



Reg. No. :

Name :

First Semester M.Tech. Degree Examination, February 2015
(2013 Scheme)

Electronics and Communication

Stream : Signal Processing

TSM 1001 : LINEAR ALGEBRA FOR SIGNAL PROCESSING

Time : 3 Hours

Max. Marks : 60

Instruction : Answer **any two** questions from **each** module. **10** marks for **each** question.

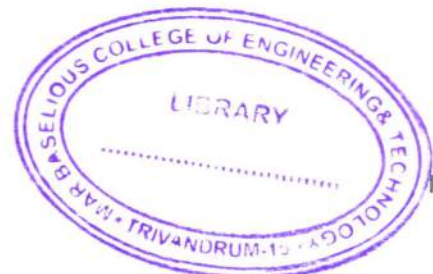
Module – 1

- a) What are the axioms defining a ring ? Give an example.
b) If R is a ring and has a unit element 1 show that $(-1)(-1) = 1$.
- Define basis and dimension for a vector space. If V be a vector space of 2×2 matrices over R , determine whether $A, B, C \in V$ are linearly dependant or not.
 $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$.
- a) Define inner product space. If V be a vector space and $u, v, \in V$ then prove the triangular inequality $\|u + v\| \leq \|u\| + \|v\|$.
b) If W be a vector space of 2×2 symmetric matrices over R , what is the dimension of W . Also find a basis for W . **(10x2=20 Marks)**

Module – 2

- a) If $CD = -DC$ and λ is an Eigen value of C show that $C(Dx) = -\lambda(Dx)$.
b) A linear operator T is defined by $T(x, y, z) = (2y + z, x - 4y, 3x)$. Find the

matrix T in the basis $\left\{ \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \right\}$.



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5. a) If the non-zero vectors v_1, v_2, \dots, v_k are mutually orthogonal show that they are linearly independent.
- b) What is Cayley-Hamilton theorem? Prove Cayley-Hamilton theorem for the square matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$.
6. a) What is minimum polynomial of a linear operator? Find the minimum polynomial of the transformation matrix $A = \begin{bmatrix} 5 & -6 & -6 \\ -1 & 4 & 2 \\ 3 & -6 & -4 \end{bmatrix}$. (10×2=20 Marks)

Module – 3

7. Define unitary transformation. Give an example for a unitary matrix. State and prove any two properties of a unitary matrix.
8. a) If λ is an Eigen value of the invertible operator T show that λ^{-1} is an Eigen value of T^{-1} .
- b) What is Eigen vector of a linear operator, T . Express the following transformation matrix in Eigen vector basis $A = \begin{bmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{bmatrix}$.
9. a) Write short notes on Jordan canonical form.
- b) Translation invariant linear transformation. (10×2=20 Marks)
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