numerical integration is used in practical applications instead of analytical integration? Write an algorithm and a program to compute the integration using composite Simpson's 3/8 rule. [2+4+4]

Section B

Attempt any EIGHT questions:

(8 × 5 = 40)

4. Explain the different types of errors that occur in numerical computations and how these errors affect the accuracy of computational results. [5]
5. Define regression. Construct the cubic spline for the following data points. [1+4]

x	2	3	4
y	4	9	16

6. Suppose a biologist is measuring the growth of a plant over time. The following height data (in cm) was recorded at different days:

Day (x)	1	3	5	7
Height (y)	5	9	15	23

Estimate the height of the plant on day 4 using Lagrange's interpolation. [5]

7. Assume a cloud storage provider monitors data storage in TB and the corresponding number of backup failures per month as:

Storage (TB)	50	70	90	110	130	150	170
Backup failures	2	5	7	10	14	17	22

Fit a straight-line model to describe the relationship between storage size and backup failures. [5]

8. Suppose a hydrologist is measuring the water level in a river at different time intervals to study the rate of rise. The data collected is given below: [5]

Time (t in hours)	1	2	3	4	5
Water Level (H in m)	2.0	3.5	5.0	6.2	7.5

Construct the divided difference table for the water level data and estimate the river's rate of rise (velocity) and acceleration at $t=2$ hours.

9. Solve the following system of linear equations using the Jacobi iteration method. [5]

$$\begin{aligned}x - 8y + z &= 1 \\7x + y - 2z &= 4 \\x + 2y + 6z &= 7\end{aligned}$$

10. Explain the difference between an initial value problem and a boundary value problem. Describe how the shooting method can be used to solve a boundary value problem. [5]
11. Find the approximate value of y when $x=0.2$ for the differential equation $\frac{dy}{dx} = x + y^2$, given that $y = 1$ when $x = 0$, using the Runge-Kutta method of order 4 with a step size of $h=0.1$. [5]
12. Consider a metallic plate of size $48 \text{ cm} \times 48 \text{ cm}$. If the top and left sides are maintained at 100°C and the bottom and right sides at 25°C , find the steady state temperatures of the interior points, assuming a grid size of $16 \text{ cm} \times 16 \text{ cm}$. [5]