1. ECE 312: Linear System Analysis II

2. 3 credits: 2-75 minute lecture sessions/week

3. Ali Pezeshki

4. Signals, Systems, and Transforms. Phillips, C., Parr, J. & Riskin, E. 2008.

5. Course Information
    a. Laplace and Z transforms, applications to modulation, filtering and sampling, state space representation
    b. Prerequisites: ECE 311 with a C or higher
    c. Required: Computer Engineering; Electrical Engineering
       Selected Elective: Lasers & Optical Engineering

6. Goals for the Course
    a. Course Learning Objectives
        i. Compute transfer functions, poles and zeroes, complex frequency response, and unit pulse response ordinary difference equation for an LTI discrete-time system
        ii. Identify connection between ODE, transfer function, unit pulse response, and complex frequency response
        iii. Identify time and frequency domain sampling and the Nyquist band
        iv. Compute Z and inverse Z transforms
        v. Utilize Z-Transform to analyze discrete-time systems
        vi. Utilize Z transform to solve ordinary difference equations
        vii. Compute and interpret discrete-time Fourier transform (DTFT)
        viii. Design simple digital filters to meet specifications
        ix. Write assembly code for a programmable DSP from an ordinary difference equation
        x. Utilize Discrete Fourier Transform to analyze frequency content of discrete time signals and to analyze frequency response of systems
        xi. Understand sub-sampling theorem in time and frequency; Fast Fourier Transform and its practical applications in discrete time filtering and signal processing; and the connection between DFT products and circular convolutions
    b. Student Outcomes
        1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        3. An ability to communicate effectively with a range of audiences
        4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of

engineering solutions in global, economic, environmental, and societal contexts

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. Topics Covered
   - Laplace transform techniques for continuous-time signals and systems
   - Properties of Laplace transform, including integration, differentiation, final values, shifting, and convolution
   - Connection to ordinary differential equations (ODEs) and linear time-invariant (LTI) systems
   - Applications of the time and frequency domain analysis tools developed in this course to problems from systems engineering
   - Problem areas may include communications (modulation/demodulation), filtering, signal processing, and controls
   - Introduction to the Discrete Fourier Transform (DFT) for analyzing the frequency content of discrete-time aperiodic signals
   - Standard properties of the DFT, including shifting and convolution. Connection between time-domain and frequency domain
   - The Fast Fourier Transform (FFT) and its applications
   - Introduction to noise signals and their characterization
   - Random processes and their properties
   - White Gaussian noise and its impact on communication and control systems