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M.Tech. Degree Examination, May/June 08
Linear Algebra

Time: 3 hrs.

Max. Marks: 100

Note : Answer any FIVE full questions.

- 1 a. Let
- F
- be a field of rational numbers, and

$$A = \begin{bmatrix} 2 & -1 & 3 & 2 \\ 1 & 4 & 0 & -1 \\ 2 & 6 & -1 & 5 \end{bmatrix}$$

Find the solution.

(06 Marks)

- b. Find the inverse of

$$A = \begin{bmatrix} 1 & \frac{1}{2} & \frac{1}{3} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \end{bmatrix}$$

(07 Marks)

- c. Solve the linear system,

$$x + 3y = 1$$

$$2x + y = 2$$

$$3x + 4y + z = 0$$

by using LU-decomposition method.

(07 Marks)

- 2 a. Prove that a subset
- W
- of a vector space
- $V(F)$
- is a subspace of
- V
- iff

$$a, b \in F, \alpha, \beta \in V \Rightarrow a\alpha + b\beta \in W$$

(06 Marks)

- b. Prove that the set of vectors
- $\{(1, 0, 0), (0, 1, 0), (0, 0, 1)\}$
- is a basis for a three dimensional vector space
- $V_3(R)$
- .

(07 Marks)

- c. Let
- $V(F)$
- be a finite dimensional vector space and
- U_1
- and
- U_2
- be the two subspaces of
- $V(F)$
- . If
- $V(F)$
- is a direct sum of
- U_1
- and
- U_2
- , then prove that
- $\dim V = \dim U_1 + \dim U_2$
- .

(07 Marks)

- 3 a. Let
- V
- and
- W
- be vector spaces over the field
- F
- and let
- T
- be a linear transformation from
- V
- into
- W
- . Suppose that
- V
- is a finite dimensional then prove that

$$\text{rank}(T) + \text{nullity}(T) = \dim V$$

(06 Marks)

- b. Let
- V
- and
- W
- be vector spaces over the field
- F
- . Let
- T
- and
- U
- be linear transformations from
- V
- into
- W
- . Prove that the function
- $(T+U)$
- defined by

$$(T+U)(\alpha) = T\alpha + U\alpha$$

(07 Marks)

- c. Show that the mapping
- $F: R^2 \rightarrow R$
- defined by
- $F(x, y) = xy$
- is not linear.

(07 Marks)

- 4 a. Let
- V
- and
- W
- be vector spaces over the field
- F
- and let
- T
- be a linear transformation from
- V
- into
- W
- . If
- T
- is invertible then prove that the inverse function
- T^{-1}
- is a linear transformation from
- W
- into
- V
- .

(06 Marks)

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Table of Contents Mtech Question Papers Of Vtu

1. Understanding the eBook Mtech Question Papers Of Vtu
 - The Rise of Digital Reading Mtech Question Papers Of Vtu
 - Advantages of eBooks Over Traditional Books
2. Identifying Mtech Question Papers Of Vtu
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Mtech Question Papers Of Vtu
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mtech Question Papers Of Vtu
 - Personalized Recommendations
 - Mtech Question Papers Of Vtu User Reviews and Ratings
 - Mtech Question Papers Of Vtu and Bestseller Lists
5. Accessing Mtech Question Papers Of Vtu Free and Paid eBooks

- Mtech Question Papers Of Vtu Public Domain eBooks
 - Mtech Question Papers Of Vtu eBook Subscription Services
 - Mtech Question Papers Of Vtu Budget-Friendly Options
6. Navigating Mtech Question Papers Of Vtu eBook Formats
 - ePub, PDF, MOBI, and More
 - Mtech Question Papers Of Vtu Compatibility with Devices
 - Mtech Question Papers Of Vtu Enhanced eBook Features
 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mtech Question Papers Of Vtu
 - Highlighting and Note-Taking Mtech Question Papers Of Vtu
 - Interactive Elements Mtech Question Papers Of Vtu
 8. Staying Engaged with Mtech Question Papers Of Vtu
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mtech Question Papers Of Vtu
 9. Balancing eBooks and Physical Books Mtech Question Papers Of Vtu
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mtech Question Papers Of Vtu
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Mtech Question Papers Of Vtu
 - Setting Reading Goals Mtech Question Papers Of Vtu
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Mtech Question Papers Of Vtu
 - Fact-Checking eBook Content of Mtech Question Papers Of Vtu
 - Distinguishing Credible Sources
 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development

- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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