**ECE PhD Screening Exam Topics: Communications**

PROBABILITY AND RANDOM PROCESSES

Basic Concepts of Probability Theory

Random Variables

Functions of a Random Variable

The Expected Value of Random Variables

The Markov and Chebyshev Inequalities

Transform Methods

The Characteristic Function

The Probability Generating Function

Multiple Random Variables

Sums of Random Variables

The Central Limit Theorem

Random Processes

Definition of a Random Process

Specifying a Random Process

Stationary Random Processes

Wide-Sense Stationary Random Processes

Wide-Sense Stationary Gaussian Random Processes

Time Averages of Random Processes and Ergodic Theorems

Analysis and Processing of Random Signals

Power Spectral Density

Response of Linear Systems to Random Signals

Optimum Linear Systems

Matched Filter

COMMUNICATIONS

Link budget analysis

Binary Digital Communications: BPSK, OOK, BFSK, and DPSK, baseband and passband waveforms, signal bandwidth, baseband line codes

Coherent demodulators for binary signaling and performance in AWGN

Noncoherent demodulators for binary signaling and performance in AWGN

Intersymbol interference

Effect of noise on FM receivers, FM threshold, threshold extension using PLL and PM and FM with feedback, pre-emphasis and de-emphasis

Bandwidth efficient digital communications: CPFSK, QPSK, OQPSK, and MSK waveforms, signal bandwidth, receiver structure, performance in AWGN, comparison with binary signaling schemes

Carrier, phase, and symbol synchronization: Phase-locked loops, Costas loops, open loop symbol synchronizers, delay-locked loops

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**Note:** This list is provided only as a guideline to the student and may not be completely comprehensive. Examiners reserve the right to determine specific areas of concentration, and students may be examined on any topic that broadly relates to the area.