ECE 250 SYLLABUS FALL 2018

WEEKS 1 & 2 - SINGLE RANDOM VARIABLES

- Definition of a Random Variable
- Discrete Random Variables
  - Cumulative Distribution Function &Probability Mass Function
  - Some important Discrete Random Variables
    - Binary; Binomial; Poisson
- Continuous Random Variables
  - Cumulative Distribution Function and Probability Density Function
  - Some Important Continuous Random Variables
    - Uniform; Exponential; Gaussian; Cauchy
- Expected Value & Moments of a Random Variable
  - Mean
  - Variance
  - Higher Moments
- Characteristic Function
  - Properties of Characteristic Functions
  - Characteristic Function **MAY** be determined by Moments
  - Moments from a Characteristic Function
- A Useful Inequality
  - Chebyshev Inequality
- Functions of a random variable
  - Expected value of a function of a random variable

WEEKS 2, 3, & 4 - MULTIPLE RANDOM VARIABLES

- PAIRS OF RANDOM VARIABLES
  - Joint Distribution, Probability Mass Function and Probability Density
  - Marginal Distribution, Probability Mass Function and Probability Density
  - Independence
  - Conditional Probability and Conditional Expectation
    - Bayes Theorem
    - Total Probability
  - Expected Value and Joint Moments of Pairs of Random Variables
    - Correlation
    - Covariance
    - Correlation coefficient
    - Schwarz Inequality
  - Joint Characteristic Function
    - Properties of Joint Characteristic Function
    - Joint Characteristic Function **MAY** be Determined by Joint Moments
    - Joint Moments from a Joint Characteristic Function
  - Sum of two Random Variables
    - Probability Mass Function and Probability Density of Sum
    - Independent Random Variables
      - Convolution of Probability Mass Function and Probability Density
      - Product of Individual Characteristic Functions
  - Jointly Gaussian Variables

Independent Gaussian Variables
Central Limit Theorem

FAMILIES OF RANDOM VARIABLES

WEEKS 5, 6, & 7 - RANDOM PROCESSES

Definition of a Random Process
- Examples of Random Processes
  - Discrete Time Process - Sequence of Independent Random Variables
  - Continuous Time Process - Random Sinusoid

Characterization of Random Processes
- Finite Dimensional: Probability Mass Functions
  - Distributions
  - Densities
  - Characteristic Functions

Second Order Random Processes
- Mean and Auto Correlation Function

Properties of Random Processes
- Stationary Random Processes
  - Strict Sense Stationarity
  - Wide Sense Stationarity (WSS)
- Independent Increment Processes

Some Important random processes
- Gaussian Process
- Poisson Process
- Random Telegraph Signal
- Shot Noise Process

Narrow Band Gaussian Process
- Sinusoid + Narrow Band Gaussian Process

Weeks 8, 9 & 10 ANALYSIS AND PROCESSING OF SECOND ORDER RANDOM PROCESSES

Power Spectral Density for Wide Sense Stationary (WSS) Processes
- Discrete Time - Sequence of Independent Variables Example
- Continuous Time - Random Sinusoid Example
- White Noise Process

Response of Linear Systems to Random Process Inputs
- Relationship Between Input and Output Mean and Correlation Function
  - General Case
  - Wide Sense Stationary Case
- Relationship Between Input and Output Power Spectral Density (WSS Case)

Some Applications
- Minimum Mean Square Error Estimation/Prediction
- Matched Filter