Course Code	**:**	**BCS-054**
Course Title	**:**	**Computer Oriented Numerical Techniques**
Assignment Number	**:**	**BCA(V)/054/Assignment/2024-25**
Maximum Marks	**:**	**100**
Weightage	**:**	**25%**
Last Dates for Submission	**:**	**31st October,2024(For July, Session)** **30th April, 2025(For January, Session)**

This assignment has seven questions of total 80 marks. Answer all the questions. 20 marks are for viva voce. You may use illustrations and diagrams to enhance explanations. Please go through the guidelines regarding assignments given in the Programme Guide for the format of presentation. Illustrations/ examples, where-ever required, should be different from those given in the course material. Use of simple calculator is allowed.

Question 1.

(a) Explain each of the following concepts, along with at least one suitable example for each: **(6 Marks)**
(i) Fixed-point number representation (ii) round-off error (iii) representation of zero as floating point number (iv) significant digits in a decimal number representation (v) normalized representation of a floating point number (vi) overflow

(b) Explain with suitable example that in computer arithmatics (i.e., numbers represented in computer, with +, −, *, / as implemented in a computer) the multiplication operation(*) may not be distributive over plus (+), i.e. $(a*(b+c))=((a*b)+(a*c))$ may not be true for some computer numbers a, b and c **(2 Marks)**

(c) Find out to how many decimal places the value 22/ 7 is accurate as an approximation of 3.14159265, where the latter is value of π, calculated up to 8 places after decimal ? **(6 Marks)**

(d) Calculate a bound for the truncation error in approximating f(x) = sin x by **(3 Marks)**

$$\sin(x) = x - x^3/(\text{fact } 3) + x^5/(\text{fact } 5),$$

where $-1 =< x =< 1$ and (fact n) denotes factorial of n

(e) Obtain Approximate the value of $(3.7)^{-1}$, using first three terms of Taylor's series expansion. **(3 Marks)**

Question 2.

(a) Solve the system of equations **(4 Marks)**

$$4x_1 + x_2 + 2X_3 = 16$$
$$2x_1 + 5x_2 + 3x_3 = 19$$
$$3x_1 + 2x_2 - x_3 = 12$$

using Gauss elimination method with partial pivoting.

(b) Perform four iterations (rounded to four decimal places) using **(8 Marks)**
(i) Jacobi Method and
(ii) Gauss-Seidel method ,
for the following system of equations.

$$\begin{bmatrix} 5 & -5 & -1 \\ 1 & -4 & 1 \\ -2 & 1 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -8 \\ -4 \\ -18 \end{bmatrix}$$

With $\mathbf{x}^{(0)} = (0, 0, 0)^T$. The exact solution is $(1, 2, 3)^T$.

Which method gives better approximation to the exact solution?

Question 3.

(a) Determine the smallest roots of the following equation: **(8 Marks)**

$f(x) = x^2 \cos(x) + \sin(x) = 0$

to three significant digits using

(i) Regula-falsi method (ii) Newton Raphson method (iii) Bisection method (iv) Secant method

Question 4.

(a) Explain what is the role of interpolation in solving numerical problems? **(2 Marks)**

(b) Express $\Delta^3 f_1$ as a backward difference. **(2 Marks)**

(c) Express $\Delta^3 f_1$ as a central difference. **(2 Marks)**

(d) For the following data develop difference table and find forward differences and backward differences **(4 Marks)**

I	x_i	y_i
0	–1	16.8575
1	0	24.0625
2	1	16.5650
3	2	–13.9375
4	3	28.5625
5	4	**144.0625**

Question 5.

(a) By decinnial census, the population of a town was given below. **(10 Marks)**

Year (x) :	1971	1981	1991	2001	2011
Population (y):	**112**	132	**158**	**189**	**226** (in thousands)

(i) Using Stirling's central difference formula, estimate the population for the year 2006

(ii) Using Newton's forward formula, estimate the population for the year 1992.

Using Newton's backward formula, estimate the population for the year 1980.

(b) If values of the function f: x → y are given as f(1) = –32, f(4) = 08, f(5) = 52, $f(7) = 167$, **(5 Marks)**

find the Lagrange's interpolation polynomial of f(x). Also, find f(3)

Question 6.

(a) Find the values of the first and second derivatives of f(x) at x = 76 from the following table. Use $0(h^2)$ forward difference method. Also, find Truncation Error (TE) and actual errors. **(5 Marks)**

x	:	76	81	86	91
f(x)	:	5.3147	5.4346	5.5637	5.6629

Question 7.

(a) Compute the value of the integral **(10 Marks)**

$$\int_{8.4}^{10.4} (5x + 4x^2 + 3)\, dx$$ by using

Rectangular Rule (ii) Trapezoidal Rule and then (iii) Simpson's 1/3 Rule