BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2021

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) *Question no.* ***1*** *is* ***compulsory.*** *Attempt any* ***three*** *questions from question nos. 2 to 5.*

(ii) *Any calculator is allowed during examination.*

1. (a) Assuming a four decimal digit mantissa, two digit exponent and one digit each for sign of mantissa and exponent, perform the following arithmetic operations, indicate overflow, if any. Use chopping, if required. The result should be in normalised form. *6*

(i) Add $0{\cdot}7265 \times 10^{-2}$ and $0{\cdot}7105 \times 10^{1}$

(ii) Subtract $0{\cdot}2516 \times 10^{+2}$ from $0{\cdot}1001 \times 10^{3}$

(iii) Multiply $0{\cdot}5125 \times 10^{50}$ and $0{\cdot}1251 \times 10^{52}$

(b) Solve the following system of equations using Gauss-Jacobi iteration method : *5*

$$5x + 2y = 19$$

$$3x + 5y = 19$$

Take initial estimate as $x_0 = 1$ and $y_0 = 1$. Perform only two iterations.

(c) Write the Newton-Raphson iterative scheme for finding the square root of a positive number n. *4*

(d) Write the name and formula of the following operators : *3*

(i) E

(ii) ∇

(iii) δ

(e) Find the Newton's forward difference interpolating polynomial for the data given below :

x	1	2	3	4	5	6
y = f(x)	1	12	33	64	105	156

Hence, calculate the value of f(x) at x = 1·5. *6*

(f) Construct the Newton's divided difference table for the following data : *4*

x	2	3	5	6
f(x)	5	10	26	37

(g) Using Simpson's $\frac{1}{3}$rd rule, find the approximate value of $I = \int_0^2 \frac{dx}{1+x}$, dividing the interval into four equal sub-intervals. *7*

(h) Define the order and degree of a differential equation. What is the order and degree of the following differential equation ? *3*

$$2\left(\frac{d^4y}{dx^4}\right)^5 + \left(\frac{dy}{dx}\right)^7 + 3x^2\left(\frac{d^2y}{dx^2}\right)^3$$

(i) Write the Newton's backward difference formula for evaluating $\frac{dy}{dx}$. *2*

2. (a) Solve the following equations using Gaussian elimination method with row interchange/pivotal condensation method : *8*

$$y + z = 1$$
$$2x + 3y + 4z = 4$$
$$4x + 2y - 3z = 11$$

(b) Find the first positive root of the equation $x^3 + x^2 - 10 = 0$ by Regula-Falsi method. Show two iterations. *7*

(c) Find the Taylor/Maclaurin series for $f(x) = e^x$ around $x = 0$. *5*

3. (a) Represent the following operators in terms of E : *3*

(i) Δ

(ii) ∇

(iii) δ

(b) Find the missing term (?) in the following data, where f(x) is a polynomial of degree 3 :

x	1	2	3	4	5
f(x)	– 3	10	?	78	145

Also find the interpolating polynomial using backward difference. *10*

(c) Find the interpolating polynomial that fits the data

x	1	2	5
f(x)	4	7	28

using Lagrange's interpolating polynomial method. *7*

4. (a) Given the following values of x and f(x) for $x = 1(0{\cdot}5)^3$:

x	1	1·5	2	2·5	3
y = f(x)	2	4·875	10	18·125	30

Find y′ and y″ at x = 1·25 using FD formula. *10*

(b) Use the Euler's method to find the solution of the differential equation

$$y' = t^4 + y^3 \text{ given that } y(0) = 1.$$

Find the solution of the above in the interval [0, 0·9] with h = 0·3. *10*

5. (a) Explain the formula for Trapezoidal rule with the help of a diagram. Also find the approximate value of

$$I = \int_0^1 \frac{dx}{1+x} \text{ using Trapezoidal rule}$$

with only one interval. *5*

(b) What is an Inverse Interpolation ? Explain with the help of an example. *4*

(c) Explain, whether in arithmetic, with 4 significant digits, the problem of solving the following system of linear equations

$$(2{\cdot}0000)x + (0{\cdot}6667)\, y = 2{\cdot}0000$$

$$(1{\cdot}0000)x + (0{\cdot}3333)y = 1{\cdot}0000$$

is ill-conditioned or not. *5*

(d) Compare and contrast the following methods : *6*

(i) Gauss elimination method and Gauss-Seidel Iterative method

(ii) Bisection method and Regula-Falsi method