Communication Theory and Systems (CTS)

Students taking the CTS section of the MS Written Comprehensive Exam will be tested on a graduate question based on ECE 153/250 (Random Processes). The material can be found in the following textbooks:

- Probability and Random Processes for Electrical Engineering by A. Leon-Garcia (Prentice Hall, 3rd edition, 2008)
- *Probability, Random Processes, and Estimation Theory for Engineers* by H. Stark and J. W. Woods (Prentice-Hall 1986)
- *Probability, Random Variables and Stochastic Processes* by A. Papoulis (McGraw Hill, 2nd edition, 1984)

The topics covered may include:

1) Basic Probability Theory

Basic axioms; probability space and measure; sigma fields, conditional probability and independence, random variable; probability distribution and density, random vectors (multivariate random variables); independence; conditional distributions, functions of random variables and random vectors, expectation, conditional expectation and its properties.

2) Sequences of Random Variables

Different notions of convergence, limit theorems, large deviations.

3) Random Vectors and Minimum Mean Squared Error (MMSE) Estimation

Best linear MMSE estimators, MMSE estimators, orthogonality principle, jointly Gaussian random variables and vectors random processes continuous - and discrete-time random processes, stationarity and wide-sense stationarity (WSS), second-order processes; mean and correlation function spectrum, Markov processes and martingales; Gaussian, Wiener, and Poisson processes.

4) Calculus for Random Processes

Continuity of random processes; differentiation and integration, orthogonal representation of random processes (Karhunen-Loeve expansion), ergodicity

5) Stationary Random Processes and Spectral Analysis

Wide sense stationary processes (WSS), power spectral density and its estimation, random processes through linear systems, spectral representation of random processes, minimum mean squared error (MMSE) estimation MMSE estimation and linear MMSE estimation for random vectors (the orthogonality principle), discrete- and continuous-time Kalman filter, the Wiener filter; spectral factorization.