1. **Course number and name**
   - **<u>EE 3353: Discrete Time Signals and Systems</u>**
2. **Credits and contact hours**
   - **3 credit hours, 3 contact hours**
3. **Instructor's or course coordinator's name**
   - **Sergio Cabrera**
4. **Text book, title, author, and year**
   - **C. L. Phillips, J. M. Parr, E. A. Riskin, Signal, Systems, and Transforms, 5th Edition, Pearson Prentice Hall, 2014.**
5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
      i. **Discrete Time Signals & Systems (3-0) Representation and analysis of discrete time signals and systems, Z-transform, DT Fourier transform, DFT, FFT, and difference equations. Emphasizes applications to communications, control and signal processing.**
   b. **prerequisites or co-requisites**
      i. **Prerequisites: EE 2353 and MATH 2326 with a grade of "C" or better**
   c. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
      i. **Required Course**
6. **Specific goals for the course**
   a. **specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)**
      i. **Perform D-T signal transformations and recognize signal properties. (ABET 3:1a,1c).**
      ii. **Recognize properties of D-T systems, solve for the impulse response and perform the convolution operation for D-T Linear Time-Invariant (LTI) Systems. (ABET 3:1a,1c).**
      iii. **Solve Difference Equations (DEs) in the time-domain. (ABET 3:1a).**
      iv. **Recognize important z-transform pairs, use z-transform properties to derive new transform pairs, determine inverse z-transforms, and apply the z-transform in LTI system analysis including the solution of Difference Equations. (ABET 3:1a,1c).**
      v. **Recognize important Discrete-Time Fourier Transform (DTFT) pairs, use DTFT properties and z-transforms to determine forward and inverse DTFTs, and apply the DTFT in LTI systems analysis and digital filtering. (ABET 3:1a,1c).**
      vi. **Analyze Fourier domain relationships between D-T signals and analog signals, and select appropriate digital filters to perform basic analog filtering tasks. (ABET 3:1c).**
      vii. **Recognize important Discrete Fourier Transform (DFT) pairs, apply the DFT to analyze the spectrum of D-T and analog signals, apply the DFT to perform convolution, and select efficient computational algorithms to evaluate the DFT using Fast Fourier Transform (FFT) methods. (ABET 3:1c).**

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered

I- Preliminaries, Introduction and Software

I- Samplers and discrete-time physical systems

II- Intro. to Matlab and Simulink

II- Discrete-Time (D-T) Signals and Systems

a) Axis and amplitude transformations and basic signal properties
b) Basic, important D-T signals including D-T sinusoids
c) Definition and properties of discrete-time systems

III- Discrete-Time Linear, Time-Invariant (LTI) Systems

a) Impulse response and D-T convolution for LTI systems
b) Properties of D-T LTI systems
c) Iterative solution of Difference Equations (DEs) and LTI Difference Equations
d) Difference Equation (DE) models, block diagrams

IV- The z-Transform

a) Definition and evaluation of unilateral z-transforms of basic causal signals
b) Unilateral z-transform properties and inverse z-transform
c) LTI systems analysis and D-T convolution using the unilateral z-transform.
d) Solution of LTI DEs using unilateral z-transforms
e) Intro. to bilateral z-transform, region of convergence, non-causal signals, etc.

V- Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT)

a) Review Sampling theory relating to Continuous-Time Fourier Transform
b) DTFT Definition and basic transform pairs
c) Properties of the DTFT and relationship to bilateral z-transform
d) Discrete-time processing of continuous-time signals (handout)
e) The Discrete Fourier Transform (DFT) and its computation using Fast Fourier Transform (FFT) algorithms
f) Application of the DFT to perform convolution
g) Windowing and spectrum analysis using the DTFT and the DFT.

VI- Digital Filtering based on LTI Systems (in parallel with Chapters 10-12 mostly using Matlab projects)

a) Response of LTIs systems to sinusoidal inputs.
b) Frequency response of Finite Impulse Response (FIR) LTI systems
c) Frequency response of DE based, Infinite Impulse Response (IIR) LTI systems.
d) Applications of LTI digital filtering: signal separation, noise removal, etc.