Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (OLD course)• EXAMINATION – SUMMER 2015

Subject Code: 714101 **Date: 11/05/2015**

Subject Name: Mathematical Methods in Signal Processing

Time: 10:30 am to 1:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Que 1) **a)** Compute transpose, inverse and rank of the matrix A , **[7]**

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{bmatrix}$$

b) i) Explain why the set of real numbers is both open and closed. **[7]**

ii) Show that the boundary of a set S is a closed set.

Que 2) **a)** Explain about binary hypothesis testing. **[7]**

b) Explain any one method of signal detection and estimation with suitable example. **[7]**

OR

b) Let (X,d) be a metric space show that $d_m(x, y) = \min(1, d(x, y))$ is a metric on X. **[7]**

Que 3) **a)** Obtain Z- transform of unit step and unit impulse. **[7]**

b) What is Bayes approach? List out applications of the approach in signal processing. **[7]**

OR

Que 3) **a)** i)ñA linear operator $A : X \to Y$ is bounded if and only if it is continuousò. Justify the statement. **[7]**

ii) Consider a data sequence $\{x|t|\}$, the correlation matrix R is

$\begin{bmatrix} .5 & .3 \\ .3 & .5 \end{bmatrix}$ and the cross ï correlation vector p with a desired signal is $\begin{bmatrix} .2 \\ .5 \end{bmatrix}$. Determine the optimal weight vector.

b) A Grammian matrix R is always positive semi define. It is positive define if and only if the vectors $p_1, p_2, p_3, ..., p_m$ are linearly independent. **[7]**

Que 4) **a)** Explain Modulation Theorem and Parsevalôs Theorem. **[7]**

b) Explain LMS algorithm with application. **[7]**

OR

Que 4) **a)** **[7]**

Find eigen values and corresponding eigen vector of the matrix A

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

b) **[7]**

For matrix T in block triangular form $T = \begin{bmatrix} T_{11} & T_{12} \\ 0 & T_{22} \end{bmatrix}$

show that $\lambda(T) = \lambda(T_{11}) \cup \lambda(T_{22})$

Que 5) **a)**

Explain Linearity and scaling property of Fourier Transform. **[7]**

b)

Let $A : H \to H$ be a bounded linear operator on a Hilbertspace H. Show that: **[7]**

i) The adjoint operator A^* is linear.

ii) The adjoint operator A^* is bounded

iii) $\|A\| = \|A^*\|$.

OR

Que 5) **a)** Let $A = \begin{bmatrix} 3 & 2 \\ 4 & -1 \end{bmatrix}$, using cayley Hamilton calculate A^9. **[7]**

b) Determine the Jordan form of A. **[7]**

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