Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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SIXTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: LINEAR ALGEBRA FOR SIGNAL PROCESSING (ECE - 336)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Explain the process of frequency estimation using signal subspace decomposition. A received signal is known to be composed of a sinusoidal signal immersed in white noise. The autocorrelation matrix is estimated to be $\begin{bmatrix} 5 & 3-j5 \\ 3+j5 & 5 \end{bmatrix}$. Estimate the frequency of signal. Also find the noise variance.

1B. With the help of an example, explain the use of eigenvalues in Google page ranking.

1C. How is SVD used in image compression?

(5+3+2)

2A. Explain the design of matched filter for radar systems to detect continuous signal buried in noise. If the communication channel is modelled as AWGN channel with power spectral density $N_o/2$, compute the maximum SNR and noise variance.

2B. An LTI system has impulse response h(n) = cos(nπ/2) and input x(n) = 2n - 1. Compute the response of this LTI system using circulant matrix. Choose n=5.

2C. Is the following matrix positive definite?

$$\begin{bmatrix} 3 & 1 & -2 \\ 1 & 6 & -4 \\ -2 & -4 & 6 \end{bmatrix}$$

(5+3+2)

3A. Find the Jordan canonical form of matrix A.

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

3B. Calculate the amperages in each part of the network shown in Figure 3B.

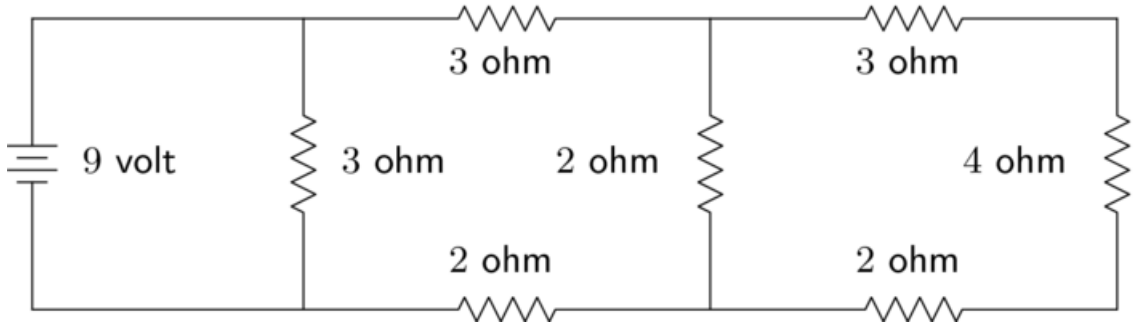

Figure 3B

3C. Is g (x) = x^2 + 3 onto transformation where g: R → R ? Is it one to one?

(5+3+2)

4A. Solve the following set of linear equations using QR decomposition.

$$\begin{aligned} x_1 \quad\quad - 3x_3 &= -2 \\ 3x_1 + x_2 - 2x_3 &= 5 \\ 2x_1 + 2x_2 + x_3 &= 4 \end{aligned}$$

4B. The flow of traffic (in vehicles per hour) through a network of streets is shown in Figure 4B.
(i) Solve this system for x_i , i=1,2,3,4,5
(ii) Find the traffic flow when $x_4 = 0$
(iii) Find the traffic flow when $x_4 = 100$

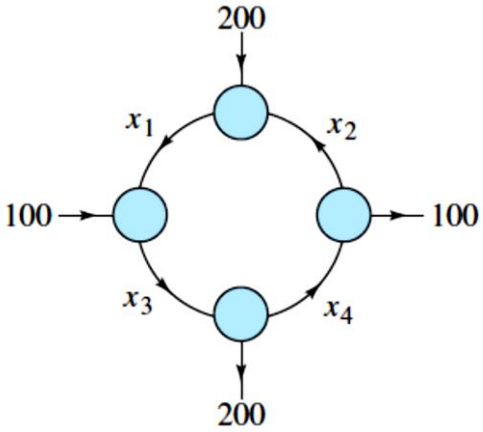

Figure 4B

4C. Compute L2-norm distance between X and Y.

X = [1+j3 1-j 3+j2]

Y = [j 2-j 1+j]

(5+3+2)

5A. Find an orthogonal matrix that diagonalizes matrix A. Show the diagonalized form of matrix A. What are the applications of matrix diagonalization?

$$A = \begin{bmatrix} 2 & 2 & -2 \\ 2 & -1 & 4 \\ -2 & 4 & -1 \end{bmatrix}$$

5B. Find the eigenvalues and eigenvectors of matrix A given below. What is the application associated with this matrix?

$$A = \begin{bmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{bmatrix}$$

5C. Find the inverse of matrix A given below.

$$A = \begin{bmatrix} 2 - i & -5 + 2i \\ 3 - i & -6 + 2i \end{bmatrix}$$

(5+3+2)

6A. Find the least squares regression line for the points (1,1), (2,2),(3,4), (4,4), and (5,6) and plot it. Find the sum of squared error for this regression line.

6B. Explain the concept of pseudo-inverse in determining the solution of over determined systems.

6C. Find matrix A which has Eigenvalues 1 and -1; and Eigenvectors [cosx, sinx] and [-sinx, cosx]?

(5+3+2)