No. of Printed Pages : 6 **BCS-054**

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

December, 2022

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : (*i*) *Any calculator is allowed during examination.*

(*ii*) *Question No. **1** is **compulsory**. Attempt any **three** more from the next four questions.*

1. (a) Solve the following system of equations using Gauss Elimination method : 6

$$2x_1 + 8x_2 + 2x_3 = 14$$

$$x_1 + 6x_2 - x_3 = 13$$

$$2x_1 - x_2 + 2x_3 = 5$$

(b) Solve the following system of equations by using Gauss-Seidel iteration method (perform two iterations) : 6

$$8x - 3y + 2z = 20$$

$$6x + 3y + 12z = 35$$

$$4x + 11y - z = 33$$

(c) Determine the value of $\sqrt{12}$ by Newton-Raphson method (perform 3 iterations), taking $x_0 = 3.5$, as initial estimate. 6

(d) Verify the relation $(1 + \Delta)(1 - \nabla) = 1$, where Δ and ∇ are forward and backward differencing operators, respectively. 6

(e) Write Bessel's formula of numerical differentiation. Briefly discuss its application with suitable example. 6

(f) Using the Lagrange's interpolation method, find the interpolating polynomial that fits the data given below : 5

x_k	f_k
0	2
1	3
2	12
5	147

(g) Write Simpson's $\frac{1}{3}$ rule and use it to compute the integral of the function $f(x)$, the respective values of x and $f(x)$ are tabulated below : 5

x	$f(x)$
0	1
0.1	1.01
0.2	1.04
0.3	1.09
0.4	1.16
0.5	1.25
0.6	1.36
0.7	1.49
0.8	1.64
0.9	1.81
1.0	2.0

2. (a) Briefly discuss the terms accuracy, precision and significant digits with suitable example of each. 6

(b) Write formula for Gauss-Jacobi iterative method. Solve the following system of equations using Gauss-Jacobi method (perform three iterations) : 7

$$-4x_1 + x_2 + 10x_3 = 21$$
$$5x_1 - x_2 + x_3 = 14$$
$$2x_1 + 8x_2 - x_3 = -7$$

(c) Write formula for the Secant method. Use it to perform three iterations for finding roots of the equation $x^3 + 4x^2 - 10 = 0$ near $x = 0$ and $x = 1$ (compute upto two decimal places only). 7

3. (a) Verify the following : 6

(i) $\Delta^3 f(x) = 0$, when $f(x) = x^2$

(ii) $E^n f(x) = e^{x+nh}$, where $f(x) = x^2$

(x varies with constant increment of h)

(b) Find the Newton's forward difference interpolating polynomial which agrees with the following data : 7

x	$f(x)$
1	10
2	19
3	40
4	79
5	142
6	235

Also, obtain the values of $f(x)$ at $x = 1.5$.

(c) Find the Lagrange's interpolating polynomial for the following data : 7

x	$f(x)$
$\frac{1}{4}$	–1
$\frac{1}{3}$	2
1	7

4. (a) If $f(x) = \frac{1}{x}$, show that : 5

$$f(a, b, c) = \frac{+1}{abc}$$

using divided difference table for $x = \{a, b, c\}$.

(b) Evaluate the integral $I = \int_0^1 \frac{dx}{\sqrt{1 + x^2}}$ by Trapezoidal rule, divide the interval [0, 1] into 5 equal parts (compute upto 5 decimal places only). 5

(c) Use Euler's method to find the solution of the IVP given below : 10

$$y' = -2ty^2, \; y(0) = 1$$

take the interval [0, 1] with step size $h = 0.2$.

5. (a) Using Runge-Kutta method of order 4, approximate y, when $x = 0.1$ and $x = 0.2$, given that $x = 0$ when $y = 1$ and $\frac{dy}{dx} = x + y$. (Take $h = 0.1$). 10

(b) Differentiate between the following : 10

(i) Euler's method and modified/improved Euler's method

(ii) Runge-Kutta method (order 2) and Runge-Kutta method (order 4)

Give advantage and disadvantage of each.