

2025

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) What is meant by a recurrence relation?
 - (b) Define absolute error and relative error with formula.
 - (c) What do you mean by Big-Theta notation?
 - (d) What is the condition for convergence of Gauss-Jacobi iteration method in solving a set of linear equations?
 - (e) Round off the following numbers correct up to 4 decimal places :
(i) 65.265342 (ii) 2.778645
 - (f) When is a relation said to be a Partial Ordering Relation?
 - (g) What are *Bernoulli trials*? Mention two conditions that define them.
 - (h) When is a graph said to be a planar graph?

Section - A

2. Define power set of a set S . What is the power set of the empty set? Determine whether the following function is a bijection from \mathbf{R} to \mathbf{R} :
 $f(x) = -3x + 4$. 1+1+3
3. Write down the usefulness of initial conditions for a sequence. Find the first six terms of the sequence defined by the following recurrence relation and initial conditions :
 $a_n = a_{n-1} + 3a_{n-2}, a_0 = 1, a_1 = 2$. 2+3
4. State and prove Bayes' Theorem. 1+4
5. What is a tree? Prove that a tree with n vertices has exactly $(n-1)$ edges. 1+4
6. Write an algorithm for solving an equation using Bisection method. 5

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Section - B

7. Give the formal definition of a function, its domain and range. Illustrate with proper examples a one-to-one and a onto function.

What is the Cartesian product of $A \times B \times C$, where $A = \{0, 1\}$, $B = \{1, 2\}$ and $C = \{0, 1, 2\}$?

Say there are 8 people namely P1, P2, ..., P8.

- (a) In how many ways can the people be lined up in a row?
 - (b) How many line-ups are there if P2, P6 and P8 want to stand together (in any order)?
 - (c) How many line-ups are there in which P2, P6 and P8 do not stand together? Give proper explanation. (2+1+1)+1+(1+2+2)
8. (a) A factory has three machines A, B and C. Machine A produces 30% of the total items, B produces 45% and C produces 25%. Out of the items produced by A, 2% are defective, by B, 3% are defective and by C, 4% are defective. If an item is selected at random and found to be defective, what is the probability that it was produced by machine B?
- (b) A discrete random variable X has the following probability distribution :

X	1	2	3	4	5
$P(X)$	0.1	0.3	0.4	0.2	0.5

- (i) Calculate the expected value (mean) of X .
 - (ii) Find the variance and standard deviation of X . 5+(2+3)
9. (a) Write down Newton's Forward Difference formula.
- (b) Given a table of values of the function, find the value of $f(1.58)$.

x	1.5	1.54	1.56	1.6	1.64	1.7
$f(x)$	3.87	3.92	3.95	4.01	4.03	4.2

4+6

10. Show that a simple graph is a tree if and only if it is connected, but the deletion of any of its edges produces a graph that is not connected. Define binary tree. Prove that the number of internal vertices in a binary tree is one less than the number of pendant vertices. 4+2+4
11. (a) Write an algorithm for finding the solution of differential equation by fourth order $R - K$ method.
- (b) Given the following table, find $f(x)$ assuming it to be a polynomial of degree three in x . Use Lagrange's Interpolation formula.

X	0	1	2	3
Y	1	3	13	32

5+5

12. (a) Solve the following system of linear equations using Gauss-Jordan elimination method :

$$2x + 3y + z = 9$$

$$x + 2y + 3z = 6$$

$$3x + y + 2z = 8.$$

- (b) What are the advantages of Gauss-Jordan method over Gaussian elimination? 7+3

13. (a) Find the positive root of the equation $x^3 - 2x - 5 = 0$ using Newton-Raphson method, correct to three decimal places. Take initial approximation $x_0 = 2$.

- (b) Compare the convergence rates of Bisection method and Newton-Raphson method. 7+3

14. (a) Use Gauss elimination method to solve the following system of linear equations :

$$x + y + z = 5$$

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

$$2x + 3y + 4z = 10.$$

- (b) State the generalized Pigeonhole principle.
- (c) How many cards must be selected from a standard deck of 52 cards to guarantee that at least two cards of the same suit are chosen? 5+2+3
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