PhD QUALIFYING EXAM STUDY GUIDE
Signals and Systems

Topics and Subtopics
• Basics of signals
  • Classification (continuous-time, discrete-time, energy, power, deterministic, random,...)
  • Real and complex sinusoids, phasor representations
  • Dirac and Kronecker delta functions, unit step function and properties
  • Orthogonality and orthonormal sets
  • Time autocorrelation functions
• Basics of systems
  • Linearity, time invariance, causality, BIBO stability, invertibility
• Time-domain representations of signals and systems
  • Convolution sum (discrete-time signals), convolution integral (continuous-time signals) and properties
  • LTI filtering using convolution
• Frequency-domain (Fourier) representations of signals and systems
  • Fourier Series and Transform, inverses and properties
  • Discrete-time and Discrete Fourier Transform and inverses
  • Properties of Fourier Series and Transform, Parseval’s Theorem
  • LTI filtering using Fourier techniques
  • Power spectral density and energy spectral density
• Laplace transform representation of signals and systems
  • Laplace transform (including region of convergence), inverse Laplace transform (including partial-fraction expansion), and properties
  • Poles and zeros in the s-plane
  • Solving differential equations with non-zero initial conditions via Laplace transform
  • LTI filtering using Laplace techniques
• z-transform representation of signals and systems
  • z-transform (including region of convergence), inverse, z-transform (including partial-fraction expansion), and properties
  • Poles and zeros in the z-plane
  • LTI filtering using z-transform
• Fundamentals of Sampling
  • Representation of continuous-time signals by sampling to discrete-time signals
  • Sampling theorem, Shannon/Nyquist sampling rate and ideal reconstruction
  • Effects of undersampling (sinusoidal case only)

Suggested Reference Materials

Suggested Reference Courses
• EEL 3135 - Discrete Time Signal & Systems
• EEL 3112 - Circuits 2

Sample Questions
• End-of-the-chapter problems in the suggested reference materials.