

# ECE 311: Linear Systems I

IN

OUT

## Calculus (MATH 160, 161)

- Can integrate and differentiate.
- Understands fundamental theorem of calculus.
- Has command of trigonometry.

## Complex Arithmetic (ECE 202)

- Understands fundamentals of complex arithmetic.
- Can apply Euler's identity.

## ODEs (MATH 340/345)

- Able to solve linear ordinary differential equations.
- Can identify homogenous and particular solutions to an ODE.

## RLC and Op AMP (ECE 202)

- Can analyze  $n^{\text{th}}$  order R,L,C and Op Amp circuits and create a corresponding ordinary differential equation.

## Pre-requisites:

- ECE202 and MATH340 or MATH345

## Concepts:

- Continuous time test signals including:
  - Impulses
  - Steps
  - Exponentials
  - Sinusoids
- Properties of LTI systems (linearity, causality, stability, time-invariance, etc.).
- Representation of Linear, Time-Invariant (LTI) systems in terms of convolution integral and impulse response.
- Interconnection of LTI systems.
- Fourier Series of periodic signals.
- Fourier Transform for aperiodic signals.
- Connection between transfer functions, poles and zeros, impulse response, complex frequency response, ordinary differential equations, and solutions.
- Computation of energy/power spectral density.
- \* Correlation.

## Applications:

- Communications
- Filtering
- Signal Processing
- Control Systems
- Circuits

## Tools:

- MATLAB

## LTI Systems

- 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

- Understands connection between transfer functions, poles and zeroes, impulse response, complex frequency response, and ODE.
- \* Can design filters to meet specifications.

## Block Diagrams

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

## Fourier Analysis

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

## Simulation

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

## ODE and Op-Amps

- \* Can design an Op-Amp circuit from an ODE or frequency response specification.

\* = Optional

As of 12/9/08