1. *Course number and name*

**ENGR 451: Digital Signal Processing**

1. *Credits and contact hours*

4 credit hours; two 75-minute lecture sessions/week, and one 3 hour laboratory

1. *Instructor’s or course coordinator’s name*

Instructor: T. Holton

1. *Textbook, title, author, and year*

Holton, T. *Digital Signal Processing: Principles and Applications*. Cambridge University Press, 2021

*a. Other supplemental materials*

* + - Oppenheim, A.V., Schafer, R.W. and Buck, J.R. (2010): Discrete-time Signal Processing, 3rd Edition. Prentice-Hall.
    - Ifeachor, E.C. and Jervis, B.W. (2001): Digital Signal Processing: A Practical Approach, 2nd Edition. Addison-Wesley.
    - Mitra, S. K. (2010): Digital Signal Processing: A Computer-Based Approach. 4rd ed. McGraw-Hill.
    - Proakis, J.G. and Manolakis, D.G. (2006): Digital Signal Processing, 4th Edition. Macmillan.

1. *Specific course information*
2. *Brief description of the content of the course (catalog description)*Properties of linear time-invariant systems. Convolution. Linear constant-coefficient difference equations. Frequency-domain representation of discrete-time signals. Discrete Fourier series and transform. Sampling and reconstruction of analog signals: aliasing, upsampling and downsampling. z- transforms and inverse z-transforms. Design and implementation of FIR and IIR filters. Minimum- phase, maximum-phase and all-pass systems. Discrete Fourier series and transform. Fast Fourier transform algorithms. Circular convolution. Applications in sound and image processing. Required laboratory with computer simulations using Matlab.
3. *Prerequisites or co-requisites*ENGR 305 (Systems Analysis); ENGR 213 (Introduction to C Programming for Engineers) or CSC 210 (Introduction to Computer Programming) or ENGR 274 (Matlab), all with grades of C- or better
4. *Indicate whether a required, elective, or selected elective course in the program*Required for Electrical and Computer Engineering programs
5. *Specific goals for the course*
   1. *specific outcomes of instruction, (e.g. The student will be able to explain the significance of current research about a particular topic.)*
      * The student will demonstrate the ability to understand time-invariance, causality and stability.
      * The student will demonstrate the ability to perform convolution.
      * The student will demonstrate the ability to determine the frequency response of a discrete-time system.
      * The student will demonstrate the ability to determine the impulse response of a discrete-time system.
      * The student will demonstrate the ability to design and analyze sampled-data systems.
      * The student will demonstrate the ability to analyze discrete-time upsampling and downsampling systems.
      * The student will demonstrate the ability to compute z-transforms, inverse transforms and regions of convergence.
      * The student will demonstrate the ability to determine the block-diagram representation of FIR and IIR systems from z-transform, impulse response or difference equations.
      * The student will demonstrate the ability to design IIR discrete-time filters based on analog filters.
      * The student will demonstrate a knowledge of circular convolution and fast Fourier transforms.
      * The student will design, debug and test MATLAB algorithms to carry out design and analysis of specified discrete-time problems.
      * The student will demonstrate ability to work in a team to perform laboratory exercises.
   2. *Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course*.  
      Course addresses ABET Student Outcome(s): 1, 2, 5, 6, 7
6. *Brief list of topics to be covered*

* Introduce basic concepts of discrete-time signals and systems.
* Properties of linearity, time-invariant systems
* Convolution
* Discrete Fourier transform
* FIR and IIR filters
* Sampling of continuous-time signals (A/D and D/A)
* Upsampling/Downsampling
* z-Transform
* Structures of discrete-time filters
* Discrete Fourier Transform (DFT)
* Fast Fourier transform (FFT)