SIDDHARTH INSTITUTE OF ENGINEERING AND TECHNOLOGY :: PUTTUR
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QUESTION BANK

Subject with Code : Adaptive signal Processing (16EC3804)

Course & Branch: M.Tech – (DECS) **Year & Sem:** I M.Tech & I-Sem

UNIT –I

EIGEN ANALYSIS & INTRODUCTION TO ADAPTIVE SYSTEMS

1 (a) Write the properties of Eigen values and Eigen vectors. [5M]

(b) Explain about importance of Eigen filters. [5M]

2 (a) With the help of a diagram explain about adaptive linear combiner. [5M]

(b) Write a short note on gradient and minimum mean-square error. [5M]

3(a) With the help of block diagram explain the principle of adaptation in detail. And give the application of the system for real time analysis. [6M]

(b) Write about adaptive channel equalization. [4M]

4(a) Find the Eigen values and Eigen vectors of the matrix. [5M]

$$A = \begin{bmatrix} 4 & 5 & 2 \\ 5 & 4 & 2 \\ 2 & 2 & 2 \end{bmatrix}$$

(b) Define energy density spectrum and power density spectrum of random sequences and clearly distinguish between them with examples. [5M]

5(a) Show that the Eigen values of correlation matrix are bounded by minimum and maximum values of the power density spectrum. [5M]

(b) Explain an application of a low rank modeling of Eigen values in communication systems. [5M]

6(a) Explain in detail about Eigen value problem. [5M]

(b)With neat sketch explain open loop and closed loop adaptive systems. [5M]

7(a) Verify which of the following discrete time signals are eigen functions of stable, linear time invariant discrete time systems. (i) $e^{j2\pi n/3}$ (ii) 5^n (iii) 4^n u(-n-1) [5M]

(b) State and prove unitary similarity transformation property for eigen values. [5M]

8(a) Explain Eigen value computation. [5M]

(b)What are the Eigen values and Eigen vectors? [5M]

9(a) Explain i) Echo cancellation ii) Noise cancellation methods in adaptive signal processing. [6M]

(b) Define i) Hermitian Matrice ii) Eigen Decomposition [4M]

10(a)Find the characteristic equation of the given matrix and also find Eigen vectors. [5M]

$$A = \begin{bmatrix} 3 & 4 & 2 \\ 1 & 4 & 8 \\ 1 & 1 & 2 \end{bmatrix}$$

(b) State and prove Minimax theorem for Eigen values and Eigen vectors. [5M]

UNIT –II

DEVELOPMENT OF ADAPTIVE FILTER THEORY& SEARCHING THE PERFORMANCE SURFACE

1(a) Write about gradient search methods. [4M]

(b) Derive the equation for simple gradient searching algorithm and its solution. [6M]

2(a) Explain about the significance of Wiener Hopf equations in adaptive filter theory. [5M]

(b) Obtain normal equation and derive the optimum solution for wiener coefficients in terms of input sequence. [5M]

3(a) Explain the principle of Wiener filter and discuss clearly the estimation procedure in Wiener filters. [5M]

(b)Explain stability and rate of convergence. [5M]

4. State and derive the expression for principle of orthogonally and its dual. Explain their geometric interpretations. [10M]

5(a) Discuss clearly the power spectral analysis using model-based approach and bring out the basic concept of this method. [6M]

(b) Discuss about smoothing and prediction. [4M]

6 (a) Explain linear optimum filtering problem. [5M]

(b)Derive the expression for Minimum Mean Square Error. [5M]

7 (a) For the given data R and P, evaluate the tap weights produced by the wiener filter. [5M]

$$R = \begin{bmatrix} 1 & 0.5 & 0.25 \\ 0.5 & 1 & 0.5 \\ 0.25 & 0.5 & 1 \end{bmatrix} \quad P - [0.5 \quad 0.25 \quad 0.125]$$

(b)Calculate Minimum Mean Square Error for the above given matrix [5M]

8(a) Explain the development of adaptive filter theory. [5M]

(b) Explain about searching the performance surface. [5M]

9(a) The R matrix and p vector is defined as is defined as

$$R = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}, P = |0.25 \quad 0.5|$$

Find the tap weights of the wiener filter. [5M]

(b) Find the value of the minimum mean square error produced by wiener filter for the above given matrix. [5M]

10(a) Explain the ideas of gradient search methods. [5M]

(b) What are the methods used for searching the performance surface? [5M]

