Course Code	**:**	**BCS-054**
Course Title	**:**	**Computer Oriented Numerical Techniques**
Assignment Number	**:**	**BCA(V)/054/Assignment/2026-27**
Maximum Marks	**:**	**100**
Weightage	**:**	**25%**
Last Dates for Submission	**:**	**31st October, 2026 (For July 2026 Session)**
	:	**30th April, 2027 (For January 2027 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.

Q1:

(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)**

Q2:

(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.

$$\begin{bmatrix} 5 & -5 & -1 \\ 1 & -4 & 1 \\ -2 & 1 & 6 \end{bmatrix} \quad \begin{bmatrix} x1 \\ y2 \\ z3 \end{bmatrix} = \begin{bmatrix} -8 \\ -4 \\ -18 \end{bmatrix}$$

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?

Q3:

(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

Q4:

(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	$\mathbf{x_i}$	$\mathbf{y_i}$	
0	–1	16.8575	
1	0	24.0625	
2	1	16.5650	
3	2	–13.9375	
4	3	28.5625	
5	4	**144.0625**	

Q5:

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

Year (x) : 1917 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, $f(7) = 167$, find the Lagrange's interpolation polynomial of f(x). Also, find f(3). **(5 Marks)**

Q6:

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 **(5 Marks)**

x :	76	81	86	91

Q7:

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

Q1:

(a) Explain each of the following concepts, along with at least one suitable example for each:
(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 (6 Marks)

Answer

(i) Fixed-point number representation. In fixed-point representation, a fixed number of digit positions is reserved for the integer part and another fixed number for the fractional part. The radix point is therefore understood to remain at one position. It is simple and fast, but its range is limited. For example, if two decimal places are fixed, the stored integer 12345 represents 123.45. In binary, a Q-format such as Q8.8 similarly reserves eight fractional bits.

(ii) Round-off error. A computer usually stores only a limited number of digits. When a number has more digits than can be stored, it is rounded to the nearest representable value. The difference introduced by this rounding is the round-off error. For example, if only four decimal digits are retained, 2.7182818 may be stored as 2.718. The error is about -0.0002818. Repeated arithmetic can accumulate such small errors.

(iii) Representation of zero as floating point number. In a normalized floating-point system, non-zero numbers are represented by a sign, significand and exponent. Zero is a special case because it cannot be normalized with a non-zero leading significand. In IEEE-style representation, zero is encoded with exponent and fraction fields equal to zero; the sign bit may give +0 or -0. Thus +0 and -0 compare numerically equal although the sign bit may differ.

(iv) Significant digits in a decimal number representation. Significant digits are the digits that carry information about the precision of a measured or computed number. Leading zeros are not significant, while zeros between non-zero digits and trailing zeros after a decimal point may be significant. For example, 0.004560 has four significant digits: 4, 5, 6 and the final 0. The number indicates precision to the millionth place.

(v) Normalized representation of a floating point number. A floating-point number is normalized when its significand is adjusted so that the first digit is non-zero, while the exponent is changed to preserve the value. In decimal scientific notation, 0.000728 is written as 7.28×10^{-4}. Normalization gives a unique standard form for non-zero values and allows the available significant