Course Code	ECE672
Course Name	Stochastic Estimation and control
Credits	2
Course Offered to	UG/PG
Course Description	This course deals with the estimation of dynamical systems. We will begin with an introduction of probability, random variables, stochastic differential equations, and basics in parameter estimation. These concepts will then be applied to state-space descriptions of linear systems following up to the Kalman filter. Nonlinear estimation methods such as the extended Kalman filter and particle filter will be introduced.

Pre-requisites

Pre-requisite (Mandatory)	**Pre-requisite (Desirable)**	**Pre-requisite(other)**
Probability and Random Processes (ECE501)		

Post Conditions

CO1	**CO2**	**CO3**	**CO4**	**CO5**
Develop and linearize a measurement model for a dynamical system	Pick an state estimator based on the system properties (nonlinearities, noise)	Given a dynamical system with process and measurement noise, design a linear/nonlinear state estimator		

Weekly Lecture Plan

Week Number	**Lecture Topic**	**Assignment/Labs/Tutorial**
1	Introduction to probability and random processes: random variables, pdf, total probability theorem, Bayes' Theorem, stochastic processes, stationarity, ergodicity	
2	Basics of estimation: Parameter estimation, maximum likelihood estimation, least squares estimation, maximum a posteriori estimation, minimum mean square estimation	Homework 1
3	Estimation of dynamic systems: Specialize to LTI systems, state space form, Recursive static estimation, minimum variance (f)	
4	The discrete time Kalman filter	Homework 2
5	The continuous time Kalman filter (f)	
6	Nonlinearity in dynamic systems, measurement models/likelihood functions, linearization	Homework 3
7	Nonlinear estimators: Extended Kalman filter, sampling a pdf, particle filter	

Assessment Plan

Type of Evaluation	**% Contribution in Grade**
Homework	60
Final Exam	40

Resource Material

Type	**Title**
TextBook	Class notes (adapted from "Stochastic estimation and control" course taught in University of Maryland, College Park)
Reference	Papoulis, A., Probability, Random Variables, and Stochastic Processes, ISBN 0070484775
Reference	Y. Bar-Shalom, X. R. Li, and T. Kirubarajan, Estimation with Applications to Tracking and Navigation: Theory Algorithms and Software. Wiley Inter-Science, 2001.