NIRMA UNIVERSITY
School of Technology, Institute of Technology
B.Tech. Electronics & Communication Engineering
Semester - VII
Department Elective IV

L	T	P	C
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Course Code	2ECDE06
Course Title	Estimation and Detection Theory

Course Outcomes (COs):

At the end of the course, students will be able to -

1. apply hypothesis testing using Bayes, Minimax, and Neyman Pearson criteria for random parameters and evaluate performance using receiver operating characteristics.
2. analyse estimation criteria using MMSE, MAP, and MLE for random parameters and unknown constants.
3. evaluate the performance of digital communication systems and spectrum sensing techniques using detection and estimation theory.
4. comprehend the performance of RADAR and Biomedical signal processing using detection and estimation techniques.

Syllabus **Teaching Hours: 45**

UNIT 1: Introduction **05**

Overview of probability and random variables, functions of random variables, characterization of random processes, types of random processes, statistics of random processes.

UNIT II: Detection Theory

Hypothesis testing, Bayes criterion, Mini-max criterion, Neyman Pearson (NP) criterion, multiple hypothesis testing, composite hypothesis testing, receiver operating characteristics (ROC), non-parametric and sequential likelihood ratio detectors. **10**

UNIT III: Estimation Theory

Basic Estimation criteria or random parameters and unknown constant, minimum mean square error (MMSE), maximum a posteriori (MAP), maximum likelihood estimate (MLE), Cramer Rao (CR) bound **10**

UNIT IV: Detection and Estimation of Signals

Detection of signals in additive white Gaussian noise, linear estimation, detection and estimation in nonwhite Gaussian noise, Wiener filter, Kalman filter, forward and backward predictions. Yule walker equations. **10**

UNIT V: Applications of Detection and Estimation Theory

Detection and tracking of an object in RADAR, detection of signals in Biomedical signal processing, detection in spectrum sensing techniques in cognitive radio. **10**

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. H. L. Van Trees, Detection, Estimation and Modulation Theory, Part I, Wiley
2. Papoulis, Probability, Random Variables and Stochastic Processes, TMH
3. R. D. Hippenstiel, Detection Theory: Applications and Digital Signal Processing, CRC Press
4. Mourad Barkat, Signal Detection and Estimation, Artech House
5. E. Biglieri, A. J. Goldsmith, H. Vincent Poor, Principle of Cognitive Radio, Cambridge

L = Lecture, T = Tutorial, P = Practical, C = Credit