Reg. No. :

Question Paper Code : X 85082

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
First Semester
Applied Electronics
AP 5152 – ADVANCED DIGITAL SIGNAL PROCESSING
(Common to M.E. Communication Systems/M.E. Communication and Networking/M.E. Digital Signal Processing/M.E. Electronics and Communication Engineering /M.E. Electronics and Communication Engineering (Industry Integrated))

(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. State the Weiner-Khitchine relation and discuss about it.
2. List the necessary and sufficient condition for a random process is said to be wide sense stationary process.
3. Define bias, unbiased and asymptotically unbiased estimate.
4. Differentiate Non-parametric and Parametric method of power spectrum estimation.
5. Mention any two applications where Kalman filter is used.
6. What is lattice filter structure ? What is the advantage of such structure ?
7. What is the advantage of adaptive filters over optimum filters ?
8. Bring out the limitations of steepest descent algorithm.
9. Mention the necessity for multistage implementation of sampling rate conversion.
10. List out few applications of multirate signal processing.

PART – B (5×13=65 Marks)

11. a) i) With necessary equations, explain in detail about special types of random process. **(7)**

ii) Derive the spectral factorization of the power spectrum $P_x(e^{jw})$. **(6)**

(OR)

b) i) x(t) is a wide sense stationary process with autocorrelation function

$$R_{X(\tau)} = 10\frac{\sin(2000\pi t) + \sin(1000\pi t)}{2000\pi t}.$$

The process x(t) is sampled at rate 1/Ts = 4,000 Hz, yielding the discrete-time-process x_n. What is the autocorrelation function $R_X[k]$ of x_n ? **(5)**

ii) State and explain Parseval's theorem with its properties. **(8)**

12. a) Explain the Bartlett and Welch method of smoothing the periodogram and evaluate the performance measures. **(13)**

(OR)

b) Explain the periodogram method of spectrum estimation in detail and also obtain the variance of the periodogram. **(13)**

13. a) i) Explain about stochastic ARMA model in detail. **(7)**

ii) How the yule walker method to solve the AR model parameters ? **(6)**

(OR)

b) Explain the Kalman filter estimation approach in detail. Derive the expression for Kalman gain that minimizes mean square error. **(13)**

14. a) Starting from the basic principles, derive the LMS weight update equation and explain the LMS adaptive algorithm in detail. **(13)**

(OR)

b) Explain in detail about exponentially weighted RLS and sliding window RLS algorithms. **(13)**

15. a) With neat diagram and relevant expressions, explain the time domain and frequency domain characteristics of a decimater with a decimation factor of 'D'. **(13)**

(OR)

b) Draw the polyphase decomposed structure of a 15-tap FIR filter with a decomposition factor of '3'. **(13)**

PART – C (1×15=15 Marks)

16. a) Assume that v(n) is a real-valued zero-mean white Gaussian noise with $\sigma_v^2 = 1$, x(n) and y(n) are generated by the equations

$x(n) = 0.5x(n-1) + v(n)$,

$y(n) = x(n-1) + x(n)$.

i) Compute the power spectrum of x(n) and y(n). **(7)**

ii) Compute Ry(k); for k = 0, 1, 2, 3. **(4)**

iii) ARMA(1, 1) spectral estimate. **(4)**

(OR)

b) A simple averaging filter is defined as

$$y[n] = \frac{1}{N}\left(x[n-1] + \ldots + x[n-N]\right)$$

This is clearly an FIR filter.

i) Let N = 4. Determine the transfer function, its zeros and poles ; **(4)**

ii) determine a general form for zeros and poles for any N ; **(4)**

iii) By comparing y(n) and y[n – 1] determine a recursive implementation.

Also the transfer function, together with its zeros and poles of the recursive implementation. Looking at this example, can we say that "any" recursive filter is IIR ? **(7)**

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