

# **ELEG 3123 – SYSTEM AND SIGNAL ANALYSIS (REQUIRED)**

## **Catalog Description**

ELEG 3123 System and Signal Analysis. 3 credit hours.

Definition and description of signals and systems; analog, digital, continuous- and discrete-time and frequency analysis of systems, Z- and Fourier Transforms, sampling and signal reconstruction, filter design and engineering applications. Co-requisite: ELEG 3121L, Pre-requisite: ELEG 2113 (or ELEG3903 and consent of instructor).

## **Textbook**

Linear Systems and Signals (2<sup>nd</sup> edition), Author: B. P. Lathi, Oxford University Press.

## **Prerequisites by Topics**

1. Differential equations
2. Concepts of linear algebra
3. Laplace transforms and Bode plots
4. AC circuit analysis

## **Course Objectives**

After completing this course, electrical engineering students should be able to determine the following:

- Response of zero-state and zero-input systems
- System stability (analog and digital) – external and internal
- Signal energy and power
- Convolution
- Properties of Z- and Fourier Transforms
- Solution of differential, linear difference, and integro-differential equations
- Controllability and observability
- Filter design by placement of zeros and poles
- Transfer functions, block diagram, LTIC and LTID systems in transform domain
- Digital processing of continuous-time signals

## **Topics**

1. Signal operations, classification and models, even and odd functions (3 classes)
2. Internal and external system descriptions, stability (BIBO) (3 classes)
3. State space analysis (2 classes)
4. Zero-input, zero-state and unit impulse response (1 class)
5. Classical solution of differential equations (2 classes)
6. Discrete signals, operations, models, equations (2 classes)
7. Examples of discrete systems and applications to engineering (2 classes)
8. Classical solutions to linear difference equations (1 class)
9. Z-transform and its properties (3 classes)
10. System realization, engineering applications and discrete filters (low pass, high pass, band pass, notch, IIR, FIR) (3 classes)
11. Frequency response, and stability from poles/zeros (3 classes)
12. Digital processing of analog signals (2 classes)
13. Periodic signals and Fourier Series, LTIC system response to periodic signals (3 classes)
14. Fourier transform and its properties, application to engineering systems, LTIC systems, ideal and practical filters (3 classes)
15. Sampling, and reconstruction from sampled signal, A/D conversion, spectral sampling (3 classes)
16. Discrete Fourier Transforms of signals and systems (DFT, FFT, DTFS) (3 classes)
17. Properties of DTFT and LTID systems (3 classes)

There are three (3) 50-minute class periods per week for a total of 15 weeks including three classes for Midterm exams and Review sessions. Two classes are reserved for exams.

**Computer Usage**

As part of homework and lab assignments, MATLAB is used for exercises and projects.

**Oral/Written Communications**

Class participation will constitute part of student's final grade. There will be a number of midterm exams, one final exam, and several homework assignments and quizzes, which constitute portions of the final grade as well.

**Design Activities**

Some activities requiring design and calculation of BW for filters, in the context of a larger system are assigned as homework.

**Relationship of Course to ABET Program Outcomes**

<b>OUTCOME</b>	<b>HOW IT WAS ADDRESSED</b>
(a)	Analysis of signals and systems – Fourier Series, Z-Transform, and Fourier Transform
(b)	Results of system output and stability analysis
(c)	
(d)	
(e)	Design and analysis of filters and specialized electrical systems
(f)	
(g)	Class participation (contribution to final grade)
(h)	
(i)	
(j)	
(k)	MATLAB

**Professional Components**

Mathematics: 30%

Sciences: 5%

Engineering Science: 30%

Engineering Design: 30%

General Education: 5%

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