8

Reg. No. :

Question Paper Code : 10527

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023

First Semester

Communication Systems

DS 4152 – STATISTICAL SIGNAL PROCESSING

(Common to: M.E Communication and Networking/M.E. Digital Signal Processing)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Bias and Variance.
2. Differentiate between ARMA and AR models.
3. Define Bayesian estimator.
4. Define Best Linear unbiased estimator.
5. How the parametric methods are overcome the limitations of non-parametric methods?
6. Compare various non-parametric methods of power spectrum estimation with respect to Figure of merit quality and variability.
7. What is Prediction filtering?
8. Define lattice filter with block diagram.
9. Write the-Hoff equation widrow-Hoff equation.
10. State the advantages of adaptive filter.

PART B — (5 × 13 = 65 marks)

11. (a) Consider a random process x(t) that assumes the values =±1 with probability 1/2 and suppose that x(t) then changes polarity with each occurrence of an event in a poison process of rate α. Find the mean variance and auto-covariance of x(t). (13)

Or

(b) Explain power spectral density function. State its important properties and prove any two of the properties. (13)

12. (a) (i) Write a note on Mean Square Error criterion. (10)

(ii) Define an efficient estimate. (3)

Or

(b) Discuss about Exponential families and Maximum Likelihood estimation. (13)

13. (a) (i) Explain clearly the Bartlett method of implementation for power spectral estimation and compare it Blackman-Tukery procedure. (7)

(ii) Bring out the relationship between the parameters of AR, MA and ARMA models of Power spectrum estimation and autocorrelation matrix of input data. (6)

Or

(b) (i) Suppose we have N = 1000 samples from a sample sequence of a random process. Determine the frequency resolution of the Bartlett, Welch (50% overlap) methods for a quality factor Q = 10. (8)

(ii) Write short notes on periodogram. (5)

14. (a) Illustrate the Kalman filter with suitable diagram and summarize how it can be used for State estimation. (13)

Or

(b) Discuss various types of optimal filters in signal modelling. (13)

15. (a) Explain the method of working of adaptive filters based on steepest descent method. (13)

Or

(b) Explain LMS algorithm with neat diagram and relevant equations. (13)

10

PART C — (1 × 15 = 15 marks)

16. (a) Explain the estimation of signal in presence of Guassian Noise with linear Observations. (15)

Or

(b) Interpret the role of statistical signal processing in the field of communication engineering.