

Branch Name:	Signal Processing and Communication
Program Code:	ET214
Course Name:	Detection and Estimation Theory
Course Code:	2ET2140104T
Pre-requisite Subject	Signals and Systems, Probability and Random Processes, Linear Algebra

Course Objective:

1. To study the detection and estimation with the processing of information bearing signals for the purpose of making inferences about the information that they contain.
2. To provide an introduction to the theoretical principles underlies the development and analysis of techniques for such processing.
3. To study the Detection and estimation applications involve making inferences from observations that are distorted or corrupted in some manner.

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40		-	-	-	100

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1	Background: Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain	2	5
2	Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.	8	15
3	Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, Frequency and arrival time, linear model.	6	15
4	Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.	6	15
5	Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.	6	15

6	Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics, linear models, best linear unbiased estimation, maximum likelihood estimation, invariance principle, estimation efficiency, Bayesian estimation, philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.	6	20
7	Signal Estimation in Discrete-Time: Linear Bayesian estimation, Wiener filtering, dynamical signal model, discrete Kalman filtering.	5	10
Total		39	100

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the time table) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same. Recommended sites for journal papers are (1) dl.acm.org (2) springer.com (3) sciencedirect.com (4) elsevier.com (5) ieeexplore.ieee.org (6) scholar.google.co.in (7) scopus.com or others of same repute.

List of Text Book:

1. "Detection, Estimation, and Modulation Theory, Part I, II, and III", H. L. Van Trees, John Wiley, 1968

References

1. "An Introduction to Signal Detection and Estimation", H. V. Poor, Springer, Second Edition, 1998
2. "Fundamentals of Statistical Signal Processing: Detection Theory", S. M. Kay, Prentice Hall, 1998
3. "Fundamentals of Statistical Signal Processing: Estimation Theory", S. M. Kay, Prentice Hall, 1993

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To understand statistical decision theory, detection of deterministic and random signals, nonparametric detection	1 Remembering 2 Understanding
CLO2	To understand and Learn various estimations methods.	2 Understanding
CLO3	To develop various applications namely, Direction-of-arrival and time-of-arrival estimation algorithms, Source localization/positioning systems,	2 Understanding
CLO4	Detection of weak signals and signals with structure.	3 Applying
CLO5	Estimation of Signal Parameters	4 Analyze
CLO6	Signal Estimation in Discrete-Time	6 Create

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CLO1					L	M						H	H	M	L	
CLO2		H	M	M	L					L		H		M	L	
CLO3		M	H		L									H		L
CLO4		M	H		L			L					L		M	H
CLO5	H	M	H		L				L			H	L		M	H
CLO6	H	M	H		L							M	L		M	H

H: High, M: Medium, L: Low