EE 603WS: Linear System Theory
Syllabus

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Textbook: A.V. Oppenheim, A.S. Willsky, & S.H. Nawab, Signals and Systems, Second Edition, Prentice Hall, 1997

Prerequisites: Calculus, complex numbers and circuit analysis, (EE348)

Course Philosophy and Goals: This course is aimed at

- Exposing the student to analytic tools used in signal processing, communications and controls (Fourier and Laplace transforms, frequency domain description of linear systems, etc.,)

- Helping students generalize the notions learned in circuit analysis to more abstract linear systems and appreciate the wide applicability of system theory to various aspects of engineering and science

Grading:

Homework: in total 11 assignments 40%
Midterm: 30%
Final: 30%

Teaching Schedule

Week 1	Chapter 1. Introduction to continuous and discrete- time signals and systems
Week 2 Week 3	Chapter 2. Linear Time-Invariant Systems
Week 4	Chapter 3. Fourier Series
Week 5	Chapter 4. Continuous-Time Fourier Transform
Week 6	Review of Ch.3 vs. Ch.4
Week 7	**Miterm**
Week 8	Chapter 5. Discrete-Time Fourier Transform & Linear Optimization
Week 9	Chapter 6&8. Time-Frequency Characterizations; Sampling
Week 10	Chapter 9. LaplaceTransform
Week 11	Chapter 10: Z-Transform
Week 12	Z-Transform vs. Linear Systems
Week 13	Linear Transform vs. Linear Systems
Week 14	**Final**

1. **Introduction to continuous and discrete-time signals and systems**

   Transformations of independent variable, periodic signals, even and odd signals, continuous and discrete-time complex exponential & sinusoidal signals, periodicity properties of discrete-time complex exponentials, unit ipulse and unit step function, basic system properties (memory, invertibility, causality, stability, time invariance, linearity)

2· **Linear Time-Invariant Systems (LTI Systems)**

   Discrete-Time LTI systems, discrete-time signal representation in terms of impulses, system impulse response, convolution sum, continuous-time LTI systems, continuous-time signal representation in terms of impulses, system impulse response, convolution integral, causality and stability, unit step response, systems defined by differential and difference equations

3. **Fourier Series**

   Response of LTI systems to complex exponentials, Fourier series representations of continuous-time periodic signals, convergence, properties, Parseval's relation, Fourier series representations of discrete-time periodic signals, properties, Parseval's relation, Fourier series and LTI systems, discrete and continuous-time filtering.

4 **Continuous-Time Fourier Transform**

   Aperiodic signal representation, convergence, transform for periodic signals, properties, Parseval's relation, convolution, duality, systems characterized by linear constant-coefficient differential equations

5 **Discrete-Time Fourier Transform**

   Aperiodic signal representation, convergence, transform for periodic signals, properties, Parseval's relation, convolution, duality, systems characterized by linear constant-coefficient difference equations

6. **Time and Frequency Characterization of Signals and Systems**

   Magnitude-phase representation of Fourier transform, magnitude-phase frequency response of LTI systems, time and frequency-domain properties of filters, first and second order systems

8. **Sampling**

   Representation of continuous-time signals by its samples (Sampling Theorem), Impulse-train S ampling, signal reconstruction from samples, the effect of undersampling (aliasing)

9. The Laplace Transform

Poles, zeros, convergence, inverse transform, properties, initial and final value theorems, LTI systems characterization and analysis, causality, stability, unilateral transform

10. The Z -Transform

Convergence, inverse transform, properties, initial and final value theorems, LTI systems characterization and analysis, causality, stability, unilateral transform