



## **Course Description**

Transform domain analysis of Linear Time-Invariant (LTI) systems such as analog and digital filters in continuous-time and discrete-time domains. Laplace, Fourier, Discrete-Time Fourier, Discrete Fourier, and z-Transforms. System representations using impulse-response functions, frequency responses, poles and zeros, and transfer functions. Graphical methods of Fourier analysis. Realizations of LTI systems as filters designed to specifications.

## **Course Components**

Lecture.

**Credit Hours:** 3.0.

**Pre-requisites and Co-requisites:** Prerequisites: 'C-' or better in (ECE 1230 OR ECE 1240) AND (CS 1400 OR CS 1420) AND passing grade in (MATH 2250 OR (MATH 2270 AND MATH 2280)) AND NOT on ECE Monitoring Group Corequisites: ECE 3505.

**Satisfies a General Elective:** Yes.

## **Course Outcomes and Objectives**

The course Fundamentals of Signals & Systems prepares students to understand, analyze, and solve continuous and discrete-time systems. The course is organized into three units: Signals & Systems, System Analysis, and Signal Analysis. By the end of the course, students will be able to

- Solve the output of a linear time-invariant system using both time-domain convolution and frequency-domain transform techniques.
- Analyze the characteristics of systems using the Laplace and z-transforms and analyze the characteristics of signals using Fourier methods.

Students will progress in the following ABET accreditation outcomes by developing

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

## **Course Requirements**

Attendance is worth 3% of the final grade. Homework assignments relating to the course material total 15% of the grade. During the semester, students will work on an application project during the lab; its presentation at a poster session is worth 2% of the final grade. After the completion of each unit, a quiz will be offered worth 10% of the grade. Lastly, two midterms and a comprehensive final make up 40% and 30% of the final grade, respectively.

Component	Contribution to Grade
Attendance	3 %
Homework	15 %
Application Project Presentation	2 %
Quizzes	10 %
Midterms	40 %
Final	30 %
Total	100 %

Table 1: Final grade composition.

## **Required and Recommended Readings**

None.

## **Grading Scale and Policies**

The final grade will be rounded to the nearest tenth of a percent and assigned a letter grade as follows:

Grade	Percentage
A	93.0 – 100.0 %
A-	90.0 – 92.9 %
B+	87.0 – 89.9 %
B	83.0 – 86.9 %
B-	80.0 – 82.9 %
C+	77.0 – 79.9 %
C	73.0 – 76.9 %
C-	70.0 – 72.9 %
E	00.0 – 69.9 %

Table 2: Final letter grade relationship.

Late work will be accepted but with a cumulative 10% deduction per day until a 50% deduction at five days late. Any late work completed after five days late will receive a standard 50% deduction.

## Preliminary Course Schedule

Date	Topic	Key Assignments
Week 1	Signals	
Week 2	Systems	
Week 3	Convolution	Quiz 1
Week 4	Laplace Transform	
Week 5	Transfer Functions	
Week 6	Filters	
Week 7	Circuits & Systems	Quiz 2
Week 8	z-Transform	
Week 9	Discrete-Time Transfer Functions	Midterm 1
Week 10	Fourier Series	
Week 11	Fourier Transform	
Week 12	Frequency Response Functions	
Week 13	Discrete-Time Fourier Transform	Quiz 3
Week 14	Sampling	
Week 15	Application Project	Midterm 2
Week 16		Final

