Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II(New course)• EXAMINATION (Remedial) – WINTER- 2015

Subject Code: 2724111 **Date:09/12/2015**

Subject Name: statistical signal processing

Time:2:30 pm to 5:00 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)** Define the following terms : **07**

1. Joint Moments
2. Gaussian Random Variables
3. Sample Mean
4. Mean Ergodic Theorem-I
5. Wiener –Hopf Equations for FIR Filter
6. Linear Prediction using FIR Wiener filter
7. Auto Regressive Moving Average Process(ARMA Process)

(b) Define autocovariance and autocorrelation matrices. State and derive the properties of the Autocorrelation matrix. **07**

Q.2 **(a)** What do you mean by ergodic process? State Mean Ergodic theorem I and Mean Ergodic theorem II with suitable mathematics. **07**

(b) Write short note on Linear Prediction. Derive the FIR Linear predictor **07**

OR

(b) Let $x(n)$ be an AR(1) process with an autocorrelation sequence $r_x(k) = (a)^{|k|}$, with $0 < a < 1$, with a first order predictor of the form $\hat{x}(n+1) = w(0)x(n) + w(1)x(n-1)$. Find out the optimum linear predictor using FIR Wiener filter. **07**

Q.3 **(a)** Explain Spectral Factorization in detail with suitable mathematics. **07**

(b) Consider the autocorrelation sequence of a random phase sinusoid as **07**

$$r_x(k) = \frac{1}{2} A^2 \cos(kw_0).$$

Compute the autocorrelation matrix and eigenvalues of the given random process $x(n)$.

OR

Q.3 **(a)** What is an Autoregressive Moving Average Process (ARMA) Process? Derive the Yule Walker equations for ARMA process. **07**

(b) Explain Filtering Random process in detail with necessary block diagram and equations. **07**

Q.4 **(a)** Derive the Wiener-Hopf equations and minimum mean square error for the Causal IIR Wiener Filter **07**

(b) State and derive Cramer Rao Theorem **07**

OR

Q.4 **(a)** Explain RLS Algorithm in detail with suitable mathematics. **07**

(b) Determine the optimum linear predictor in noise using FIR Wiener filter, for AR(1) process x(n) that has an autocorrelation sequence given by $r_x(k) = a^{|k|}$ **07**

Q.5 **(a)** Explain Bartlett method for Power spectrum estimation with suitable **07**

mathematics.

(b) Derive the maximum entropy spectrum estimation with suitable mathematics. **07**

OR

Q.5 **(a)** Explain Blackman- Tukey method for Power spectrum estimation with suitable mathematics. **07**

(b) Derive the minimum variance spectrum estimation with suitable mathematics. **07**

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