Numerical Methods and Data Structures
(EE–405)

Time: 3 hours

Use separate answer script for each half.

Full Marks: 70

Answer SIX questions, taking THREE from each half.

Two marks are reserved for neatness in each half.

FIRST HALF

1.(a) (i) Develop the algorithm for Newton-Raphson method for the solution of transcendental equations. (ii) Discuss the convergence characteristic of this method.

(b) Find one positive root of $f(x) = 2e^{-x} - \sin x = 0$ in the interval $[0, 1]$ using Newton-Raphson method. Assume $|f(x)| \leq 0.0001$. ((3+3)+5)

2.(a) (i) Distinguish between direct method and indirect method of solution of linear algebraic equations. (ii) Name at least one of each of them.

(b) Solve the following equations using Gauss-Jordan method. Show all the intermediate steps.

$$x_1 \ - 3x_2 \ + 12x_3 = \quad 10$$
$$5x_1 \ - 12x_2 \ + 2x_3 = \ -33$$
$$x_1 \ - 14x_2 \qquad\quad = \ -103$$

((2+2)+7)

3. Apply Gauss-Seidel method to solve the following equations using relaxation technique. Take $\lambda = 0.90$ and assume $c_0 \leq 0.05$ and $x_1^{(0)} = x_2^{(0)} = x_3^{(0)} = 0.0$.

$$4x_1 \ - x_2 \ - x_3 = -2$$
$$6x_1 \ + 8x_2 \qquad\quad = \ 44$$
$$-6x_1 \qquad\quad + 12x_3 = \ 60$$

(11)

4.(a) (i) What is the basic difference between polynomial interpolation and least squares regression? (ii) How could you fit a sinusoidal function to a set of given data points using least squares technique?

(b) Fit a parabola to the following data points using least squares technique. Hence compute $f(3.5)$.

$f(x)$	2.1	7.7	13.6	27.2	40.9	61.1
x	0	1	2	3	4	5

((2+5)+4)

5. Write notes on the following: (7+4)

(a) Newton's interpolating polynomial of degree n

(b) Fourth order Runge-Kutta method

Answer question no. 6 and any two from the rest

6. Fill-up the blanks with appropriate words or sentence.

      (a) `vi' is an _____ .
      (b) ?: Operator is used to compute _____ in C.
      (c) UNIX commands are case _____.
      (d) A valid C variable name must start with _____ .
      (e) A valid C statement should end with a _____ .
      (f) Underflow and overflow can occur in case of _____ .
      (g) Queues is a _____ system.
      (h) Recursive call is _____ in C.
      (i) #define PI 22/7 is called _____ in C.
      (j) Name of modes of 'vi' editor are _____ .
      (k) In case of an array, the lower bound of the subscript is _____ .

$$(1 \times 11 = 11)$$

7. (a) Discuss about binary searching, its merits and demerits.
   (b) Write a linear search function in C with appropriate comments.   (6+5=11)

8. (a) What is a linked list? Discuss about the various kinds of linked list.
   (b) Develop an application of linked-list in C.   (5+6=11)

9. (a) Write a brief note on 'Complex Number' in C.
   (b) What is stack? Explain it's features and operations.   (5+6=11)

10. Write short notes on any two of the following topics.
   (a) Iterative and recursive methods
   (b) Numerical Integration

   (c) Dynamic array $(5\frac{1}{2} \times 2 = 11)$