M.Tech (Microwave & Communication Engineering) PVP17

DETECTION AND ESTIMATION THEORY

17ECMC1T1 **Credits: 4**
Lecture: 4 periods/week **Internal assessment:40 marks**
Semester end examination: 60 marks

Prerequisites: **Linear Algebra, Random Process**

Course Objectives:

- To Analyse the need for estimation techniques in Communication and Signal Processing
  To analyse estimation problems and apply suitable estimation and detection techniques.
- To Analyse signal or parameter estimation techniques are preferred and develop estimation techniques that are suitable for the context from a wider perspective
- To Analyse impact of white Gaussian noise on Detection of Signals

Course Outcomes:

At the end of the course Student will be able to

- Implement the estimation techniques in Communication and Signal Processing problems and acquire expertise in Classical and Bayesian estimation techniques for parameters and signals, and Detection of signals in the presence of white Gaussian noise
- Conduct in-depth analysis of estimation problems and apply suitable estimation and detection techniques that meet the constraints of the problem such as performance, bandwidth and power overheads and computational complexity
- Judge the scenarios under which signal or parameter estimation techniques are preferred and develop estimation techniques that are suitable for the context from a wider perspective
- Design and implement the solutions to problems that are critical to humanity

UNIT I

Fundamentals of Estimation Theory: Role of Estimation in Signal Processing, Unbiased Estimation, Minimum variance unbiased(MVU) estimators, Finding MVU Estimators, Cramer-Rao Lower Bound, Linear Modelling-Examples, Sufficient Statistics, Use of Sufficient Statistics to find the MVU Estimator .

UNIT II

Estimation Techniques
Deterministic Parameter Estimation: Least Squares Estimation-Batch Processing, Recursive Least Squares Estimation, Best Linear Unbiased Estimation, Likelihood and Maximum Likelihood Estimation
Random Parameter Estimation: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation
State Estimation: Prediction, Single and Multistage Predictors, Filtering, TheKalman Filter

UNITIII

Fundamentals of Detection Theory :

Hypothesis Testing: Bayes' Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Min-Max Criterion, Neyman-Pearson Criterion, Multiple Hypothesis, Composite Hypothesis Testing: Generalized likelihood ratio test (GLRT), Receiver Operating Characteristic Curves.

UNIT IV

Detection of Signals in White Gaussian Noise (WGN) : Binary Detection of Known Signals in WGN, M-ary Detection of Known Signals in WGN, Matched Filter Approach, Detection of signals with Random Parameters

Text Book:

1) H. L. Van Trees, "Detection, Estimation and Modulation Theory," Parts 1 and 2, John Wileyand Sons

References:

1) H. V. Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer-Verlag, 1994.
2) E. L. Lehman, "Testing Statistical Hypothesis," John Wiley, 1986.
3) M. D. Srinath, P. K. Rajasekaran and R. Vishwanathan, "An Introduction to statistical Signal Processing with Applications," Prentice-Hall, 1996.