UNIT –III

STEEPEST DESCENT & LMS ALGORITHMS

1(a) Explain Newton's method in multidimensional space. [5M]

(b)Explain gradient search by the method of steepest descent. And compare this method with Newton's method. [5M]

2(a) Explain overview of the structure of LMS algorithm. [5M]

(b) Explain about Adaptive line enhancement. [5M]

3 (a) What are the necessary conditions for the convergence of LMS algorithm? [5M]

(b) Write a short note on implementation of LMS algorithm. [5M]

4. Describe about learning curves and bring out its importance with respect to gradient search algorithms. [10M]

5(a) Explain clearly the linear estimation of signals. [4M]

(b)Discuss the three applications of linear estimation in brief. [6M]

6(a) Derive the condition for stability of an LMS algorithm. [5M]

(b) Explain noise cancelling application of LMS algorithm. [5M]

7(a) Discuss clearly the power spectral analysis using model-based approach and bring out the basic concept of this method. [5M]

(b) Explain statistical LMS algorithm. [5M]

8 (a) Explain the principle and operation of LMS algorithm. [5M]

(b) Discuss about the principle of operation of adaptive beam forming. [5M]

9(a) Explain about LMS adaptation algorithms. [5M]

(b) Explain echo cancelling application of LMS algorithm in telephone circuits. [5M]

10.The performance surface is given by $\gamma=11+4w+0.5w^2$, . What is the range of convergence parameter will provide an over damped weight adjustment curve. [10M]

UNIT –IV

RLS ALGORITHM

1. (a) Draw the block diagram and signal flow graph of an RLS algorithm and derive an expression for it. [6M]

(b) What is matrix inversion lemma and explain it? [4M]

2(a) Derive the condition for mean-square deviation of RLS algorithm. [5M]

(b) Explain importance of transversal filters in RLS algorithm. [5M]

3(a) Discuss about convergence behavior of RLS algorithm. [5M]

(b)Explain about ensemble average learning curves. [5M]

4(a) Explain about the recursion for updating the sum of weighted error squares and why. [5M]

(b) Write about convergence analysis of RLS algorithm. [5M]

5(a) Explain how RLS algorithm is used in adaptive equalization. [5M]

(b) Explain about the selection of the regularization parameter. [5M]

6(a) Discuss about the recursive mean square estimation for random variables. [6M]

(b) Explain single-weight adaptive noise canceller. [4M]

7(a) Explain exponentially weighted recursive lest square algorithm. [7M]

(b) Explain signal to noise ratio for adaptive equalization [3M]

8. Explain about recursion for the sum of weighted error squares. [10M]

9(a) Explain about applications of RLS algorithm on adaptive equalization. [5M]

(b) Explain the concept of regularization. [5M]

10(a) Explain the importance of RLS algorithm in Adaptive signal processing. [5M]

(b)What are the advantages of RLS algorithm over LMS algorithm. [5M]

UNIT –V

KALMAN & NON-LINEAR ADAPTIVE FILTERING

1. (a) Write about statement of Kalman filtering problem and explain it. [5M]

(b) Explain how Kalman gain vector is computed in LMS algorithm. [5M]

2(a) Write about blind equalization. [5M]

(b) Discuss the principles of adaptive echo-canceller. [5M]

3 (a) What is an extended Kalman filter? Explain how the block diagram of a Kalman filter is to be modified to derive extended Kalman filter. [5M]

(b) Draw the signal-flow graph representation of the Kalman and extended Kalman filters. Show that for a linear model of a dynamic system these two representations are same. [5M]

4 (a)Explain Bussgang algorithm for blind equalization. [5M]

(b)Explain about Blind equalizer in detail. [5M]

5(a) Discuss about the recursive mean square estimation for random variables. [6M]

(b) What are the practical considerations for subspace decomposition? [4M]

6 (a) Write the different approaches for blind deconvolution. [5M]

(b) Explain an algorithm used for blind equalization [5M]

7.With the help of block diagram explain Kalman filter. Discuss the role of each block with necessary equations. [10M]

8 (a) Explain Square root filtering phenomenon. [5M]

(b) Explain about various considerations for blind deconvolution. [5M]

9.Write short notes on the following with respect to Kalman filter:

(a) Divergence phenomenon [5M]

(b) UD factorization [5M]

10(a) Write a short note on recursive mean square estimation of random variable. [5M]

(b) Briefly discuss about extended Kalman filtering. [5M]

Prepared by: **P.SAI KUSUMA-ECE Dept**