(i) Printed Pages: 4 Roll No. .....

(ii) Questions : 9 Sub. Code : 1 7 9 3 1

Exam. Code : 0 0 2 9

Bachelor of Computer Applications 3rd Semester

(2124)

COMPUTER ORIENTED NUMERICAL METHODS

Paper : BCA-16-304

Time Allowed : Three Hours] **[Maximum Marks : 65**

Note :—Attempt **FIVE** questions in all, including Question No. **9** in Section–E which is compulsory and attempt **ONE** question each from Sections–A, B, C and D.

SECTION—A

1. (a) The roots of $x^2 + 83.4x + 1 = 0$ are approximately $x_1 = -0.01199213$ and $x_2 = -83.38800785$. Suppose now that you work under four-digit rounding arithmetic. Calculate x_1 using the following two different formulas :

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \text{ and } x_1 = \frac{-2c}{b + \sqrt{b^2 - 4ac}}.$$

Compute the relative error obtained by the two formulas. Explain why the second formula gives a more accurate answer than the first one.

(b) What is error propagation ? Illustrate the propagation of errors with a suitable method and examples. 6,7

2. How is floating point number stored in the memory of computers ? What are the factors that affect their accuracy and range ? With the help of suitable example, show that associative law of floating point addition may not be valid in numerical computations. 13

SECTION—B

3. Use Newton's method and the Bisection method to approximate the value of $\sqrt{2}$ to within 10^{-4}. Do this in two parts :

   (a) Use Newton's method with an initial guess $p_0 = 1$. How does this compare with the bisection method, in terms of number of iterations required ?

   (b) Use the Bisection method with initial intervals as [1, 2]. How does this compare to the Newton's method from part (a) ? 13

4. Given the initial guess $(x_1^{(0)}, x_2^{(0)}, x_3^{(0)}) = (0, 0, 0)$. Use Gauss-Seidel method to find the first three approximations $(x_1^{(1)}, x_2^{(1)}, x_3^{(1)})$ of the solution to the system of equations $Ax = b$, where

$$A = \begin{bmatrix} 1 & -2 & 1 \\ 2 & 1 & -1 \\ 3 & 2 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}.$$ 13

SECTION—C

5. Suppose we know the following values of a function F : F(0) = 0, F(1) = 2, F(2) = 8 :

   (a) Write down the divided differences F[0], F[0, 1] and F[0, 1, 2].

   (b) Write down the forward-differences $\Delta f(x_0)$, $\Delta^2 f(x_0)$.

   (c) Write down the appropriate Newton's interpolating polynomial. What is the order of the interpolating polynomial ?

   4,4,5

6. Define the concept of numerical integration. Evaluate $I = \int_0^1 (1/(x^3 + 10) \cdot dx$ using :

   (a) Trapezoidal rule, and

   (b) Simpson's rule with 3 and 5 points. 6,7

SECTION—D

7. Applying Euler's method and Runge-Kutta method, find the value of y when x = 0.3. Given that :

$$\frac{dy}{dx} = x - y \text{ and } y(0) = -1.$$

   13

8. What is meant by approximation of a function by using Chebyshev's series ? Use this method to approximate the series expansion of sin(x) up to three digits accuracy.

   13

SECTION—E

(Compulsory Question)

9. (a) Differentiate between 1's complement representation and 2's complement representation of numbers by taking examples.

   (b) Find order of convergence of False-Position method.

   (c) Differentiate between divided and backward difference table with examples.

   (d) Explain what is a predictor-corrector method. Explain what it means for a predictor-corrector method to be stable. Discuss the stability and convergence of predictor-corrector methods. 3×3,4