



MANIPAL
ACADEMY of HIGHER EDUCATION
(Institution of Excellence Deemed to be University)

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Midterm Examination- September 2025

M. Tech. (CSE/CSIS) Semester-I
Computational Methods and Stochastic Processes (MAT 5128)

Date: 12 September 2025 Time: 02:15 PM - 03:45 PM Max. Marks: 30

NOTE: 1. Answer all questions.

2. Draw diagrams and write equations wherever necessary.

Marks

0.5
Marks

1. The singular values of the following matrix are

$$\begin{bmatrix} 3 & 0 \\ 0 & 4 \\ 0 & 0 \end{bmatrix}$$

- (a) $\sqrt{3}, \sqrt{4}, 0$ (b) $-3, -4$ (c) $\sqrt{3}, \sqrt{4}$ (d) $3, 4, 0$

0.5
Marks

2. The number of closed walks of length 2 in the following graph is:



- (a) 10 (b) 8 (c) 6 (d) 4

0.5
Marks

3. Consider the second-order partial differential equation

$$u_{xx} + 2u_{xy} + u_{yy} = 0.$$

Which of the following best describes this PDE?

- (a) parabolic (b) hyperbolic (c) elliptic (d) Poisson

0.5
Marks

4. Let G be a graph with 15 vertices and 11 edges. Then the number of connected components in G is at least:

- (a) 2 (b) 4 (c) 3 (d) 1

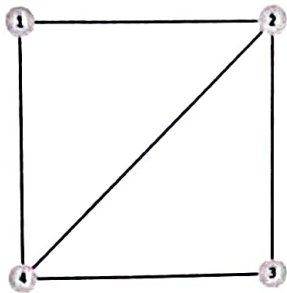
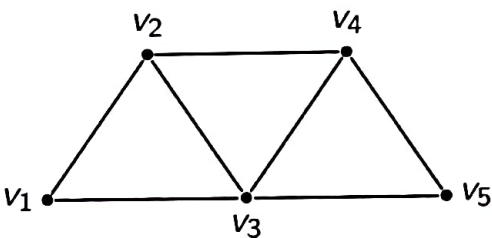
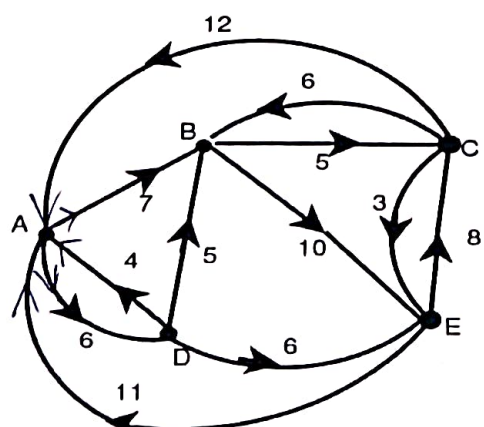
2
Marks

5. A cubic graph is a graph in which every vertex has degree 3. If a connected cubic graph has 15 edges, then prove that the number of vertices in the graph G is 10.

3
Marks

6. Find QR decomposition of the following matrix:

$$A = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}.$$

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|-----|---|---------|
| 7. | Using Kirchhoff's Matrix-Tree theorem, find the number of spanning trees in the following graph: | 3 Marks |
| |  | |
| 8. | Solve $y'' + xy = 1$, with boundary conditions $y(0) = 0$; $y'(1) = 1$ and step $h = 0.5$, using finite difference method. | 3 Marks |
| 9. | Show that if a graph G is a tree, then there exists a unique path between every pair of vertices. | 3 Marks |
| 10. | With step $h = 0.5$, solve $xy'' + y = 0$ with boundary conditions $y(1) = 1$; $y(2) = 2$ using finite difference method. | 3 Marks |
| 11. | Construct a maximal subgraph of the following graph with the property P : Subgraph has no cycles. | 3 Marks |
| |  | |
| 12. | Find the singular value decomposition of the following matrix | 4 Marks |
| | $A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ | |
| 13. | Using Dijkstra's algorithm, find the shortest paths from point B to all other vertices in the graph given below. | 4 Marks |
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