### List of Lectures:

Lecture	Unit	Topic
1	1.1	Signals & Systems: Signals
2	1.2	Signals & Systems: Signal Properties
3	1.3	Signals & Systems: Systems
4	1.4	Signals & Systems: The Impulse Response & Convolution
5	1.5	Signals & Systems: LCCODEs & Convolution
6	1.6	Signals & Systems: The Impulse Response & LTI Properties
7	2.1	System Analysis: The Laplace Transform
8	2.2	System Analysis: The Transfer Function
9	2.3	System Analysis: Sinusoidal Response and Bode Plots
10	2.4	System Analysis: Filter Design
11	2.5	System Analysis: Inverse Laplace Transform
12	2.6	System Analysis: Unilateral Laplace Transform & Circuits
13	2.7	System Analysis: z-Transform
14	2.8	System Analysis: Discrete-Time Transfer Functions
15	2.9	System Analysis: Inverse z-Transform
16	3.1	Signal Analysis: Fourier Series
17	3.2	Signal Analysis: Discrete-Time Fourier Series
18	3.3	Signal Analysis: Fourier Transform
19	3.4	Signal Analysis: Frequency Response Functions
20	3.5	Signal Analysis: System Identification
21	3.6	Signal Analysis: Discrete-Time Fourier Transform
22	3.7	Signal Analysis: Discrete-Time Frequency Response Functions
23	3.8	Signal Analysis: Sampling & Signal Discretization
24	3.9	Signal Analysis: System Discretization: Bilinear Transform

This syllabus is subject to change at the discretion of the instructor.

## **University Policies**

**Americans With Disabilities Act (ADA):** The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities.

All written information in this course can be made available in an alternative format with prior notification to the Center for Disability & Access (CDA). CDA will work with you and the instructor to make arrangements for accommodations. Prior notice is appreciated. To read the full accommodations policy for the University of Utah, please see Section Q of the Instruction & Evaluation regulations.

In compliance with ADA requirements, some students may need to record course content. Any recordings of course content are for personal use only, should not be shared, and should never be made publicly available. In addition, recordings must be destroyed at the conclusion of the course.

If you will need accommodations in this class, or for more information about what support they provide, contact:

Center for Disability & Access 801-581-5020 [disability.utah.edu](mailto:disability.utah.edu)

Third Floor, Room 350 Student Services Building 201 S 1460 E Salt Lake City, UT 84112

**Safety at the U:** The University of Utah values the safety of all campus community members. You will receive important emergency alerts and safety messages regarding campus safety via text message. For more safety information and to view available training resources, including helpful videos, visit [safeu.utah.edu](http://safeu.utah.edu).

To report suspicious activity or to request a courtesy escort, contact:

Campus Police & Department of Public Safety 801-585-COPS (801-585-2677) [dps.utah.edu](mailto:dps.utah.edu) 1735 E. S. Campus Dr. Salt Lake City, UT 84112

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status, or genetic information.

If you or someone you know has been harassed or assaulted, you are encouraged to report it to university officials:

Title IX Coordinator & Office of Equal Opportunity and Affirmative Action 801-581-8365 [oeo.utah.edu](mailto:oeo.utah.edu) 135 Park Building 201 Presidents' Cir. Salt Lake City, UT 84112

Office of the Dean of Students 801-581-7066 [deanofstudents.utah.edu](mailto:deanofstudents.utah.edu) 270 Union Building 200 S. Central Campus Dr. Salt Lake City, UT 84112

To file a police report, contact:

Campus Police & Department of Public Safety 801-585-COPS (801-585-2677) [dps.utah.edu](mailto:dps.utah.edu) 1735 E. S. Campus Dr. Salt Lake City, UT 84112

If you do not feel comfortable reporting to authorities, the U's Victim-Survivor Advocates provide free, confidential, and trauma-informed support services to students, faculty, and staff who have experienced interpersonal violence.

To privately explore options and resources available to you with an advocate, contact:

Center for Campus Wellness 801-581-7776 [wellness.utah.edu](http://wellness.utah.edu) 350 Student Services Building 201 S. 1460 E. Salt Lake City, UT 84112

**Academic Misconduct:** It is expected that students comply with University of Utah policies regarding academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative artificial intelligence (AI) tools without citation, documentation, or authorization. Students are expected to adhere to the prescribed professional and ethical standards of the profession/discipline for which they are preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for their profession/discipline may be subject to academic sanctions as per the University of Utah's Student Code: Policy 6-410: Student Academic Performance, Academic Conduct, and Professional and Ethical Conduct.

Plagiarism and cheating are serious offenses and may be punished by failure on an individual assignment, and/or failure in the course. Academic misconduct, according to the University of Utah Student Code:

“...Includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information... It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct.”

For details on plagiarism and other important course conduct issues, see the U's Code of Student Rights and Responsibilities.