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Register Number:……………………..

B.E DEGREE EXAMINATIONS: NOV/DEC 2014

(Regulation 2009)

Seventh Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE128: Advanced Digital Signal Processing

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Parametric approach of estimating the power spectrum is based on
   a) using a model for the process
   b) estimating the autocorrelation sequence for the given data set
   c) eigen value decomposition
   d) minimum norm algorithm
2. Variance of the periodogram is
   a) $P_x(e^{j\omega})$
   b) $\frac{1}{2}P_x(e^{j\omega})$
   c) $P_x^2(e^{j\omega})$
   d) $2\,P_x^2(e^{j\omega})$
3. Kalman filter is a
   a) linear shift invariant filter for estimating stationary processes
   b) linear shift invariant filter for estimating non stationary processes
   c) shift varying filter applicable to stationary processes
   d) shift varying filter applicable to both stationary as well as non stationary processes
4. Wiener Hopf equations are a set of
   a) Linear equations
   b) non linear equations
   c) linear Toeplitz equations
   d) non linear Toeplitz equations
5. For jointly wide sense stationary processes, the LMS algorithm converges in the mean, if,
   a) $0 < \mu < 2$
   b) $0 < \mu < 2/\lambda_{max}$
   c) $0 < \mu < 2\,\lambda_{max}$
   d) $0 < \mu < \lambda_{max}$

6. An LMS adaptive filter having N+1 coefficients require

a) N additions and N multiplications to update the filter coefficients

b) N+1 additions and N+1 multiplications to update the filter coefficients

c) N additions and N +1 multiplications to update the filter coefficients

d) N+1 additions and N multiplications to update the filter coefficients

7. If $X(e^{j\omega})$is the spectrum of the signal x[n], then the spectrum of the upsampled signal x[n/L] is

a) $X(e^{j\omega/L})$

b) $X(e^{j\omega L})$

c) $X(e^{j\omega L/2})$

d) $X(e^{j\omega 2L})$

8. Given x[n]=(1,2,4,3,2,3,2}. The downsampled signal x[2n] is

a) {1,4,2,2}

b) {1,0,2,0,4,0,3,0,2,0,3,0,2}

c) {4,3,2}

d) (1,3,2}

9. Haar wavelet function is defined as

a) $\Psi(x) = \begin{cases} 1, & 0 \le x < 0.5 \\ -1, & 0.5 \le x < 1 \\ 0, & elsewhere \end{cases}$

b) $\Psi(x) = \begin{cases} 1, & 0 \le x < 1 \\ 0, elsewhere & \end{cases}$

c) $\Psi(x) = \begin{cases} 1, & -1 \le x < 0 \\ -1, & 0 \le x < 1 \\ 0, & elsewhere \end{cases}$

d) $\Psi(x) = \begin{cases} 1, & 0 \le x < 1 \\ -1, & 1 \le x < 2 \\ 0, & elsewhere \end{cases}$

10. Which one of the statements is correct with reference to wavelet domain signal analysis:

a) Scaling functions extract the details and wavelet functions perform approximation

b) Scaling functions perform approximations and wavelet functions extract the details.

c) Wavelet functions perform approximations and also extraction of details.

d) Wavelet functions perform approximations only.

PART B (10 x 2 = 20 Marks)

11. Define bias and consistency.
12. In estimating the power spectrum, would there be any benefit in replacing the rectangular window with some other window such as Bartlett, Hanning etc.,?
13. Distinguish between filtering and smoothing operations.
14. What are the limitations of Wiener filter and how it is overcome in Kalman filter?
15. State the reasons for the popularity of FIR adaptive filters compared to IIR adaptive filters.

16. What is the difference between mean square error and least square error?
17. Given $H(z) = 1 + 2z^{-1} + 3z^{-2} - 2z^{-3} + 4z^{-4}$ Draw the direct form realization.
18. State the necessity for multistage implementation in the design of multirate systems.
19. What is the advantage of STFT compared to Fourier transform?
20. Define wavelet functions.

PART C (5 x 14 = 70 Marks)

21. a) Prove that the periodogram method of estimating the power spectrum is an asymptotically unbiased estimate.

(OR)

b) Use Levinson Durbin recursion to solve the autocorrelation normal equations and find a third order all pole model for a signal having autocorrelation values $r_x(0) = 1,\ r_x(1) = 0.5,\ r_x(2) = 0.5,\ r_x(3) = 0.25$

22. a) Derive the Wiener Hopf equation for the FIR Wiener filter.

(OR)

b) Find the optimum linear predictor for an AR(i) process x[n] that has an autocorrelation sequence given by $r_x(k) = \alpha^{|k|}$ with a first order predictor of the form $x[n+1] = w(o)x[n] + w(1)x[n-1]$ and explain the same.

23. a) With necessary quantitative analysis, explain the gradient search using steepest descent method.

(OR)

b) Derive the LMS algorithm for an adaptive linear combiner with multiple inputs. Also discuss its convergence to the optimum weight vector solution.

24. a) Explain decimation both in time and frequency domain with necessary quantitative analysis and illustrations.

(OR)

b) State the need for anti aliasing and antiimaging filters in multirate system design with necessary quantitative analysis and illustrations.

25. a) Prove the Heisenberg Uncertainity principle for continuous wavelet transform.

(OR)

b) Explain the implementation of wavelet transform using sub-band coding.

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