Register Number……………………

M.E. DEGREE EXAMINATIONS: DECEMBER 2009

First Semester

ANE503: ADVANCED DIGITAL SIGNAL PROCESSING

(Common to Applied Electronics and communication Systems Branches)

Time: Three Hours **Maximum Marks: 100**

Answer All the Questions:-

PART A (10 x 2 = 20 Marks)

1. Give the types of stochastic models.
2. State the properties of Auto-correlation Function.
3. Show that mean is an unbiased estimate.
4. What is the need for Spectrum Estimation?
5. State the properties of predictor error filters.
6. Write down the normal equations for all pole modeling using auto correlation method.
7. Write down the steepest descent algorithm.
8. What is the condition for convergence of LMS algorithm?
9. Give an important advantage of multi-rate DSP systems.
10. If $y(n) = x(M_n)$ represent the input-output relationship of decimator. Show that it is a time varying system.

PART B (5 x 16 = 80 Marks)

11. (a) (i) Let x(n) be a stationary random process with zero mean and autocorrelation $r_x(k)$. we form the process y(n) as follows: y(n) = x(n) + f(n), where f(n) is a known deterministic sequence. Find the mean m_y (n) and the autocorrelation $r_x(k,l)$ of the process y(n). (8)

(ii) The input to a linear shift-variant filter with unit sample response $h(n) = \delta(n) + 0.5\,\delta(n-1) + 0.25\,\delta(n-2)$ is a zero mean wide-sense stationary process with autocorrelation $r_x(k) = (0.5)^{|k|}$. What is the variance of the output process? Also, Find the autocorrelation of the output process, $r_y(k)$ for all k. (8)

(OR)

(b) Suppose we are given a linear shift-invariant system having a system function

$$H(z) = (1- (1/2)\, z^{-1}) / (1- (1/3)\, z^{-1})$$

that is excited by zero mean exponentially correlated noise x(n) with an autocorrelation sequence $r_x(k) = (0.5)^{|k|}$. Let y(n) be the output process, y(n) = x(n) * h(n).

(i) Find the autocorrelation sequence $r_y(k)$ of y(n)

(ii) Find the cross-correlation $r_{xy}(k)$ between x (n) and y (n).

12. (a) (i) Explain Barlett spectrum estimation. (8)

(ii) Explain how the Blackman and Turkey's method is used in smoothing the Periodogram? Derive the mean and variance of power spectral estimate of the Blackman and Turkey method. (8)

(OR)

(b) (i) Give the reasons for choosing AR model for spectral estimation and also discuss the criteria for selection of AR model order. (8)

(ii) Compare parametric and non –parametric estimates. (4)

(iii) Determine the Periodogram of white noise and show that this is an inconsistent estimate. (4)

13. (a) (i) Explain about Forward and backward linear predictors. (6)

(ii) Design a FIR filter that produces the minimum – Mean square estimate of a given process by filtering a set of statistically related process. (10)

(OR)

(b) (i) Solve the following set of Toeplitz equations using Levinson recursion. (8)

$$\begin{bmatrix} 4 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 4 \end{bmatrix} \begin{bmatrix} x(0) \\ x(1) \\ x(2) \end{bmatrix} = \begin{bmatrix} 9 \\ 6 \\ 12 \end{bmatrix}$$

(ii) Explain the concept of IIR, FIR casual wiener filter. (8)

14. (a) (i) Explain the concept of AR lattice and ARMA lattice – ladder filters. (8)

(ii) Explain the application of adaptive filters in noise cancellation. (8)

(OR)

(b) (i) What do you mean by channel Equalization? How it is achieved using an adaptive filter. (10)

(ii) Give the reasons for choosing FIR adaptive filters. (8)

15. (a) (i) Explain how multi stage implement of sampling rate conversion is performed. (8)

(ii) Derive the general polyphase frame work for decimators. (8)

(OR)

(b) (i) Discuss the effect of down sampler in the frequency domain. (8)

(ii) Illustrate the multistage design of decimator and Interpolator. (8)

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