THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Random Dynamical Systems

AEROENG 8830

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Elements of axiomatic theory of probability, measure theory, stochastic differential equations, and martingales. Study of tools, e.g., sequential Monte Carlo, stochastic linearization, moment closure, Fokker-Planck equations, parameter estimation.

Prerequisites and Co-requisites:
Prereq: ECE 6001, or Grad standing in Mechanical or Aerospace Engineering, or permission of instructor.

Course Goals / Objectives:
- Fundamentals of deterministic dynamical systems; linear systems, linearization
- Build the foundation of the axiomatic theory of probability as developed by Kolmogorov: sets, measurable spaces, conditional probability, random variables, expectations, conditioning, independence, convergence of random variables
- Use of indirect tools for probabilistic analysis: Generating functions: moment generating functions, characteristic functions; limit theorems: laws of large numbers and central limit theorem
- Develop basic understanding of random processes, starting with sources of uncertainty in dynamic systems. Focus initially on linear dynamic random systems, power spectral density, wide sense stationary processes
- Build an in-depth understanding of Markov chains, their recurrence and stationarity. Develop the theory that leads to sampling algorithms, importance sampling, Markov chain Monte Carlo and stochastic optimization
- Develop the theory and tools for continuous time stochastic processes: stochastic differential equations, Brownian motion, Monte Carlo simulations, Direct moment closure, stochastic linearization, Fokker-Planck equations and its stationary solutions

Course Topics:

- Deterministic Dynamical Systems
- Numerical Simulations and Linear Perturbation Theory
- Axiomatic Theory of Probability
- Convergence of random variables
- Generating functions
- Random walks
- Limit Theorems
- Markov chains
- Stationary solutions
- Sequential Monte Carlo, Markov chain Monte Carlo, Stochastic Optimization
- Stochastic differential equations
- Wiener process, Brownian motion
- Moment closure
- Stochastic linearization
- Fokker-Planck equations, stationary solutions

Designation:

Elective