Subject: **Communication Theory**

Summary: This exam will evaluate the student's undergraduate and mature junior graduate understanding of communication theory and how it is used in the design and performance evaluation of communications systems. The specific topics to be addressed are provided as keywords below. Beyond these basic topics, which relate mainly to DIGITAL communications, you should have a basic understanding of analog communications systems, and of how the basic topics listed below impact actual digital communications systems.

Keywords

Background linear systems and stochastic processes:

- Discrete and continuous time linear system and Fourier theory, sampling theory.
- Discrete and continuous probability theory.
- Power spectra and correlation functions.
- Gaussian and other random processes.
- Geometric representation of signals and noise.

Source and Channel Coding and Information Theory:

- Theory of uniform and nonuniform quantizers.
- PCM representation of waveforms.
- Measures of information, entropy, Huffman coding, mutual information.
- Channel capacity.
- Simple block and convolutional coding techniques.
- Coding gain in binary and Gaussian channels, distance properties of codes.
- Soft and hard decision decoding in Gaussian channels.

Digital Transmission:

- Power spectrum and bandwidth of digitally modulated signals.
- Nyquist criterion for ISI (intersymbol interference-free transmission and pulse shaping to eliminate ISI)

- Baseband and carrier-modulated signalling: M-ary PAM, BPSK, QPSK, QAM, PSK, FSK.
- Optimal detection of these signals in Gaussian noise, based on the geometric representation of random waveforms, matched filtering.
- Methods of evaluating error probability.
- Differential and noncoherent detection.
- Signal-to-noise ratio (SNR) and Eb/N0.
- Comparison of different modulation formats with respect to required SNR or Eb/N0 and bandwidth.