Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-III Regular Examination January 2011

Subject code: 730405

Subject name: Adaptive Signal Processing

Date: 10 /01 /2011 **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.**

Q.1	**(a)**	Explain Hermitian-symmetry and Toeplitz properties of a correlation matrix.	**06**
	(b)	Show that a correlation matrix is almost positive definite.	**05**
	(c)	Construct a correlation matrix of a wide sense stationary (WSS) process if $r(0)=1$, $r(1)=(1+j)/\sqrt{2}$ and $r(2)=j$.	**03**
Q.2	**(a)**	Explain the Yule-Walker equation for a WSS process.	**07**
	(b)	Derive the Wiener-Hopf equation for a filtering problem.	**07**
		OR	
	(b)	Derive the condition for asymptotic stationarity on the AR coefficients of a second order AR process.	**07**
Q.3	**(a)**	Derive the error surface and canonical form of the cost function in a linear filtering problem.	**07**
	(b)	Explain the forward prediction filtering and derive the corresponding augmented Wiener-Hopf equation.	**07**
		OR	
Q.3	**(a)**	Explain the backward prediction filtering and derive the relation between the forward and backward predictors.	**07**
	(b)	Derive and explain Levinson-Durbin algorithm for linear prediction.	**07**
Q.4	**(a)**	Explain the all-pole, all-pass lattice filter structure for linear predictors.	**07**
	(b)	Derive the transfer function of a forward prediction-error filter based on Levinson-Durbin recursion.	**07**
		OR	
Q.4	**(a)**	Show that the forward prediction-error filter is minimum phase by applying Rouche's theorem.	**07**
	(b)	Show that the backward prediction-error filter is maximum phase.	**07**
Q.5	**(a)**	Explain the basic idea of the steepest descent algorithm showing that the cost function is minimized.	**07**
	(b)	Apply steepest-descent algorithm to the Wiener filter and derive the equation for the corresponding gradient vector.	**07**
		OR	
Q.5	**(a)**	Explain the LMS (least mean squares) algorithm.	**07**
	(b)	Explain the NLMS (normalized LMS) algorithm.	**07**

****