



National Institute of Technology Meghalaya
An Institute of National Importance

CURRICULUM

Programme	M.Tech/Ph.D	Year of Regulation	2021-22
Department	Electronics and Communication Engineering	Semester	II

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	T	P	C	INT	MID	END	Total	
EC 548	Signal Detection and Estimation Theory	3	0	0	3	50	50	100	200	
Course Objectives	To provide students an understanding of the concepts related to application of statistical hypothesis testing to the detection of signals in noise.	Course Outcomes	CO1	Able to use the statistical information in basic detection theory to solve the problems that involve detection of signals in the presence of noise						
	To explore the detection of multiple signals with unknown parameters.		CO2	Able to detect multiple types of signals (deterministic signals, random signals, signals with unknown parameters)						
	To familiarize students on the concepts of statistical parameter estimation methods to extract information from signals in noise.		CO3	Able to analyse optimal estimators for various signal parameters.						
	To summarize the application of filtering in signal detection and estimation process.		CO4	Able to understand optimal filtering, linear estimation, and Wiener/Kalman filtering.						

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	CO1	3	2	2	1	0	0	0	0	2	0	0	0	3	2	3	0
2	CO2	2	3	2	2	0	0	0	0	2	0	0	0	3	1	2	0
3	CO3	1	2	3	2	2	0	0	0	0	0	0	1	2	2	3	0
4	CO4	1	3	3	0	0	0	0	0	1	0	0	0	2	3	2	0

SYLLABUS

No.	Content	Hours	COs
I	<i>Background:</i> Review of random variables and processes, review of vector space and vector-space interpretation of random variables, problem formulation and objectives of signal detection and signal parameter estimation in discrete-time domain.	03	CO1
II	<i>Statistical Decision Theory:</i> Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio test (LRT), receiver operating characteristics, composite hypothesis testing, locally optimum tests, generalized LRT, detector comparison techniques, asymptotic relative efficiency	05	CO1
III	<i>Detection of Deterministic Signals:</i> Matched filter detector and its performance, generalized matched filter, detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.	03	CO2
IV	<i>Detection of Random Signals:</i> Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.	05	CO2
V	<i>Nonparametric Detection:</i> Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.	05	CO2
VI	<i>Estimation of Signal Parameters:</i> 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.	12	CO3 CO4
VII	<i>Signal Estimation in Discrete-Time:</i> Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.	03	CO4
Total Hours		36	

Essential Readings

- H. L. Van Trees, "Detection, Estimation and Modulation Theory", Part I, II, and III, Second Edition, John Wiley, 2012.
- H.V.Poor, "An Introduction to Signal Detection and Estimation", Second Edition, Spring Verlag, 1994.
- S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", First edition, Printice hall, Volume I, 1993.
- S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", First edition, Printice hall, Volume II, 1998.

Supplementary Readings

- D. L. Melsa and J. L. Cohn, "Detection and Estimation Theory", First edition, McGraw Hill, 1978.
- L. L. Scharf, "Statistical Signal Processing: Detection, Estimation, and Time Series Analysis", First edition, Addison-Wesley, 1991.