

**M.E DEGREE EXAMINATION: DECEMBER 2008**

First Semester

**P07AE101 ADVANCED DIGITAL SIGNAL PROCESSING**

(Common to APPLIED ELECTRONICS and COMMUNICATION SYSTEMS Branches)

**Time: Three Hours**

**Maximum Marks: 100**

**Answer ALL Questions:-**

**PART A (20×1 = 20 Marks)**

1. In zero mean random processes
  - A) Auto covariance and auto correlation are not equal
  - B) Auto covariance and auto correlation are equal
  - C) Auto correlation and cross-correlation are equal
  - D) Auto correlation and cross-correlation are not equal
  
2. The power spectrum of a WSS random process is
  - A) Negative
  - B) Complex number
  - C) Non negative
  - D) Zero
  
3. The difference between the expected value of estimate and the actual value is called
  - A) Unbiased
  - B) Asymptotically unbiased
  - C) Consistency
  - D) Bias
  
4. Two random processes are said to be orthogonal if
  - A) Cross-correlation of two random processes is zero
  - B) Auto-correlation of two random processes is zero
  - C) Random process are said to be uncorrelated
  - D) Random process are said uncorrelated
  
5. Expected value of the periodogram is define by the parameter
  - A) Convolution
  - B) Auto correlation
  - C) Convolution & Fourier transform
  - D) Convolution, Fourier transform & auto correlation
  
6. Balck man-Tukey method is for
  - A) Averaging periodograms
  - B) Modified periodograms
  - C) Perodogram smoothing
  - D) Both averating and smoothing percodogram
  
7. The figure of merit of welch's method is
  - A)  $0.89 \frac{2\pi}{N}$
  - B)  $0.72 \frac{2\pi}{N}$
  - C)  $0.43 \frac{2\pi}{N}$
  - D)  $0.73 \frac{2\pi}{N}$
  
8. Spectral line splitting of an AR(2) process occurs when
  - A)  $X(n)$  is over modeled
  - B)  $X(n)$  is under modeled
  - C) Model order is too low
  - D) Model order is moderatc

9. Prediction of the value  $X(n)$  is defined by

- A) Weighted linear combination of present values
- B) Weighted linear combination of past values
- C) Weighted linear combination of present & past values
- D) Weighted linear combination of past & future values

10. The Levinson -Durbin algorithm is a

- A) Serial processing
- B) Parallel processing
- C) Piplining process
- D) Serial input & parallel output processing

11. The noise-whitening filter for the MA process is

- A) All zero filter
- B) All pole filter
- C) Pole zero filter
- D) No pole -zero filter

12. Wiener filter MMSE is minimized by

- A) Increasing filter length
- B) Increasing filter co-efficiency
- C) Reducing filter length
- D) Using lettice filter structure

13. A practical limitation of steepest descent – adaptive filter is

- A) Expectation is unknown
- B) Weight error vector is unknown
- C) Gradient vector unknown
- D) Stepsiz is unknown

14. LMS algorithm requires

- A)  $2P+1$  multiplication &  $2P+1$  additions per output
- B)  $2P+3$  multiplication &  $2P+2$  additions per output
- C)  $2P$  multiplication &  $2(P-1)$  additions per output
- D)  $2(P-3)$  multiplication &  $2P$  additions per output

15. Advantage of adaptive noise canceller over a wiener filter is that

- A) Adaptive noise canceller used when processes are stationary
- B) Adaptive noise canceller used when processes are ergodic
- C) Adaptive noise canceller used when processes are moving average
- D) Adaptive noise canceller used when processes are non stationary

16. Posteriori error in exponentially weighted RLS algorithm is defined as

- A) Error that occurs after the gain vector is updated
- B) Error that occurs before the gain vector is updated
- C) Error that occurs after the weight vector is updated
- D) Error that occurs after exponential weighting factor is updated

17. In multi rate signal processing the sampling rate conversion is achieved by

- A) Cascading decimeter with interpolator
- B) Cascading an interpolator with decimeter
- C) Frequer synthesizer
- D) Poly phase structure

18. Decimeter is transformed to interpolater and vice versa by

- A) Poly phase filters
- B) Transposing operation
- C) Decomposition process
- D) Addition of decimeters with interoleter and vice versa

19. Poly phase filters perform the computations

- A) At the higher sampling rate
- B) At the below Nquiste rate
- C) At the low sampling rate but not less than Nquiste rate
- D) At the very high sampling rate

20. Poly phase subfilters are

- A) All-pass filters with same-phase characteristics
- B) Band-pass filters with different-phase characteristics
- C) All-pass filters with different-phase characteristics
- D) Band-pass filters with quaturature-phase characteristics

**PART B (5×16 = 80 Marks)**

21. (a)(i) State and prove Wiener-Khintchine theorem (8)

(ii) State and prove spectral factorization theorem (8)

**(OR)**

(b)(i) Find a filter which when driven by unit variance white noise will yield a random process having a power spectrum

$$P_x(e^{j\omega}) = 5 + 4 \cos 2\omega / 10 + 6 \cos \omega \quad (8)$$

(ii) State the properties of auto correlation function (8)

22. (a)(i) Derive the yule-walker equations that relate the auto correlation function to the parameters of the filter (10)

(ii) Explain power estimation using Barlett method (6)

**(OR)**

(b)(i) For the AR process of order one described by  $x(n) = a_1 x(n-1) + \omega(n)$  where  $a_1$  is a constant and  $\omega(n)$  is a white noise of zero mean and variance  $\sigma^2$ . Find the mean and auto correlation of  $x(n)$  (10)

(ii) Compare the performance of different non parametric methods of power spectrum estimation. (6)

23. (a)(i) Explain levinson recursion algorithm to solve a set of Toeplitz equations (10)

(ii) Discuss forward linear prediction in detail (6)

**(OR)**

- (b)(i) Obtain the Wiener-Hopf equations of a FIR wiener filter (8)  
(ii) Explain how Kalman filter is used to estimate an unknown constant (8)

24.(a)(i) Develop the mathematics foundation for a steepest descent method and also derive the condition for convergence of LMS algorithm for jointly wide-sense stationary process (8)

- (ii) What do you mean by channel equalization? How is it achieved using an adaptive filter (8)

**(OR)**

(b)(i) Explain the sliding window RLS algorithm (8)

- (ii) Compare the performance of LMS and RLS algorithm (8)

25.(a) Consider an interpolator with  $I=3$  processing an input sequence of length  $N=6$ . Assume that the order of the FIR filter used in the interpolator is 12. Draw the poly phase structure for this interpolator after deriving necessary equations. (16)

**(OR)**

(b)(i) Discuss on subband coding and one of it's application. (6)

- (ii) Define wavelet-transform. Describe filter bank implementation of wavelet expansion of signals. (10)

\*\*\*\*\*