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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, APRIL/MAY 2018

Branch:Electronics & Communication

Stream(s):

1. ***Signal Processing***
2. ***Microwave & Television Engineering***
3. ***Telecommunication Engineering***

Course Code & Name:

01EC6302, ESTIMATION AND DETECTION THEORY

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

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PART A

1. Derive Neyman-Pearson Theorem 9
2. Find the MAP decision rule for 9

$$H_0 : x[0] \sim N(0,1)$$
$$H_1 : x[0] \sim N(0,2)$$

if $P(H_0)=1/2$ and also if $P(H_0) = 3/4$. Sketch the decision regions.

3. Consider the detection problem of deterministic signal s[n], n=0,1,....,N-1 embedded in correlated noise w[n], n=0,1,....,N-1, $w \sim N(0,C)$. Derive a matched filter receiver for the detection. 9

PART B

4. If x[n]=A+w[n], for n = 0,1,....N-1 are observed and w =[w[0], ...,w[N-1]] ~ N(0,C), find Cramer-Rao lower bound of A. 9
5. Sinusoidal signal $s[n] = A\cos(2\pi f_0 n + \Phi)$ unknown amplitude A, A >0, and unknown phase is embedded in noise. Find the least square estimate for A and Φ. 9
6. Consider the data $x[n] = Ar^n + w[n]$, n = 0,1, ... , N-1, where A is the parameter to be estimated, r is a known constant and w[n] is zero mean white noise with variance σ^2. The parameter A is modeled as a random variable with mean μ_A and variance σ^2_A and is independent of w[n]. Find the LMMSE estimator of A. 9

PART C

7. Consider the estimation of desired signal d[n] based on an excitation x[n] where d[n] and x[n] are assumed to be real valued stationary process. Derive the expression for Wiener filter tap weights $w=[w_0\, w_1 .... w_{N-1}]$ which minimize the estimation error e[n] = d[n]-y[n], where y[n] is the output of the Wiener filter. 12
8. Discuss the applications of Kalman filtering in image processing. 12
9. a Discuss the applications of Maximum Likelihood Estimation in Communication receivers. 6

   b Discuss the applications of Wiener filter in speech processing and image processing. 6

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