**ELEN 3020 ‑- Linear System Analysis**

**Credits/contact hours:** 3

**Course Coordinator:** Dr. Henry Medeiros

**Text Book:** Linear Systems and Signals (2nd Ed), B. P. Lathi, Oxford Univ Press, 2004, ISBN 0195158334

**Course Information:**

Mathematical models of continuous-time and discrete-time signals and systems are studied in this course. The time domain viewpoint is developed for linear time invariant systems using the impulse response and convolution integral. The frequency domain viewpoint is also explored through the Fourier Series and Fourier Transform. Basic filtering concepts including simple design problems are covered. Application of the Laplace transform to block diagrams, linear feedback, and stability including Bode plots are discussed. The sampling theorem, the z-transform, and the Discrete Fourier Transform are introduced. Examples of electrical, mechanical, and biomedical signals and systems are used extensively throughout the course.

**Required** for the Electrical Engineering program and for the Bioelectronics major in the Biomedical Engineering program. Elective course in the Computer Engineering program.

**Prerequisites:** [ELEN 2020](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/) and [MATH 2451](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/) and [MATH 2451](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/); or [BIEN 2300](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/) and [MATH 2451](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/); or [ELEN 3001](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/) and [MATH 2451](http://bulletin.marquette.edu/undergrad/collegeofengineering/departmentofelectricalandcomputerengineering/).

**Contribution to Professional Component:**

Engineering Science 90 %

Engineering Design 10 %

**Course Goals:**

To introduce the students to the basic concepts of continuous and discrete signals and systems using both mathematical and computer-based linear systems analysis techniques.

**Course Objectives:**

*By the end of this course, you should be able to ....*

1. represent continuous time signals and systems mathematically.
2. work with signals and systems in both the time and frequency domains.
3. calculate the response of linear systems using both time domain and frequency domain techniques.
4. calculate and apply the Fourier series and Fourier transform.
5. analyze systems to determine transfer function representations.
6. use the Laplace transform to analyze transfer function representations and determine system properties and responses to given input signals.
7. design basic continuous time filters.
8. mathematically represent the sampling of continuous-time signals and use the Nyquist theorem to identify discrete-time frequency ranges and aliasing effects.
9. apply the above signals and systems techniques to specific electrical, mechanical, and physiological systems.

**Contribution to Student Outcomes:** Partial fulfillment of criterion 3 objectives A, C, E, G, K

**Course Topics:** (Chapter in text)

1. Introduction to Signals and Systems (0)
2. System Modeling Concepts (1)
3. Time Domain System Analysis (2)
4. Fourier Series (3)
5. Fourier Transform and Its Applications (4)
6. Laplace Transform (5)
7. Applications of Laplace Transforms (6)
8. Analog Filters (Appendix E)
9. Discrete-Time Signals and Systems (8)
10. Discrete Fourier Transform and Fast Fourier Transform Algorithms (10)