ELCT 222 – Signals & Systems

Course Coordinator

Undergraduate Program Committee

Catalog Description

Analysis of continuous-time signals and systems in time and frequency domains, Fourier series and transforms, Laplace transforms; introduction to discrete-time signals.

Course delivery structure:

Lectures

Credit Hours 3

**Contact Hours** - three 50-minute lecture periods per week.

Prerequisite(s) by course

C or better grade in MATH 242 and ELCT 221

Prerequisite by topics

Differential equations, basics in Laplace transform, basic circuits theory and analysis

Required Textbooks and other materials:

1. Fawwaz Ulaby, Andrew E. Yagle, Signals and Systems, ISBN-13: 978-1607854869, Michigan Publishing 2018
2. Class notes, posted on Blackboard
3. MATLAB

Course Learning Outcomes:

Students who successfully complete the course will at least be able to:

1. Identify the signal types and perform elementary transformations, such as time-shift and time-scaling, on continuous- and discrete-time signals
2. Determine the impulse and step responses of linear-time invariant (LTI) systems and analyze their impacts on the signals by using convolution
3. Compute the Laplace transform of a signal and assess the stability of a system by using its transfer function
4. Use Fourier series and Fourier transforms to analyze signals in the frequency domain and design filters in MATLAB for various applications
5. Use sampling theorem for signal sampling and reconstruction

Learning outcomes for ELCT222 are equivalent for all delivery methods.

Course Topics:

* Basic properties of signals and systems
* Laplace transform and its applications
* Fourier series and Fourier transform and their applications
* Nyquist theorem and sampling/aliasing

**Technology**

Minimal required student technical skills: general computer literacy

Course Contribution to ABET Student Outcomes:

ELCT 222 Learning outcomes contribute to the achievement of the following ABET student outcomes:

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| --- | --- |
| Course Learning Outcome | ABET Student Outcome |
| 1-5 | 1 |

Technology Requirements

You are pursuing an engineering degree, and this is a technical class, so it has somewhat high expectations for technical skills. Beyond the usual web-interactive skills, you will be expected to perform the followings:

* The student should proficiently use a word processor to write reports, and to save files in pdf format for submission of homework assignments.
* MATLAB is heavily utilized in this course. Basic knowledge of MATLAB is enough for most of the tasks. MATLAB Help is quite helpful in understanding some of the built-in commands.
* All work must be submitted to the instructor via the course Blackboard site. Hence, the students must have consistent and reliable access to a computer and the internet. The students must be capable of organizing and saving electronic files, using e-mail and attaching/downloading files, checking e-mail and the course Blackboard site daily, and downloading and uploading documents.

Course assignments

Assignments (computer and/or problem) will be given approximately every two weeks and will generally be due one week after the assignment. Some problems will require the use of MATLAB or similar software.

Late homework = ZERO score (please see Missed Assignments below for further details).

There will also be multiple quizzes throughout the course. Quizzes will be either during the sessions or on the same day through short assignments. All assignments will be accessible via the course Blackboard site, and submission will be through Blackboard.

The weight of the assignments in the final course grade is as follows:

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| --- | --- |
| Problem assignments | 18% |
| Computer assignments | 17% |
| Quizzes | 15% |
| Midterm exams | 20% |
| Final exam | 30% |

The grading scheme is as follows:

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| **Grading Schema** |
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The instructor reserves the right to adjust the scale if needed. The lowest of several might be dropped depending on the total number of quizzes/homework assignments.

Course Outline/Schedule

Topics for each class meeting are listed below. However, circumstances may call for a departure from this schedule. Any changes to the schedule will be made in advance.

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| --- | --- | --- | --- | --- | --- |
|  |  |  | **Date** | **Topic Description** | **Chapter** |
| **1** | **Topic 1** | W | 8/21/2024 | Discrete and continuous time signals, complex signals, waveforms, periodicity, power, and energy | Chapter 1 |
| **2** | F | 8/23/2024 |
| **3** | M | 8/26/2024 |
| **4** | W | 8/28/2024 |
| **5** | F | 8/30/2024 |
| **6** | **Topic 2** | W | 9/4/2024 | Linearity, time-invariance, convolution, impulse response | Chapter 2 |
| **7** | F | 9/6/2024 |
| **8** | M | 9/9/2024 |
| **9** | W | 9/11/2024 |
| **10** | F | 9/13/2024 |
| **11** | M | 9/16/2024 |
| **12** | W | 9/18/2024 |
| **13** | F | 9/20/2024 |
| **14** |  | M | 9/23/2024 | **MIDTERM EXAMINATION #1** |  |
| **15** | **Topic 3** | W | 9/25/2024 | Laplace transform, transfer function, poles, and zeros, properties, stability and its applications (like RLC filters, inverted pendulum, temperature, step motor control) by solving first- and second-order differential equations)  Review | Chapters 3-4 |
| **16** | F | 9/27/2024 |
| **17** | M | 9/30/2024 |
| **18** | W | 10/2/2024 |
| **19** | F | 10/4/2024 |
| **20** | M | 10/7/2024 |
| **21** | W | 10/9/2024 |
| **22** | F | 10/11/2024 |
| **23** |  | M | 10/14/2024 |
| 24 | W | 10/16/2024 |
| **Fall Break Oct. 17 - 18** | | | | | |
| **25** |  | M | 10/21/2024 |  |  |
| **26** | W | 10/23/2024 |
| **27** | F | 10/25/2024 |
| **28** |  | M | 10/28/2024 | **MIDTERM EXAMINATION #2** |  |
| **29** | **Topic 4** | W | 10/30/2024 | Phasor-domain technique, Fourier series representations and its properties, Parseval’s Theorem, Fourier transform and its properties, convolution theorem, bandwidth, Laplace vs. Fourier transform, and applications of Fourier analysis (like 2-D image filtering, anti-jamming filter, spectra of musical notes, denoising a Trumpet Signal, amplitude modulation) | Chapters 5-6 |
| **30** | F | 11/1/2024 |
| **31** | M | 11/4/2024 |
| **32** | W | 11/6/2024 |
| **33** | F | 11/8/2024 |
| **34** | M | 11/11/2024 |
| **35** | W | 11/13/2024 |
| **36** | F | 11/15/2024 |
| **37** | M | 11/18/2024 |
| **38** | W | 11/20/2024 |
| **39** | **Topic 5** | F | 11/22/2024 | Sampling theorem and signal reconstruction, ADC and DAC, Nyquist rate, aliasing | Chapters 6 |
| **Thanksgiving 11/25, 11/27, 11/29** | | | | | |
| **40** |  | M | 12/2/2024 |  |  |
| **41** | W | 12/4/2024 |
| **42** |  | F | 12/6/2024 | Review: a review of semester topics |  |