APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY
08 PALAKKAD CLUSTER

Q. P. Code : CES0819222-I **(Pages: 3)** **Name:** ....

Reg. No: ....

SECOND SEMESTER M.TECH. DEGREE EXAMINATION APRIL 2019

Branch: Electronics & Communication Engineering Specialization: Communication Engineering & Signal Processing

08EC 6222 ESTIMATION & DETECTION

Time: 3 hours **Max. Marks: 60**

Answer all six questions.

Modules 1 to 6: Part 'a' of each question is compulsory and answer either part 'b' or part 'c' of each question.

Q.no.	Module 1	Marks
1.a	Determine the Maximum-Likelihood decision rule associated with the following messages. m_1: $p(z/m_1) = \frac{1}{\sqrt{2\pi}}\exp(\frac{z^2}{2})$; m_2: $p(z/m_2) = \frac{1}{2\sqrt{2\pi}}\exp(\frac{z^2}{8})$	3
	Answer b or c	
b	State and explain MAP Decision criterion.	6
c	Determine the decision rule associated with the following conditional probabilities: m_1: $p(z/m_1) = \begin{cases} e^{-z} & for\ z \geq 0 \\ 0 & othrewise \end{cases}$; m_2: $p(z/m_2) = \begin{cases} e^{z-1} & for\ z \leq 1 \\ 0 & othrewise \end{cases}$ with $P\{m_1\} = 0.5$, $P\{d_2 \mid m_1\} = 0.1$ using (1) Neyman-Pearson criterion (2) Probability of error criterion.	6

Q.no.	Module 2	Marks
2.a	State and explain MIN-MAX Criterion.	3
	Answer b or c	
b	Determine the Baye's decision rule associated with the following conditional probabilities: $$m_1: \quad p(z/m_1) = \frac{1}{2}e^{-\lvert z\rvert}$$ $$m_2: \quad p(z/m_2) = e^{-2\lvert z\rvert}$$ The costs are given by $C_{11}= C_{22}=0$; $C_{12}=1$; $C_{21}=2$ and $P\{m_2\}=0.75$.	6
c	Explain BAYES RISK criterion with example.	6

Q.no.	Module 3	Marks
3.a	Write a short note on Integrating optimum receiver.	3
	Answer b or c	
b	If the observation is formed by adding an independent zero-mean, unit-variance Gaussian random variable to each component of the signal vector : $z = s + n$, where n and s are I-dimensional vectors and $$s_1 = \begin{bmatrix} 0 \\ 0 \\ 0 \\ . \\ . \\ 0 \end{bmatrix} \text{ and } s_2 = \begin{bmatrix} s_1 \\ s_1 \\ s_1 \\ . \\ . \\ s_1 \end{bmatrix}$$ Obtain an optimum decision for this problem. Find the expression for sufficient statistic $l(z)$ and the decision region.	6
c	With neat block diagram, explain matched filter receiver.	6

Q.no.	Module 4	Marks
4.a	State and explain Baye's estimation criterion.	3
	Answer b or c	
b	Obtain an expression for linear minimum variance estimator $\hat{\theta}_{LMV}$ for the two dimensional observation of a scalar parameter given by $$Z=\begin{bmatrix} 1 \\ 1 \end{bmatrix}\theta + \begin{bmatrix} n_1 \\ n_1 \end{bmatrix}$$ where the statistical parameters are $\mu_\theta=0$; $V_\theta=V$; $\mu_n=0$; $V_n==\sigma^2 I$.	6

c	Briefly explain linear mean squares method.	6

Q.no.	Module 5	Marks
5.a	Explain maximum likelihood estimation.	4
	Answer b or c	
b	Develop a linear unbiased minimum error variance algorithm for state estimation for the given vector equation $X(k+1) = \phi(k+1)\, x(k) + \Gamma\,(k) w(k)$ w(k) is the input noise and zero mean white noise process with co-variance cov $\{w(k), w(j)\} = V_w(k) S_k(k-j)$	8
c	Show that for any unbiased estimator of a scalar θ, the conditional variance is bounded by $\mathrm{var}\{\hat{\theta}\,/\theta\} \geq (\{E\partial/\partial\theta(\ln p(z/\theta)\,\}\hat{}2)^{-1}$ Define an efficient estimate. Prove that the maximum likelihood estimate for the parameter θ from the set of observations $Z_i = \theta + n_i \qquad i = 1,2,3,\ldots I$ n's are identically distributed Gaussian random variable with zero mean and σ^2 variance.	8

Q.no.	Module 6	Marks
6.a	What is concept of sufficient statistics?	4
	Answer b or c	
b	Briefly explain minimum variance unbiased estimation.	8
c	Write short note on sensitivity and error analysis.	8