ECE 3210 Signals and Systems

Instructor:	Eric Gibbons	**E-mail:**	ericgibbons@weber.edu
Office:	NB 245J	**Website:**	Canvas
Day Lecture Time:	TH 9:00AM-10:15AM	**Day Lecture Room:**	NB 101
Day Lab Time:	W 1:30PM-4:30PM	**Day Lab Room:**	NB 101
Ev. Lecture Time:	MW 4:30PM-7:20PM	**Ev. Lecture Room:**	NB 101
Ev. Lab Time:	MW 4:30PM-7:20PM	**Ev. Lab Room:**	NB 112

Note: Please do not hesitate to ask me if you have questions or concerns about the course. If I am away from my office, the easiest method of contact is via email.

Office hours

My office hours are posted on my website and on Canvas.

Course description

Topics related to analyzing linear time-invariant continuous and discrete systems and signal transformations, convolution, frequency spectra, Laplace transforms, Z transforms, and fast Fourier transforms. This course is a combination of lectures and laboratory exercises. Laboratory activities include computer simulation, analysis, and numerical modeling of signals and systems.

Learning outcomes

The student will:

- Analyze LTI system responses in the time domain
- Represent and manipulate continuous-time signals in the frequency domain
- Represent and manipulate discrete-time signals in the frequency domain
- Design, build, and analyze linear and time-invariant systems in hardware
- Perform signal processing tasks in software

Prerequisites

ECE 2260 and (ENGR 2240 or MATH 2250 or (MATH 2270 and MATH 2280))

Textbook

Lathi, B. P., & Green, R. (2023). *Signal processing and linear systems* (2nd ed.). New York, NY: Oxford University Press.

NOTE: The lectures will follow this text *very* closely. I strongly advise you to read the book as we go through the course. Assignments will not be based on problems on from the book, so if you can find a 1st edition of the book, you can save some money.

Assignments

You will have weekly homework assignments. These assignments are based on selected problems from the textbook from various signal processing textbooks and old examinations. You will be given Jupyter Notebooks to complete the assignments. I strongly recommend that you work the problems out by hand (pencil and paper) and then complete the Notebook after you have worked the problem out.

Homework will be distributed and collected via GitHub. Homework will be graded based on correctness. You will receive feedback each week based on your work after it is graded. You are welcome to work together in groups to solve the problems, but the solutions you submit must be your own. I strongly

encourage you to fully understand your submission because the examinations, which are an individual effort, will be based on the homework problems.

Each homework is associated with a particular exam (see schedule). If your score on that exam exceeds the homework average for the homeworks associated with the exam, the exam grade will replace the homework grade. The opposite is not true. If you score below the homework average on the exam, the homework grade will be used.

Occasionally pop quizzes will be given in class and will count towards your homework grade. These quizzes will be based on the material covered in the previous week.

Laboratory assignments

Laboratory assignments will be done individually if there is insufficient lab equipment, in which case the hardware portion may be done in pairs. Each lab will, generally, require a submitted lab report and associated code written for the lab. The lab report must be completed using the provided LaTeX template.

Most labs will have a programming component. You must be proficient in numerical Python (NumPy, SciPy, Matplotlib) at the level of ECE 1400. You are welcome to use lab computers for your programming. Furthermore, you may use your personal machines if they are configured so that you can do the assignments. All unit tests will use Python 3.12. We will use GitHub for code submission, so ensure you have a GitHub account. As juniors in an electrical and/or computer engineering program, you should be able to write code at a reasonable level. Please do not send me emails asking me to debug your code for you. I can offer general guidance but will not hunt bugs for you.

The lab due dates and times will generally be the Friday the week indicated on the schedule.

Late work policy

Late work will not be accepted after the due date. Once the GitHub repository is closed, you will not be able to submit your work. Similarly, once the Canvas assignment is closed, you will not be able to submit your lab reports.

Exams

There will be two midterm examinations during the semester. There will also be a comprehensive final examination. The objective of the examinations will be to test your knowledge of fundamentals and your ability to apply the concepts learned in the class in situations you may not have encountered before. You may bring one sheet of formulas for the first exam, two sheets of formulas for the second exam, and three sheets of formulas to the final exam.

Academic integrity

As part of the student code (PPM 6-22), you are expected to be academically honest and ethical. Academic dishonesty includes cheating; plagiarizing; colluding with others to be dishonest; falsifying information; giving, selling, or receiving unauthorized course or test information; using a tool or other aid not explicitly permitted by your instructor such as generative AI (e.g. ChatGPT) to complete assignments or exams; or infringing on others' copyrights and intellectual property. Academic dishonesty can have serious consequences in the class and/or at WSU. Be sure, if you borrow an idea, to express it in language entirely your own and let the reader know the idea's source in a citation note.

For software submissions, I will routinely run your code through a plagiarism detection system. If you are caught cheating, you will receive a zero for the assignment and may be reported to the Dean of Students. A second infraction will result in a failing grade for the course.

Grading

As shown below, grades are based on the weighted average of the exams, homework, and laboratory assignments.

Homework:	15%
Labs:	20%
Midterms (each):	20%
Final exam:	25%

Letter grades are assigned according to the scale below.

A	$\geq$	90%
A-	$\geq$	86%
B+	$\geq$	83%
B	$\geq$	80%
B-	$\geq$	76%
C+	$\geq$	73%
C	$\geq$	70%
C-	$\geq$	66%
D+	$\geq$	63%
D	$\geq$	60%
F	$<$	60%

These are the *maximum* cutoffs for each letter. As an instructor, I reserve the right to lower the percentage cutoffs at the end of the semester as appropriate.

