CS 596 Syllabus

Semester:	Spring 2022
Course title:	Mathematics of Digital Signal Processing II
Instructor:	Professor Matt Klassen
Email:	mklassen@digipen.edu
Phone:	(425) 895-4423
Office hours:	M,Th 10:30-11:30, or by appointment
Course Web Page:	http://azrael.digipen.edu/MAT321
Time/Place:	M,W 9:00-10:20, in Jimbo, and online in Teams

WEB PAGES AND MOODLE:

The Moodle page for CS 596 (MAT 321) will contain a link to the course web page. The web page is the central repository for all course documents, including homework assignments. Updates to homework will be posted on the web page only. Scores for quizzes, homework, exams, and projects, will be posted through perl scripts on the course web page and also on Moodle.

The Moodle page will be used for chat, forums, and for submission of homework, projects and quiz and exam scratch work.

The Teams channel will be used for lectures. Students may record lectures and review them in Teams. Recording with Teams is convenient but not high quality. For best quality, recording with OBS is recommended.

MATERIALS:

Text: *A Digital Signal Processing Primer*, by Ken Steiglitz. The course is based on this text, lecture material, notes, and homework.

Reference Materials (not required) :

Digital Signal Processing, by Oppenhiem and Schafer
Digital Filters for Everyone, by Rusty Allred
Music: A Mathematical Offering, by David Benson
Schaum's Outline: Digital Signal Processing, by Monson Hayes
On the Sensations of Tone, by Hermann Helmholtz
Real Sound Synthesis for Interactive Applications, by Perry Cook
Signals, Sound, and Sensation, by William Hartmann
Designing Sound, by Andy Farnell

COURSE DESCRIPTION:

This course continues to explore the mathematical foundations of digital signal processing, with applications to digital audio programming. Topics include: Review of digital signals, Z-transforms and convolution, filter types, applications of fast Fourier transform, switching signals on and off, windowing, spectrograms, aliasing, digital to analog conversion, Nyquist Theorem, filter design, Butterworth filters, reverb, and the phase vocoder.

COURSE GOALS AND OBJECTIVES:

1) Students will learn some of the basic algorithms in digital signal processing using complex numbers, such as the Discrete and Fast Fourier Transforms, and various filters.

2) Students will become familiar with basic concepts of digital signal processing and will describe these from the mathematical perspective.

3) Students will solidify their knowledge of Linear Algebra and Calculus by using these subjects as tools to solve problems involving vector spaces of complex numbers, continuous functions, and discrete functions and signals.

QUIZZES AND EXAMS:

Quizzes will be given periodically to test comprehension of lecture material. There are no make up quizzes, but I do drop your lowest two quiz scores. The quizzes will last for approximately twenty minutes. Quizzes are posted online on the course website during class. Quizzes and exams can be done online. Submission of answers is through the website and submission of scratchwork is through Moodle. Both submissions are required by the due date/time to avoid a score of zero.

For multiplie choice quizzes and exams, please follow these procedures: Work out the quiz problems and circle your answers on the question sheet. When you are finished, transfer the answers to the answer sheet. Go to a web browser and enter the answers online. Under no circumstances are you allowed to discuss the quiz questions with any other student during the quiz or the data entry process. Scratch work may be used to verify that you did your own work. Your scores will be posted online by your student ID.

There will be a midterm exam given during regular class hours, and a final exam. There are *NO* make up exams unless you have a *compelling and well documented reason* for missing a test.

Calculators, notes, books, are allowed on quizzes and exams.

GRADING:

Midterm Exam	20%
Final Exam	20%
Homework	20%
Quiz	20%
Projects	20%

Grades will be determined based on total course percentage. Percentage scores will determine letter grades according to the scale: (in the worst case)

A	$93-100$	A-	$90-92.9$		
B+	$87-89.9$	B	$83-86.9$	B-	$80-82.9$
C+	$77-79.9$	C	$73-76.9$	C-	$70-72.9$
D	$60-69.9$	F	<60		

ACADEMIC INTEGRITY:

Academic dishonesty, or cheating, occurs when a student represents someone else's work as their own, or assists another student in doing so. This can happen on exams, quizzes, homework, or projects. Academic dishonesty also may occur when a student uses any prohibited reference or equipment in the completion of a task. For example, the use of a calculator, notes, books or the internet when it is prohibited. Plagiarism is a common form of academic dishonesty. This can take the form of copying and pasting exerpts from the web, and representing them as original work. The type and severity of any occurence, as well as the legitimacy of any claim of academic dishonesty, will be judged by the instructor and the disciplinary committee. All students are asked to help in promoting a culture of academic integrity by discouraging cheating in all forms.

HOMEWORK ASSIGNMENTS:

Homework will be assigned and posted on the web page and collected weekly. You are responsible for checking the web page and noting the assignments and the due date. You may work on homework together, as well as consult the tutors and the instructor. However, the final work that you turn in must be your own work.

PROJECTS:

The full description of the programming project can be found on the course web page. Submission of projects should be in a zipped folder which contains source and executable and which can be uploaded on the Moodle page.

COMPUTATIONAL RESOURCES:

You are encouraged to do linear algebra and other calculations for the homework using a calculator or symbolic package such as SciLab. The symbolic algebra package SciLab is free and open-source, and is similar to MATLAB.

DISABLED STUDENT SERVICES:

Students with physical, psychological or learning disabilities that affect their ability to perform major life activities associated with this class may be eligible for reasonable accommodations under the Americans with Disabilities Act. If you have a documented disability please contact the Disability Support Services office to arrange for accommodations for this class.

GRADUATE STUDENTS:

Graduate students will be required to do a class presentation or report which will be factored in as part of their homework grade. The subject matter will involve an in depth analysis of a particular problem, or an application, and will require some synthesis of current work and contributions in the field. This will form part of the graduate student exposure to research methods in course work.

TENTATIVE WEEKLY TOPICS:

Week	Dates	Topics
1	Jan 3 - 7	time/frequency domains, discrete-time phasors
2	Jan 10 - 14	Z-transform and convolution
3	Jan 17 - 21	inverse Z-transform, stability
4	Jan 24 - Jan 28	Applications of the FFT, switching signals on and off
5	Jan 31 - Feb 4	Windowing, spectrograms
6	Feb 7 - 11	Summary of transforms, time-frequency correspondences
7	Feb 14 - 18	Periodization and the continuous Fourier transform Midterm Exam: Wednesday, Feb.16
8	Feb 21 - Feb 25	Fourier transform of rect, sinc, and Gaussian
9	Feb 28 - Mar 4	Convolution integral for continuous functions
	Mar 7 - 11	Spring Break
10	Mar 14 - 18	Schwartz functions and Distributions as limits Tempered distributions as linear functionals
11	Mar 21 - 25	Shift and derivative properties for Fourier transform Sampling and Interpolation: from continuous to discrete
12	Mar 28 - Apr 1	Nyquist theorem, digital to analog conversion
13	Apr 4 - 8	reverb, oversampling
14	Apr 11 - 15	filter design and implementation
15	Apr 18 - 22	Final Exams