1. *Course number and name*

**ENGR 305: Systems Analysis**

1. *Credits and contact hours*

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

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

Instructor: Mohammad Hajiaboli, Instructor

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

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

Lathi, B.P. *Signal Processing and Linear Systems*., New York, Oxford University Press, 2021

* 1. *Other supplemental materials*

Holton, T. *ENGR 305 Notes.* Available online at [http://www.sfsu.edu/~ee/305.](http://www.sfsu.edu/~ee/305) Username and password are given at the first lecture.

Hajiaboli, M. Course Notes. Available online on iLearn page of the course.

1. *Specific course information* 
   1. *Brief description of the content of the course (catalog description)*

Analysis of signals and systems in the time and frequency domains. Linearity and time invariance, causality and stability. Time-domain solutions of differential equations. Impulse response. Convolution. Fourier series and Fourier transform methods. Laplace transforms. System functions, Bode and polezero plots. System stability. Sampling theorem. Elements of discrete-time signal processing: discretetime signals, convolution, difference equations, and z-transforms.

* 1. *Prerequisites or co-requisites*

MATH 245: Elementary Differential Equations and Linear Algebra ENGR 205: Electric Circuits.with a grade of C- or better

* 1. *Indicate whether a required, elective, or selected elective course in the program*

Required for Computer Engineering Required for Electrical Engineering

Required for Mechanical Engineering.

1. *Specific goals for the course* 
   1. *Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.* 
      * Students will have familiarity with signal characteristics and basic signal operations
      * Students will demonstrate the ability to model physical systems by electrical analogs.
      * Students will demonstrate the ability to determine systems' linearity, time invariance, causality, and stability.
      * Students will demonstrate the ability to use time-domain methods of solving differential equations to determine the impulse response, zero input, and zero state responses.
      * Students will demonstrate familiarity with convolution operation and its properties.
      * Students will demonstrate the ability to determine Fourier series and Fourier transform of functions.
      * Students will demonstrate the ability to determine Laplace transforms and inverse transforms.
      * Students will demonstrate the ability to determine the system function, Bode, and pole-zero plots.
      * Students will have a familiarity with the sampling theorem and spectrum analysis of AM radio signals.
      * Students will demonstrate the ability to perform block diagram simplification representing a system function.
      * Students will demonstrate the ability to design a feedback control system for reducing steady-state error.
   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): a, c, e, k. (1, 2, 6)

1. *Brief list of topics to be covered* 
   * Introduce basic concepts of signals and systems.
   * Characterization of continuous-time signals.
   * Modeling of physical systems by electrical analogs
   * Linearity and time invariance.
   * Causality and stability.
   * Time-domain methods of analysis of linear systems. Zero input response, Zero State Response
   * Impulse response. Convolution.
   * Time-domain solutions of differential equations.
   * Fourier series and Fourier transform methods.
   * Application of Fourier: Sampling theorem, spectrum analysis of AM and QAM modulation
   * Bilateral and unilateral Laplace transform methods. Inverse Laplace transform.
   * Causality, stability, Region of Convergence in Laplace domain
   * Laplace transform solution of differential equations.
   * System functions. Bode plots. Pole-zero plots.
   * Introduction to control theory, stability criteria, phase margin.
   * Introduction to the principle of PID controller design for controlling the steady-state error.