

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – III • EXAMINATION – WINTER • 2013****Subject code: 730405****Date: 28-11-2013****Subject Name: Adaptive Signal Processing****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

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

- Q.1 (a)** Describe three different types of linear stochastic models, and distinguish with each other. **07**
- (b)** What is synthesis and analysis in the context of models, explain how one can use stochastic models for both the purpose? **07**

- Q.2 (a)** Explain four basic classes of adaptive filtering applications **07**
- (b)** The statistical characterization of a multiple linear regression model of order four is as follows : **07**

The correlation matrix of the input vector $u(n)$ is

$$R = \begin{bmatrix} 1.1 & 0.5 & 0.1 & -0.1 \\ 0.5 & 1.1 & 0.5 & 0.1 \\ 0.1 & 0.5 & 1.1 & 0.5 \\ -0.1 & 0.1 & 0.5 & 1.1 \end{bmatrix}$$

The cross-correlation vector between the observable data and the input vector is

$$p = [0.5, -0.4, -0.2, -0.1]^T$$

The variance of the observable data $d(n)$ is 1. The variance of the additive white noise is 0.1. A Wiener filter of varying length M operates on the input vector $u(n)$ as input and on the observable data $d(n)$ as the desired response. Compute and plot the mean square error produced by the Wiener filter for $M=0,1,2,3,4$

OR

- (b)** Derive Wiener hopf equation and canonical form of the error performance surface. **07**
- Q.3 (a)** Consider forward and backward linear prediction weight vectors in context of prediction show that forward prediction weight factors and backward prediction weight factors are related with each other. **07**
- (b)** Describe and explain augmented Wiener-Hopf Equations for Backward prediction. **07**

OR

- Q.3 (a)** List properties of correlation matrix and describe any three. **07**
- (b)** What is the importance of Levinson-Durbin recursion Algorithm ? Describe how it can be used in prediction. **07**
- Q.4 (a)** Derive the expression for range of step size parameter for stability of steepest Descent Algorithm. **07**

- (b) Consider a Wiener filtering problem characterized by the following values 07
for the correlation matrix R of the tap-input vector $u(n)$ & the cross
correlation vector P between $u(n)$ and the desired response $d(n)$

$$R = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$$
$$p = \begin{bmatrix} 0.5 \\ 0.25 \end{bmatrix}$$

Suggest a suitable value for the step size parameter μ that would ensure convergence of the method of Steepest descent, based on the given value for matrix R .

OR

- Q.4 (a) Derive weight update equation of LMS algorithm from steepest descent 07
algorithm
(b) Define misadjustment parameter for linear adaptive filtering problem and 07
derive it for LMS algorithm.

- Q.5 (a) Explain NLMS algorithm with necessary derivation. 07
(b) What is difference between Recursive least square (RLS) method and least 07
square (LS) method of adaptive filtering? What improvement can be
achieved using RLS compared to LS?

OR

- Q.5 (a) What is principle of Orthogonality and Corollary of Principle of 07
Orthogonality in context when input be, represented as time series.
(b) Derive the canonical form of the cost function (Mean Square Error) for LMS 07
algorithm.
