Seat No.: ________ Enrolment No.____________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 714101N **Date: 08-01-2013**

Subject Name: Mathematical Methods in Signal Processing

Time: 02.30 pm – 05.00 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]**

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

b) Let $f: X \to R$ be an arbitrary function defined on a set X. Show that $d(x,y)=|f(x)-f(y)|$ is a Pseudometric. **[7]**

Que 2) **a)** Explain about stochastic AR and MA models. **[7]**

b) Explain about binary hypothesis testing. **[7]**

OR

b) For Given vector , compute the l_p metric $d_p(X,0)$ for $p=1,2,4,10,100,\infty$. Comment on why $d_p(X,0)\to \max(X_i)$ as $p\to\infty$. **[7]**

Que 3) **a)** Explain significance of Auto correlation and cross correlation function. **[7]**

b) What is the significance of HMM model ? **[7]**

OR

Que 3) **a)** **[7]**

Consider a data sequence $\{x|t|\}$, the correlation matrix R is $\begin{bmatrix} .5 & .3 \\ .3 & .5 \end{bmatrix}$ and the cross –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 any two properties of Fourier transform. **[7]**

b) Explain sampling process with suitable example. Discuss about axtialiasing filter. **[7]**

OR

Que 4) **a)** A linear operator $A: X \to Y$ is bounded if and only if it is continuous. **[7]**

b) Show that if A has both a left inverse and a right inverse, they must be same. **[7]**

Que 5) **a)** Explain two applications of ML estimation. **[7]**

b) Explain any two properties of z- transform. **[7]**

OR

Que 5) **a)** **[7]**

i) If λ is an eigen value of a nonsingular matrix A , show that $\frac{|A|}{\lambda}$ is an eigen value of $adj\ A$.

b) **[7]**

Verify Cayley-Hamilton theorem for $A=\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ and use it to find the simplified form of $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I_3$

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