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Reg. No. :

Name :

First Semester M.Tech. Degree Examination, March 2013
(2008 Scheme)
(Electronics & Communication Engineering)
TTM 1001 : LINEAR ALGEBRA FOR COMMUNICATION

Time : 3 Hours

Max. Marks : 100

Answer any five questions.

- I. a) Check that vectors $(1, 1, 1)$, $(-i, 1-i, 0)$, and $(0, i, -1)$ are linearly independent over \mathbb{C} .
- b) Find the change of basis matrix from $\{(1, 0, 0), (0, 1, 0), (0, 0, 1)\}$ to $\{\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}}, (0, 1, 0), (0, 0, i)\}$.
- II. a) Define the four fundamental subspaces of a linear transformation.
- b) Let $R_1 = \{(1, 1, 0), (2, 0, 1), (3, 2, 0)\}$ be a basis of \mathbb{R}^3 and $S_1 = \{(1, 2), (2, 5)\}$ be a basis of \mathbb{R}^2 . Define $T = \mathbb{R}^3 \rightarrow \mathbb{R}^2$ by $T \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x + y + z \\ 2x - y + 3z \end{bmatrix}$. Find the matrix representation of T .
- III. a) Define an inner product.
- b) Discuss the solution of the system and find the solution if it exists, for
- $$\begin{aligned} x + y - 2z &= 1 \\ 2x + y - z &= 2 \\ 3x + 2y - z &= 3 \\ 4x + 2y - 2z &= 4 \end{aligned}$$



- IV. a) Prove the Rank-Nullity Theorem.
b) Show that the Null space of a linear transformation is a subspace.
- V. a) Represent convolution as a matrix operation.
b) Show that the following matrix is unitary;

$$A = \begin{bmatrix} \frac{1}{2} & \frac{1+i}{2} & -\frac{1}{2} \\ -\frac{i}{\sqrt{3}} & \frac{i}{\sqrt{3}} & \frac{1}{\sqrt{3}} \\ \frac{5i}{2\sqrt{15}} & \frac{3+i}{2\sqrt{15}} & \frac{4+3i}{2\sqrt{15}} \end{bmatrix}$$

- VI. a) Determine the QR factorisation of the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.
b) Define SVD and give two applications of SVD.
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