Register Number: ……………………..

B.E., DEGREE EXAMINATIONS: NOV/DEC 2012

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. Periodogram is a -----------------------estimator.

   a) inconsistent   b) consistent

   c) unbiased   d) asymptotically biased

2. If the autocorrelation function is $\eta/2\ \delta(k)$, then the power spectral density is----------------

   a) $\eta/4$ b) $\eta^2/2$

   c) $\eta/2$ d) 4η

3. ------------is used for estimation of non-stationary processes

   a) FIR wiener filter   b) IIR wiener filter

   c) Kalman filter   d) Lattice filter

4. The Wiener-Hopf equation for causal IIR Wiener filter is ----------------

   a) ∞
       $\sum_{l=-\infty} h(l)\ r_x\ (k-l) = r_{dx}(k)$

   b) ∞
       $\sum_{l=0} h(l)\ r_x\ (k-l) = r_{dx}(k)$

   c) ∞
       $\sum_{l=0} h(l)\ r_x\ (l-k) = r_{dx}(l)$

   d) ∞
       $\sum_{l=-\infty} h(l)\ r_x\ (l-k) = r_{dx}(k)$

5. The total number of multiplications and additions performed in adaptive filter are -------&-------

   a) $2p+3$, $2p+4$ b) $2p+3$,$2p+2$

   c) $2p+4$, $2p+3$ d) $2p+2$,$2p+3$

6. The exponential weighting factor λ for growing window RLS is -------------

   a) 0   b) 1

   c) < 1   d) >1

7. Anti-imaging filter is used in --------------process.

   a) interpolation   b) decimation

   c) sampling   d) downsampling

8. The sampling rate of a discrete time signal x(n) ={4,4,4,4} is changed by a factor of 2/3. The resultant sequence is ----------------

   a) {4,0,0,4}   b) {4,0,4}

   c) {4,0,4,4}   d) {4,0,4,0,4,0,4}

9. The approximation and detail coefficients of a continuous function can be obtained by using --- and------------ functions respectively.

   a) scaling, wavelet   b) Haar,Daubechies

   c) Daubechies,Haar   d) wavelet,scaling

10.
    -------------- filtering corresponds to differencing operation

    a) Low pass   b) High-pass

    c) Band-pass   d) Band-stop

PART B (10 x 2 = 20 Marks)

11. Define Bias and consistency of an estimator.

12. Find the periodogram of the sequence x(n) = {1,2,3,4} using DFT

13. Compare forward and backward linear predictors

14. How does discrete kalman filter differ from wiener filter in estimation?

15. Draw the block diagram of adaptive filter

16. What is the relationship between order of the filter and step size in LMS adaptive filter?

17. What is the need for anti-imaging and anti-aliasing filters in sampling rate conversion?

18. Draw the multistage structure of decimator and write the necessary mathematical expressions

19. What is STFT? Mention its advantages

20. Compare Haar and Daubechies wavelets

PART C (5 x 14 = 70 Marks)

21. a) (i)   Explain the various methods of computing periodogram and evaluate its bias.   (10)

       (ii) Compare the various non-parametric methods of spectrum estimation   (4)

                                      (OR)

    b) (i)   Derive the Yule-walker equation for ARMA(p,q) process and also discuss   (10)
             about ARMA(p,q) spectrum estimation

       (ii) Find the power spectral density of the autocorrelation sequence, $r_x(k) = \alpha^{|k|}$ (4)
             where $|\alpha| < 1$

22. a) (i) Obtain the Wiener-Hopf equations and Minimum mean square error for FIR (8) Wiener filter

    (ii) Let $d(n)$ be an AR(1) process with an autocorrelation sequence $r_d(k) = \alpha^k$, (6) $0<\alpha<1$, and suppose that $d(n)$ is observed in the presence of uncorrelated white noise $v(n)$ that has a variance of $\sigma_v{}^2$, $x(n) = d(n) + v(n)$. Design a first order wiener filter to reduce the noise in $x(n)$.

(OR)

  b) Explain how does discrete kalman filter produce the best estimate of $x(n)$. Find the kalman gain that minimizes the mean square error.

23. a) (i) Explain the design of adaptive filter based on steepest descent method. What is (10) the drawback of the method? Explain how is it overcome in LMS adaptive algorithm?

    (ii) With neat diagram, explain any one application of adaptive filter. (4)

(OR)

  b) What is RLS? Derive the recursive solution for exponentially weighted RLS algorithm with appropriate initialization.

24. a) (i) Explain the decimation process with an example. Also derive the frequency (7) domain relation of input and output of decimator.

    (ii) With essential mathematical expressions, explain the interpolation process with (7) an example

(OR)

  b) Discuss about Direct form FIR filter and Polyphase filter structures that are used in sampling rate conversion process.

25. a) (i) Define Discrete wavelet transform pair. Using Haar scaling and wavelet (6) functions, find the approximation and detail co-efficients of the discrete function $f(n)=\{1,4,-3,0\}$

    (ii) What is MRA? Describe scaling and wavelet functions and their recursive MRA (8) equations.

(OR)

b) (i) Define CWT and inverse CWT (4)

(ii) Explain the filter bank implementation of wavelet transform with sub-band (10) coding.

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