Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL 2018
SUBJECT: LINEAR ALGEBRA FOR SIGNAL PROCESSING (ECE - 4008)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Kirchoff's loop equations for a resistive network is given below. Find loop currents using LU decomposition:

$$I_1 + 2I_2 - 2I_3 = 9$$
$$2I_1 + 5I_2 + I_3 = 9$$
$$I_1 + 3I_2 + 4I_3 = -2$$

1B. Calculate the inverse of the given matrix using Gauss Jordan method: $\begin{bmatrix} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{bmatrix}$

1C. Using REF justify whether or not given matrix is invertible: $\begin{bmatrix} 0 & 3 & -5 \\ 1 & 0 & 2 \\ -4 & -9 & 7 \end{bmatrix}$

(5+3+2)

2A. Write down eight rules that are required to satisfy addition and scalar multiplication of elements of a linear vector space. Show that if $V_1, V_2, \ldots, V_n$ are elements of a vector space V, then span$(V_1, V_2, \ldots, V_n)$ is a subspace of V.

2B. Determine a spanning set of null space, column space, row space and rank of the matrix

$$A = \begin{bmatrix} -3 & 6 & -1 & 1 & -7 \\ 1 & -2 & 2 & 3 & -1 \\ 2 & -4 & 5 & 8 & -4 \end{bmatrix}$$

2C. Find the pseudoinverse of a matrix $A = \begin{bmatrix} 3 & 2 & 2 \\ 2 & 3 & -2 \end{bmatrix}$

(5+3+2)

3A. Diagonalize the following matrix: $D = \begin{bmatrix} 2 & 2 & -1 \\ 1 & 3 & -1 \\ -1 & -2 & 2 \end{bmatrix}$

3B. Find the eigenvalues and eigenvectors of a matrix A that satisfies the following relations:

i) $A\begin{bmatrix} -0.6535 \\ 0.7569 \end{bmatrix} = \begin{bmatrix} 0.8604 \\ -0.9966 \end{bmatrix}$ and ii) $A\begin{bmatrix} -0.4204 \\ -0.9073 \end{bmatrix} = \begin{bmatrix} -2.2351 \\ -4.8240 \end{bmatrix}$

3C. If A is a Hermitian matrix, show that its eigenvalues are real and that the eigenvectors of distinct eigenvalues of A are orthogonal.

(5+3+2)

4A. Write down the procedure for QR factorization. Determine QR factorization of

$$\begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

4B. Develop a filter using the Schwarz's inequality to detect signals immersed in AWGN.

4C. Define the generalized Fourier series.

(5+3+2)

5A. Perform a singular value decomposition on the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 3 & 2 \end{bmatrix}$

5B. Convolve the following matrices $f(n, m) = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$ and $h(n, m) = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$

5C. Find four point IDFT of signal $X(k) = [\,10, -2 + j2, -2,\ -2 - j2]^T$ using Twidle factor matrix.

(5+3+2)