

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2013****Subject code: 730405****Date: 15-05-2013****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) What is synthesis and analysis in the context of stochastic models, explain how one can use stochastic models for both the purpose? **07**

(b) Consider an autoregressive process $u(n)$ of order 2, described by the difference equation $u(n)=u(n-1)+0.5u(n-2) + v(n)$ **07**

Where $v(n)$ is a white-noise process of zero mean and variance 0.5.

- (a) Write the yele Walker process of zero mean and variance 0.5
- (b) Solve these two eqautions for the autocorrel;ation function values $r(1)$ and $r(2)$
- (c) Find the variance of $u(n)$

Q.2 (a) State and derive the principal of orthogonality in context of wiener filter. **07**

(b) Consider a wiener filtering problem characterized as follows : The correlation matrix R of the tap input vector $u(n)$ is **07**

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

The cross correlation vector p between the tap input vector $u(n)$ and the desired response $d(n)$ is

$$p = \begin{bmatrix} 0.5 \\ 0.25 \end{bmatrix}$$

- (a) Evaluate the tap weights of the wiener filter
- (b) What is the minimum mean squared error produced by this wiener filter?

OR

(b) Define Adaptive Filter. Discuss different approaches the development of linear adaptive filters in brief. **07**

Q.3 (a) Explain backward linear prediction and describe its structure. Clearly explain one step backward predictor and backward prediction error filter. **07**

(b) Describe and explain augmented Wiener-Hopf Equations for Forward prediction. **07**

OR

Q.3 (a) Explain forward linear prediction and describe its structure. Clearly explain one step forward predictor and forward predict ilter. **07**

(b) Explain significance of Levinson-Durbin recursion Algorithm, and describe how it can be used to predict. **07**

Q.4 (a) Derive the expression for range of step size parameter for stability of steepest Descent Algorithm. **07**

- (b) In the method of steepest descent, show that the correction applied to the tap weight vector after $n+1$ iterations may be expressed as **07**

$$dw(n+1) = nE[u(n)e^*(n)]$$

Where $u(n)$ is the tap input vector and $e(n)$ is the estimation error. What happens to this adjustment at the minimum point of the error performance surface? Discuss your answer in light of the principle of orthogonality.

OR

- Q.4** (a) Compare the LMS algorithm with the steepest descent. **07**
(b) Show the Misadjustment parameter for LMS filter is $M = (\mu/2) * \text{tr}[R]$ **07**

- Q.5** (a) Discuss three assumptions required for the development of statistical LMS theory. **07**
(b) What is difference between Recursive least square (RLS) method and least square (LS) method, adaptive filter? What improvement can be achieved using RLS compared to LS? **07**

OR

- Q.5** (a) Explain NLMS algorithm with necessary derivation. **07**
(b) What is principle of Orthogonality and Corollary of Principle of Orthogonality in context of, input be represented as time series. **07**
