

# E1 244: Detection and Estimation Theory

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Class held on: 05 Aug 2009 (write the date of the lecture you are transcribing here)

## 1 Topics

- Introduction to the transcribing of class notes
- Syllabus and course schedule
- Other topics of interest

## 2 Class Notes

Remember to:

- Change the file-name of the class-notes - replace 01\_Jan\_2011 with the date of the lecture you are transcribing.
- Replace the author field with your name
- Replace the e-mail address field with your email address. Preferably, use a “permanent” email address.
- Replace the Date field with the date of the lecture you are transcribing.

**Course Description:** This course is an introduction to the basic theory of signal detection and estimation. The first part of the course is on parameter estimation. We will discuss various estimation criteria, present various optimal estimators and investigate their performance. The second half is on statistical inference, or detection theory. Various techniques for detection and performance analysis will be discussed. Time permitting, we will discuss more advanced topics and applications including the EM algorithm, decentralized detection, change detection, etc, towards the end of the course. The **prerequisite** for this course is the Random Processes class.

Course website: <http://ece.iisc.ernet.in/~cmurthy>. Click on E1 244 on the left panel.

Google group: <http://groups.google.com/group/E1-244-spring-2011>

Instructor: Chandra R. Murthy

T. A.: B. N. Bharath and Nirmal Shende

Grading:

- Test - 1: **Friday, 11th Feb. 2011, in class (25%)**  
Test - 2: **Monday, 14th Mar. 2011, in class (25%)**  
Final: **Friday, 26th Apr. 2011, 9am-12pm (50%)**

**Homeworks:**

- Homeworks will be in the form of problem sets that are given out periodically and also as isolated problems that occur during lectures. You are encouraged to do the homeworks either in teams or on your own. Either is fine so long as you understand what's going on.
- Some homeworks will be in the form of Matlab programming assignments. You can complete them either using SERC's computational resources (make sure you have a working account) or using your own or your advisor's computational resources.

**Textbooks/References:**

1. H. V. Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer-Verlag, 1994.
2. H. L. Van Trees, "Detection, Estimation and Modulation Theory," Parts 1 and 2, John Wiley Inter-Science.
3. E. L. Lehman, "Testing Statistical Hypothesis," John Wiley, 1986.
4. M. D. Srinath, P. K. Rajasekaran and R. Vishwanathan, "An Introduction to Statistical Signal Processing with Applications," Prentice-Hall, 1996.
5. To review probability: A. Papoulis, "Probability, random variables, and stochastic processes," McGraw-Hill International Edition.

**Tentative Lecture Schedule**

Sl. No.	Topics	# Lectures
1	Estimation theory: Bayesian, MMSE and MAP estimation	2
2	Fischer-Neyman factorization theorem, Rao-Blackwell theorem	2
3	Maximum-Likelihood estimation	2
4	Exponential families and the Cramer-Rao Bound	2
5	Consistency, efficiency and asymptotics	2
6	Kalman filtering	2
7	Linear estimation of signals, Weiner filtering	2
8	Bayesian, Neyman-Pearson & Minimax detection	2
9	Composite hypothesis testing, Generalized LRT	2
10	Sequential and distributed detection	4
11	Performance analysis	2
12	Signal detection in continuous time, KL theorem	2
13	Detection in Gaussian noise	2