ECE 312: Linear Systems II

IN

Time and Frequency (ECE 311)

- Understands linearity, causality, stability, and time-invariance.
- Understands interplay between time and frequency domain analysis of LTI systems.
  - Impulse response and convolution
  - Complex frequency response and sinusoidal response
  - Bandwidth and time constant

ODEs and Transfer Functions (ECE 311)

- Understands connection between transfer functions, poles and zeroes, impulse response, complex frequency response, and ODE.

Block Diagrams (ECE 311)

- Can determine transfer function of a system built of other interconnected linear systems.

Fourier Analysis (ECE 311)

- Can analyze spectral components of inputs and outputs of systems.
- Can compute transforms and series for standard signals.

Simulation (ECE 311)

- Can analyze systems in time and frequency domain using MATLAB and/or Simulink tools.

Pre-requisites:

- ECE311

∗ = Optional

As of 12/9/08

Concepts:

- Laplace transform and its use in analyzing continuous-time LTI systems.
- Discrete time test signals, including impulses, steps, exponentials, and sinusoids.
- Properties of LTI systems (causality, stability, time-invariance, etc.).
- Representation of discrete LTI systems in terms of difference equations, convolution sum, and system response.
- Definition and use of Z-transform for discrete time signals and systems and its connection with DTFT.
- Connection between transfer functions, poles and zeros, units pulse response, complex frequency response, ordinary difference equations, and solutions.
- Introduction to FIR and IIR digital filter design.
- Definition and use of Discrete Fourier Transform.
- Sampling and aliasing
  - Sampling theorems in time and frequency.
  - Nyquist band
- Computation of energy/power spectral density.

∗ Correlation.

Applications:

- Communications
- Filtering and signal processing
- Computer based control systems
- Image processing.

Tools:

- MATLAB

OUT

ODE and Transfer Functions

- From an ordinary difference equation for an LTI discrete-time system can compute:
  - Transfer function
  - Poles and zeroes
  - Complex frequency response
  - Unit pulse response
- Understands connection between ODE, transfer function, unit pulse response, and complex frequency response.

Sampling and Aliasing

- Understands time and frequency domain sampling.
- Can specify anti-aliasing filter and sampling rate for alias-free A/D conversion.
- Understands the Nyquist band.

Z-Transform and DTFT

- Can compute Z and inverse Z transforms.
- Can use Z-Transform to analyze discrete-time systems.
- Can use Z transform to solve ordinary difference equations.
- Can compute and interpret discrete-time Fourier-transform (DTFT).

Digital Filters

- Can design simple digital filters to meet specifications.

DFT and FFT

- Can use Discrete Fourier Transform to analyze frequency content of discrete time signals and to analyze frequency response of systems.

∗ Understands sub-sampling theorem in time and frequency.

- Understands Fast Fourier Transform and its practical applications in discrete time filtering and signal processing.
- Understands connection between DFT products and circular convolutions.

ODE and Programmed Logic

∗ Can write assembly code for a programmable DSP from an ordinary difference equation.