

**2026**

**COMPUTER SCIENCE — HONOURS**

**Paper : DSCC-5**

**(Computational Mathematics)**

**Full Marks : 75**

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer **question no. 1** and **any three** from **Section - A** and **any five** from **Section - B**.

1. Answer **any five** questions : 2×5
- (a) Can absolute error be negative — why?
  - (b) What is path in a graph?
  - (c) Define power set. What is the cardinality of the power set of a set having 5 elements?
  - (d) Define small o-notation.
  - (e) Write down the formula of Newton-Raphson method.
  - (f) When is a relation said to be an equivalence relation?
  - (g) When are two graphs said to be isomorphic?
  - (h) Can a graph have degree sum to be odd — why?

**Section - A**

2. Let  $R$  be a relation defined on the set  $A = \{\text{set of all integers}\}$  such that for any  $a, b, \in A$ ,  $(a, b) \in R \Leftrightarrow a \leq b$ . Show that  $R$  is a partial order relation. 5
3. (a) What is a sample space?  
(b) Write the sample space when a coin is tossed twice.  
(c) A coin is tossed three times. Find the probability of getting exactly one head. 1+1+3
4. (a) Define initial condition. Why is it required?  
(b) Find the solution of the recurrence relation given below — (1+1)+3
- $$a_n - 6a_{n-1} + 9a_{n-2} = 0, a_0 = 1, a_1 = 6$$

**Please Turn Over**

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5. (a) State the Pigeonhole principle.  
 (b) How many numbers must be selected from the set  $[1, 2, 3, 4, 5, 6]$  to guarantee that at least one pair of these numbers add upto 7? 2+3
6. Prove that a simple graph with  $n$  vertices and  $k$  connected components can have at most  $(n - k)(n - k + 1)/2$  edges. 5

### Section - B

7. (a) Write an algorithm for finding a root of the equation  $f(x) = 0$  using Bisection method.  
 (b) Use this Method to find  $\sqrt{41}$  correct to three decimal places.  
 (c) What is the drawback of the Bisection method? 4+4+2
8. (a) Given the following table of values :
- |        |        |        |        |        |
|--------|--------|--------|--------|--------|
| $x$    | 0.4    | 0.6    | 0.7    | 0.85   |
| $f(x)$ | -0.924 | -0.685 | -0.389 | -0.246 |
- Estimate the value of  $f(0.65)$  using Lagrange Interpolation.
- (b) Determine the roots of the equation  $e^{-x} - x = 0$  by Newton-Raphson method correct to four decimal places. 5+5
9. (a) Prove that the number of internal vertices in a binary tree is one less than the number of pendent vertices.  
 (b) What are the advantages of Gauss-Jordan method over Gaussian elimination?  
 (c) Find the number ( $m$ ) of ways that nine toys can be divided among four children, if the youngest child is to receive three toys and each of the others two toys each. 3+3+4
10. (a) State and prove the general form of Inclusion-Exclusion principle.  
 (b) In a class of 40 students, 25 study Mathematics, 15 study Computer Science and 5 study both. How many study at least one of the subjects?  
 (c) Differentiate between Graph and tree. 4+3+3
11. (a) Write down the composite expression for Simpson's  $\frac{1}{3}$ rd rule.

Use Simpson's  $\frac{1}{3}$ rd rule to evaluate  $\int_0^3 (x^3 + 2x) dx$  by taking six equal intervals.

- (b) Write an algorithm for fitting a straight line using least-square method for a given set of values. Assume that  $y$  is dependent on  $x$ . (2+4)+4

12. (a) Let  $X$  be a random variable with probability distribution

|          |     |     |     |     |
|----------|-----|-----|-----|-----|
| $x$      | 1   | 3   | 5   | 7   |
| $P(X=x)$ | 0.2 | 0.4 | 0.6 | 0.1 |

Find :  $E(X)$ ,  $\text{Var}(X)$  and the Standard deviation of  $X$ .

- (b) The probability that a machine produces a defective item is 0.1. In a sample of 10 items, find the probability that at most 2 items are defective using the Binomial distribution. (2+2+2)+4
13. (a) Define  $\Delta$ ,  $\nabla$  and  $E$ . Prove that  $\Delta \cdot \nabla = \Delta - \nabla$  and  $\Delta + 1 = E$ . The symbols have their usual meanings.
- (b) Solve the following system using Gauss-Seidel method—
- $$2x + y + 4z = 12$$
- $$8x - 4y + 2z = 25$$
- $$4x + 11y - z = 33$$
- (c) Compare the Gauss-Jacobi and Gauss-Seidel methods in terms of convergence and explain why one is faster than the other. 4+4+2
14. (a) Write an algorithm for finding the solution of differential equation by fourth order  $R - K$  method.
- (b) Prove that a connected graph  $G$  is an Euler graph if and only if it can be decomposed into circuits. 5+5