

TILAK MAHARASHTRA VIDYAPEETH, PUNE
BACHELOR OF SCIENCE
(DATA SCIENCE) (787)/
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING) (788)
EXAMINATION: JANUARY - 2026
SEMESTER - I

Sub: Applied Mathematics (78725 -104, 78825-104)

Date : 9/01/2026

Total Marks : 60

Time: 10.00am To 12.30pm

Instructions:

1. All questions are compulsory unless and otherwise stated.
2. Bold figures to the right of every question are the maximum marks for that question.
3. Candidates are advised to attempt questions in order.
4. Answers written illegibly are likely to be marked zero.
5. Use of scientific calculators, Log tables, Mollier Charts is allowed.
6. Draw neat and labelled diagrams wherever necessary.

Q.1. Solve the following. (Any 4)

(08)

1. Find the conjugate of the matrix

$$A = \begin{pmatrix} 1 - i & 2 + i \\ 3 & -i \end{pmatrix}$$

2. Find the minor of the element a_{22} of the matrix

$$A = \begin{pmatrix} 5 & 1 \\ 2 & 3 \end{pmatrix}$$

3. Draw the truth table for implication $p \rightarrow q$.
4. Write the negation of the statement: "Every natural number is positive."
5. Solve the Linear Programming Problem: Maximize $Z = 4x + y$ subject to $x + 2y \leq 6$, $x \geq 0$, $y \geq 0$.
6. Solve the system of equations
 $3x - y = 5$, $2x + y = 7$.

Q.2 Solve the following. (Any 3)

(09)

1. Verify De Morgan's Laws for the sets $A = \{a, b, c\}$ and $B = \{c, d\}$. Also find $A \cup B$ and $A \cap B$.
2. Determine whether the function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = x^3$ is injective and surjective.
3. Using the Pigeonhole Principle, show that among any 27 numbers, at least two have the same remainder when divided by 26.
4. Find the value of $\binom{10}{4}$

Q. 3 Solve any the following. (Any 2)**(08)**

1. Solve the recurrence relation $a_n = 2a_{n-1} + 1$, given $a_0 = 0$.
2. Define Real valued function. Find the distance between the points $(0, 0)$ and $(3, 4)$.
3. Find the Singular Value Decomposition of the matrix $A = \begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$

Q.4 Solve the following. (Any 3)**(15)**

1. Consider the connected graph G with vertex set $V = \{a, b, c, d, e, f\}$ and edge set $E = \{(a, b), (a, c), (b, c), (b, d), (c, e), (d, e), (d, f), (e, f)\}$. Find all paths joining a to f and determine the length of the shortest path.
2. Define Graph, Tree with suitable diagram. Define maximum eccentricity, minimum eccentricity, and the centre of the tree.
3. Determine whether the matrix $A = \begin{pmatrix} 4 & 1 \\ 0 & 2 \end{pmatrix}$ is diagonalizable.
4. Define a spanning tree. Find the edge connectivity of a graph having 5 vertices and 8 edges.

Q. 5. Solve the following. (Any 2)**(20)**

1. Find the eigenvalues and eigenvectors of the matrix $A = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$
2. Define and Verify the Cayley–Hamilton Theorem for the matrix $A = \begin{pmatrix} 1 & 2 & 0 \\ 0 & 1 & 3 \\ 0 & 0 & 2 \end{pmatrix}$
3. Evaluate $\iint_R (x + 2y) \, dx \, dy$ over the rectangular region $R = \{(x, y) : 0 \leq x \leq 1, x^2 \leq y \leq x\}$ using Fubini's Theorem.