Campus closure

If the class needs to be held virtually due to campus closure, sickness, or any other appropriate reason, you will receive a notification from your instructor via Canvas. Remember that attendance is just as important virtually as in the face-to-face option. During video conferencing, be present, avoid multitasking, and wait for your turn to speak and/or contribute to the class discussion. Be courteous and respectful of your classmates. As stated in the class recording policy, you may not record any segments and/or the full class unless you have authorization from the instructor. If you do not have the technology necessary for video conferencing, contact your instructor as soon as possible. This policy applies also to virtual office hours.

Disability services

If you require accommodations or services due to a disability, please contact Disability Services (DS) in room 181 of the Student Services Center (Ogden campus) or room 262 Building D2 (Davis Campus). Disability Services can arrange to provide course materials (including this syllabus) in alternative formats upon request.

Professionalism and respect

The sense of human dignity and belonging of all members of the Weber State community is a necessary part of a healthy learning environment. Therefore, you should practice civil deportment, and avoid treating others in a manner that is demeaning or derisive in any respect. Diverse viewpoints and opinions are welcome in this class, and we will practice the mutual deference so important in the world of work when expressing them. Thus, while I encourage you to share your opinions, you will be expected to do so in a manner that is respectful toward others.

Recording

The university prohibits students from recording class lectures unless the faculty member grants explicit permission (PPM 6-22.6.6). Any lectures recorded and posted on Canvas or shared to your Weber State University student email are for the exclusive use of students enrolled in the class and may not be shared without previous authorization. Violations will be referred to the Dean of Students for adjudication under the student code (PPM 6-22).

Student responsibilities

As a student at Weber State University, you are expected to act responsibly and appropriately as you attend a public institution of higher education. When you enroll as a student at WSU, you agree to abide by the standards of appropriate and responsible behavior outlined in the student code (PPM 6-22). This applies to your behavior as an individual when participating in group settings on campus and if you represent Weber State University at an off-campus event. Choosing to ignore these important student responsibilities could result in university disciplinary actions.

Core beliefs and challenging subject matter

Faculty members teach in line with the best standards of their discipline and choose materials appropriate to help the class master expected course outcomes. A student may disagree with course content, but unless the content conflicts with a student's core beliefs, students are expected to engage professionally, as described above. If after reading the syllabus and class program, you expect there will be a conflict with your core beliefs, you should consider withdrawing from the class before the last day to drop classes without penalty. If you find this solution unworkable, you may request a resolution from the instructor, in writing with a copy to the department chair, explaining what burden the class requirement would place on your beliefs. Students who are not satisfied with the outcome may seek assistance through the Office of Equal Opportunity.

Harassment, discrimination, and sexual misconduct

Weber State University is committed to providing an environment free from harassment and other forms of discrimination based upon race, color, national origin, pregnancy, and pregnancy-related conditions such as childbirth, false pregnancy, miscarriage, abortion, or related conditions, (including recovery), genetics, disability (see PPM 3-34), religion, sex, sexual orientation, gender identity/expression, veteran, active military status, age (over 40 in employment discrimination), and other classifications protected by law. If you have questions regarding the university's policy against discrimination and harassment, or if you have questions about reporting discrimination or harassment, you may contact the university's Office of Equal Opportunity (OEO) by calling 801-626-6240 or visit the OEO website.

Course Outline

This is a *tentative* outline for the course. The material coverage for each exam is color-coded in the table. The homework column indicates the coverage for each homework assignment. They will be due the following Friday, giving you a full week after the material is presented in order for you to work on the homework. The exams will be held in the testing center Thursday-Saturday of the week they are scheduled. The final exam will be held during the final exam period.

Week	Material	HW	Lab
exam coverage: mt01			
8/25	1. Introduction to signals (1.1-1.6) 2. Systems, zero input response (1.6-1.8, 2.1-2.2)	hw01	lab01: Lab basics
9/1	1. Labor Day—no class 2. Impulse response, zero state response, convolution (2.3-2.4)	hw02	
9/8	1. Graphical convolution, system stability, and behavior (2.4-2.6) 2. Orthogonal signals and correlation (3.1-3.3)	hw03	lab02: Impulse response
9/15	1. Fourier series (3.4-3.7) 2. Fourier transform (4.1-4.2)	hw04	lab03: Convolution
9/22	1. Fourier transform properties (4.3) 2. Signal transmission through a system (4.4-4.6)	hw05	lab04: Fourier series and THD
exam coverage: mt02			
9/29	1. Review for Exam 1 2. Windowing and sampling (4.9, 5.1-5.2)	hw06	lab05: LTI response to periodic signal
10/6	1. DFT (5.5) 2. FFT (5.6) **mt01**	hw07	lab06: Aliasing
10/13	1. Laplace transform (6.1) 2. Laplace transform properties (6.2)	hw08	lab07: Shazam
10/20	1. Solving electric circuits with Laplace (6.3-6.4) 2. Block diagrams (6.5)	hw09	lab0X: Cardiac signal processing
exam coverage: final			
10/27	1. Realization with op-amps (6.6) 2. Review for Exam 2	hw10	lab0X: Cardiac signal processing
11/3	1. System response and Bode plots (7.1-7.2) 2. Butterworth and Chebyshev (7.5-7.7) **mt02**	hw11	
11/10	1. Discrete-time signals (8.2-8.4) 2. Discrete-time systems, zero-input (9.1-9.4)	hw12	lab08: System realization and frequency response
11/17	1. Discrete-time systems, zero-state (9.5-9.6) 2. DT signal processing with the DTFT (10.1-10.4, 10.6)	hw13	lab09: Filter design
11/24	1. Z-transform (10.7, 11.1-11.2) 2. No lecture—Thanksgiving	hw14	
12/1	1. Z-transform solution (11.3-11.4) 2. Final review	hw14	lab10: Discrete-time systems