MAT 399/121 Syllabus

Semester:	Spring 2019
Course title:	Mathematics of Digital Sound Processing
Instructor:	Professor Matt Klassen
Email:	mklassen@digipen.edu
Phone:	(425) 895-4423
Office hours:	M,W 12:30-2:30, T 12:30-1:30, or by appointment
Course Web Page:	http://azrael.digipen.edu/MAT121
Time/Place:	meetings: W 2:00-3:00 Boulanger

WEB PAGES AND MOODLE:

The Moodle page for MAT121 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.

The Moodle page will be primarily used for chat, forums, and for submission of projects.

MATERIALS:

There is no required course text book. The course is based on lecture material, notes, projects and homework.

Reference Materials (not required) :

A Digital Signal Processing Primer, by Ken Steiglitz
Musimathics, Volumes 1 and 2, by Gareth Loy
Digital Filters for Everyone, by Rusty Allred
Music: A Mathematical Offering, by David Benson
Designing Sound by Andy Farnell

PREREQUISITES:

MAT 120 and CS 116.

COURSE DESCRIPTION:

This course explores further topics in the mathematical foundations of music and sound, with emphasis on digital signal processing. Topics include digital signals and sampling, spectral analysis and synthesis, convolution, filtering, sound synthesis, and physical modeling.

COURSE GOALS AND OBJECTIVES:

1) Students will learn some of the basic algorithms in digital signal processing and implement these 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 Algebra by using these subjects as tools to solve problems involving 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 the lowest two quiz scores. The quizzes will last for approximately twenty minutes.

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. You should turn in the answer sheet at the front of the room, and keep the question sheet for reference. 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 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.

Sample projects may include: Wave file manipulations, such as normalization of amplitude, dynamic range modification, fade-in and out, concatenation of wave files for speech, real-time audio engine basics using existing software such as Swift and AVAudioEngine.

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.

TENTATIVE WEEKLY TOPICS:

Week	Dates	Topics
1	Jan 6, 8	Introduction to Complex Numbers: rectangular and polar forms, norm, conjugate, complex vectors, complex dot product.
2	Jan 13, 15	Phasors, trigonometry and algebra review. Wav files and basic programming concepts.
3	Jan 20, 22	Introduction to Discrete Fourier Transform. Spectral analysis and synthesis. Basic operations on sound files.
4	Jan 27, 29	Sampling and Quantization, Aliasing, Decibels. Normalization of amplitude.
5	Feb 3, 5	Feedforward Filters, Delay and Transfer function. Basic filter implementation for wav files.
6	Feb 10, 12	Periodic sounds, Fourier series and transforms. Zero crossings, periodicity.
7	Feb 17, 19	Feedback filters, poles and zeros, resonance.
8	Feb 24, 26	LTI filters, rational transfer functions.
	Mar 3, 5	Spring Break
9	Mar 10, 12	z-transform and convolution. Basic implementation of echo.
10	Mar 17, 19	Basic synthesis and physical models of sound.
11	Mar 24, 26	Comb and plucked string filters, resonance and tuning, first-order allpass filter.
12	Mar 31, Apr 2	Digital-to-analog conversion.
13	Apr 7, 9	Artificial reverb algorithms
14	Apr 14, 16	Filter Design and applications.
15	Apr 20-24	Final Exams