P 7025

M.E. DEGREE EXAMINATION, MAY/JUNE 2006.

First Semester

Applied Electronics

AX 131 — ADVANCED DIGITAL SIGNAL PROCESSING

(Common to M.E. Computer and Communication, M.E. VLSI Design and M.E. Communication Systems)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Parseval's theorem.

2. How do you get power spectral density of a random signal?

3. What are the performance measures for the periodogram - based spectrum estimation technique?

4. What is model-based spectrum estimation?

5. What are the advantages of lattice structure?

6. What is the significance of Toeplitz matrix in signal processing?

7. What is the weight vector update equation of LMS algorithm?

8. What is the step size in LMS algorithm for convergence?

9. What is meant by sub band coding?

10. What are the effects in spectrum due to decimation?

PART B — (5 × 16 = 80 marks)

11. (i) Find the auto correlation sequence whose power spectral density is given by $\frac{1}{5+3\cos w}$. (6)

(ii) The power spectrum of a wide-sense stationary process $x(n)$ is $(25-24\cos w)/(26-10\cos w)$. Find the whitening filter $H(z)$ that produces unit variance white noise when the input is $x(n)$. (10)

12. (a) (i) Explain periodogram estimator. (8)

(ii) Explain in what way the Bartlett's method and Welch's method differ from periodogram method. (8)

Or

(b) (i) Explain th AR-model based spectrum estimation. (10)

(ii) The auto correlation sequence $r_x(k)$ of the process $x(n)$ is given by $r_x(k) = \propto^{|k|}; |k| \leq M$. Construct the Yule-Walker equation for AR process of order 3 assuming white noise has a variance of σ_w^2. (6)

13. (a) Invert a Toeplitz matrix $R = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ using Levinson-Durbin algorithm.

Or

(b) (i) Derive FIR Wiener-Hopf equation. (10)

(ii) How do you convert the Wiener-Hopf equation into linear prediction? (6)

14. (a) (i) Derive the weight update equation for steepest descent algorithm. (12)

(ii) In what way LMS algorithm differs from steepest descent algorithm? Explain. (4)

Or

(b) (i) Describe the concept of RLS adaptive filters. (8)

(ii) Describe the application of adaptive filters in echo cancellation. (8)

15. (a) (i) Explain the process by upsampling and downsampling a signal. (8)

(ii) What is subband coding? Explain. (8)

Or

(b) (i) Briefly describe the salient features of wavelet transform. (8)

(ii) Realize the FIR transfer function using polyphase decomposition $H(z) = \sum_{n=0}^{7} h(n) z^{-n}$ with $h(n) = h(N-1-n)$. (8)
