**Reg. No. :** | | | | | | | | | | |

# Question Paper Code: 41222

M.E. DEGREE EXAMINATION, DECEMBER 2014.

First Semester

Communication Systems

14PCM101 – ADAPTIVE SIGNAL PROCESSING

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (5 x 1 = 5 Marks)

1. The two random signal is said to be orthogonal in the condition of
   (a) $\gamma_{xy} = 1$ (b) $\gamma_{xy} = 0$ (c) $\gamma_{xy} = -1$ (d) $\gamma_{xy} = \infty$

2. In ---------- method first allow the sequences $x_i(u)$ to overlap and second is to allow a data window for producing set of modified periodogram
   (a) Bartlett's method (b) Welch method
   (c) Blackman-Tukey method (d) Maximum entrop method

3. The Wiener filter is called an optimum filter in ---------- sense
   (a) Minimum mean square error (b) Better noise removal
   (c) Better non stationary signal (d) Better prediction

4. In steepest descent adaptive filter the step size must be ---------- to reduce the error.
   (a) zero (b) -1 (c) 2 (d) $-1 < \mu < 0$

5. An efficient realization structure of the sampling rate converter uses
   (a) Interpolation (b) Decimation
   (c) Polyphase filter (d) All of the above

PART - B (5 x 3 = 15 Marks)

6. State Wiener – Khintchine relation.

7. What are the limitations of the nonparametric methods of spectrum estimation?

8. Determine the frequency resolution of Welch method of power spectrum estimate for a quality factor of Q=10. Assume the overlap as 50% and the length of the sample is l000.

9. State the reason for popularity of FIR adaptive filter.

10. What is need for anti imaging filter in up sampler?

PART - C (5 x 16 = 80 Marks)

11. (a) (i) Obtain the mean and auto correlation of the real valued harmonic process $x(n) = \sin(nw_0+\phi)$, where n and $w_o$ are constants and $\phi$ is a random variable uniformly distributed over the interval $-\pi$ to $\pi$. (10)

(ii) State and derive spectral factorization theorem. (6)

Or

(b) (i) Find the auto correlation sequence of $P_x(e^{jw}) = \frac{1}{5+3\cos w}$ (8)

(ii) Differentiate time average over, ensemble averages. (4)

(iii) List the difference between auto covariance and auto correlation with an example. (4)

12. (a) (i) Give a brief description about moving average spectrum estimation with an example. (8)

(ii) Find an unit sample response which derive by unit variance with yield a random process having a power spectrum $P_x(e^{jw}) = (5+4\cos w) / (10+6\cos w)$. (8)

Or

(b) (i) Derive the Yule - Walker equation for ARMA (p,q) process. Also briefly Describe how Yule - Walker method is used in spectral estimation. (8)

(ii) Design an AR(2) process for a real valued random process having auto correlation function $r(k) = 10^* \delta(k)+0.5^{|k|}$ (8)

13. (a) (i) Use the generalized Levinson –Durbin algorithm to solve the normal equations recursively for the n-step forward and backward predictions. (10)

(ii) Explain FIR Wiener filter design procedure in detail. (6)

Or

(b) (i) Derive the expression for discrete Kalman filter. (12)

(ii) Differentiate between LMS and RLS algorithm. (4)

14. (a) (i) Explain the application of adaptive filters as noise cancellation. (8)

(ii) Explain adaptive linear prediction using LMS algorithm. (8)

Or

(b) (i) Explain the types of adaptive recursive algorithm in detail. (8)

(ii) With an example explain the AR lattice and ARMA lattice in detail. (8)

15. (a) (i) Derive the frequency domain relations of inputs and output for decimator and explain with any specific spectral shapes. (8)

(ii) Explain the concept of poly phase decomposition in implementing multirate system. (8)

Or

(b) (i) With a neat diagram explain the QMF bank. (8)

(ii) Explain the multistage implementation of multirate system in detail. (8)

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