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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: ELECTRONICS and COMMUNICATION

Stream(s):

1) SIGNAL PROCESSING

2) TELECOMMUNICATION ENGINEERING

Course Code & Name: 01EC6301 APPLIED LINEAR ALGEBRA

Answer *any two full* questions from *each* part
Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

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PART A

1.	a.	Define a Field, Give an example for a finite Field	3
	b.	Show that the set $L_p = \{ (a_1,a_2, \ldots), a_i \in \mathbf{R}, \Sigma\ \lvert a_i \rvert^p < \infty \}$ is a vector space.	3
	c.	Let V be a vector space and U and W are subspaces of V. Define the sum of subspaces U+W. When will be the sum U+W is direct sum ? Express $\mathbf{R}^3$as direct sum of subspaces of $\mathbf{R}^3$.	3
2.	a.	Find t such that the following vectors are linearly independent. $\{ [\cos(t), \sin(t)]^T, [-\sin(t), \cos(t)]^T \}$	3
	b.	Prove that all bases in a finite dimensional vector space have the same number of vectors.	3
	c.	Solve the following linear system of equations using Gauss elimination $x+3y-4z = 11, 3x-2y+z = -2, x+y-2z = 1$	3
3.	a.	Show that the subset W of $\mathbf{R}^3$ given by $W = \{[x_1, x_2, x_3]$ such that $x_1+x_2+x_3=0\}$ is a subspace of $\mathbf{R}^3$. Find a basis of W.	5
	b.	Let **V** be an n-dimensional vector space and $R = \{v_1,v_2,v_3, \ldots, v_n\}$ is a basis of **V**. Show that every vector in **V** can be expressed uniquely as a linear combination of the basis vectors in R.	4

PART B

4.	a.	Let $T : \mathbf{R}^3$ to $\mathbf{R}^2$ is a linear transform defined by $T(x,y,z) = (x+z, y+z)$. Find dimension of range of T and dimension of null space of T. Verify Rank-Nullity theorem.	5
	b.	Let $R = \{(1, 1, -1), (2,0,1), (0, 2, -1) \}$ and $S = \{(1, -1, 2), (1,0,1), (0, 2, 3) \}$ be bases of $\mathbf{R}^3$.Find R to S change of basis matrix.	4

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5. a. State the properties of inner product for a vector space over C 2
b. Find the L_1 norm and L_2 norm of the vector x =(1+2j, 2-3j, 1-j) 3
c. State and prove Triangular inequality. 4

6. a. Let x = (1, 2, 1, 2) and y = (2, -3, 0, 2). Resolve the vector y into two orthogonal components in which one is along with x. 2
b. Define orthogonal subspaces of a vector space. What are the important orthogonal subspaces associated with an mxn matrix A ? 3
c. Find the matrix representing the linear transform T : $\mathbf{R}^3$ to $\mathbf{R}^3$ defined by T(xyz) = (x-y, y-z, z-x) with respect to the basis B = { (1,1,0), (0,1,1) , (1,0,1) } 4

PART C

7. a. Determine the geometric multiplicity and algebraic multiplicity of the eigenvalues of the matrix = $\begin{bmatrix} 3 & 2 & 0 \\ 0 & 1 & 3 \\ -4 & -4 & -5 \end{bmatrix}$. 6
b. Give Examples for the following 6
   1. Hermitian Matrix
   2. Unitary Matrix
   3. Orthogonal Matrix
   4. Normal Matrix

8. a. State Spectral Theorem 2
b. Define positive definite matrix 2
c. Let **V** be an n-dimensional vector space over **C** and T : **V** to **V** a linear transform with distinct eigenvalues $\{\lambda_1, \lambda_2, \ldots, \lambda_k\}$. Prove that the sum of geometric multiplicities of the eigenvalues is utmost n. 8

9. a. Find the pseudo inverse of the matrix A = $\begin{bmatrix} 1 & 2 \\ 2 & 0 \\ 0 & 2 \end{bmatrix}$ 8
b. Prove that eigenvectors corresponding to the distinct eigenvalues of a matrix are linearly independent. 4

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