

1. *Course number and name*

ENGR 451: Digital Signal Processing

2. *Credits and contact hours*

3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. *Instructor's or course coordinator's name*

Instructor: Tom Holton, Ph.D.

Course coordinator: Tom Holton, Professor of Electrical and Computer Engineering

4. *Text book, title, author, and year*

Holton, T. *Digital Signal Processing Course Notes*: www.sfsu.edu/~ee/451

a. *Other supplemental materials*

References:

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

5. *Specific course information*

a. *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.

b. *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 290 (Matlab), all with grades of C- or better.

- c. *Indicate whether a required, elective, or selected elective course in the program*
Required for Electrical Engineering
Required for Computer Engineering

6. *Specific goals for the course*

- a. *Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*

- The student will demonstrate the ability to analyze discrete-time systems to determine their linearity, 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 correlation and fast Fourier transforms.
- The student will design, debug and test MATLAB algorithms to carry out design and analysis of specified discrete-time problems.

- b. *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): a, c, e, k.

7. *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)
- Circular convolution