

CT 505: Detection & Estimation Theory

DAU (Formerly DA-IICT), Autumn Semester 2025-2026

Instructor: Dr. Abhishek Jindal

Course Credits (L-T-P-C): 3-0-0-3

Course Level (UG/PG): Senior UG & PG (For B.Tech 5th/7th and M.Tech 1st semesters)

Lecture Timings: TBD

Laboratory Timings: TBD

Prerequisites: For senior UG students - SC224: Probability & Statistics or MC216: Probability & Random processes, and SC223: Linear Algebra; For PG students: any course on probability at UG level

Course Contents:

1. Maximum likelihood theory
2. Minimum variance and best linear unbiased estimators
3. Cramer-Rao Lower bound
4. Bayesian, MMSE and MAP estimation
5. Kalman filter
6. Bayesian, Neyman-Pearson & Minimax detection
7. Composite hypothesis testing, Generalized LRT
8. Detection of random/deterministic signals in presence of noise

Assignments: Although the course has no dedicated slot for the tutorial, analytical problems will be regularly given to be solved. The solution may or may not be required to be submitted. The problems shall help in preparing for the exams.

Course References:

1. *Fundamentals of Statistical Signal Processing - Volume I: Estimation Theory*, Steven M. Kay, publisher: Prentice Hall, 1993.
2. *Fundamentals of Statistical Signal Processing - Volume II: Detection Theory*, Steven M. Kay, publisher: Prentice Hall, 1993.
3. *An Introduction to Signal Detection and Estimation (2nd Edition)*, H. V. Poor, publisher: Springer-Verlag, 1994.
4. *Statistical Inference for Engineers and Data Scientists*, Moulin and Veeravalli, publisher: Cambridge University Press, 2019.
5. *Statistical Inference (2nd Edition)*, Casella and Berger, publisher: Duxbury Press, 2002.
6. *Signal Detection and Estimation*, Mourad Barkat, publisher: Arctech House, 2005.

Evaluation Policy:

First In-Semester Examination (20 August to 23 August)	30%
Second In-Semester Examination (03 October to 07 October)	30%
End-Semester Examination (21 November to 29 November)	40%

Attendance Policy: Attendance will be marked in each lecture. At the end of the semester, if a student has an overall attendance of less than 70% and he/she has scored a total marks of Y out of 100, then the total marks will be recalculated as $Y - \min(5, 70 - \text{your attendance in \%})$. Note that the 30% of absence includes all medical and co-curricular-activities related leaves.

Course Outcomes: After completing the course, students will be able to:

- The hypothesis testing framework.
- Understand the theory of receiver design under additive noise.
- Design and performance analysis of various estimation algorithms.

P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
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Lecture Schedule:

Description	No. of Lectures
Topics 1-3	15
Topic 4-5	8
Topics 6-7	12
Topic 8	5