

MUS 470 Syllabus

Semester:	Fall 2024
Course title:	Audio Design Project III (Lecture)
Instructor:	Professor Matt Klassen
Email:	mklassen@digipen.edu
Phone:	(425) 895-4423
Office hours:	M,Th 11:00-12:00, or by appointment
Course Web Page:	http://azrael.digipen.edu/MUS470
Time/Place:	lectures: Th 3:00-3:50, in Jimbo

COURSE DESCRIPTION:

This course explores advanced topics in audio design and implementation. Lectures address issues that come up in audio programming at several levels: low level algorithms, mid-level components such as plugins and graphs, and high-level programming such as user interfaces and interactive music. Lecture topics include: audio engine design and implementation, spatial audio, and digital signal processing.

PREREQUISITES and COREQUISITES:

Prerequisites: CS 245, MAT 320, MUS 371, MUS 371L

Corequisites: MUS 470L

COURSE OUTCOMES:

After successful culmination of the course, students should be able to fulfill the following outcomes:

- a) Understand some important low-level algorithms in audio.
- b) Reinforce knowledge of mid-level components and audio plugins.
- c) Implement user interfaces for audio applications.
- d) Implement a software application related to audio engine design, spatial audio, algorithmic music, synthesis, audio with machine learning, or digital signal processing.

GRADING:

Presentations and Assignments	50%
Class Participation (see below)	50%

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

CLASS PARTICIPATION:

Students are expected to be on time and to attend all classes and labs. An unexcused absence or lateness will cost the student 10% of the class participation grade. Full participation grade is easy to earn simply by attending class, working on assignments, asking questions, participating in discussions.

ACADEMIC INTEGRITY:

Academic dishonesty in any form will not be tolerated in this course. Cheating, copying, plagiarizing, or any other form of academic dishonesty (including doing someone else's individual assignments) will result in, at the extreme minimum, a zero on the assignment in question, and could result in a failing grade in the course or even expulsion from DigiPen.

All students are asked to help in promoting a culture of academic integrity by discouraging cheating in all forms.

DISABILITY SUPPORT SERVICES:

If students have disabilities and will need formal accommodations in order to fully participate or effectively demonstrate learning in this class, they should contact the Disability Support Services Office at (425)629-5015 or dss@digipen.edu. The DSS Office welcomes the opportunity to meet with students to discuss how the accommodations will be implemented. Also, if you may need assistance in the event of an evacuation, please let the instructor know.

GUEST SPEAKERS and TOPICS:

Guest speakers may be invited to speak on various topics relating to audio programming for games, audio for virtual and augmented reality, and spatial audio. Such guest speakers may come from DigiPen or from the audio community and industry. Topics in the course will change from year to year, and will be partially based on the students' interests, as well as research interests of the instructor.

RELIGIOUS ACCOMMODATION:

DigiPen Institute of Technology provides reasonable accommodations to students who may be absent from activities or incur significant hardship due to religious holidays or observances. These holidays or observances must be part of a religious denomination, church, or religious organization, and the course instructor must be notified in writing during the first two weeks of the course. The institute's policy for grievances is published in the course catalog.

TEAMS and STREAMING:

I am prepared to stream lectures through Teams in order to accommodate students who might need to stay away from campus due to symptoms or illness. Requests to stream should be made through email or Teams at least 2 hours prior to class time. Students are welcome to record in Teams or to use OBS to record the live stream for later viewing. The Teams recordings can be very poor quality, both video and audio, so OBS is recommended if higher quality is needed.

MATERIALS:

Reference Materials: (not required)

Ambisonics: A Practical 3D Audio Theory for Recording, Studio Production, Sound Reinforcement, and Virtual Reality, by Franz Zotter and Matthias Frank.

Head-Related Transfer Function and Virtual Auditory Display, by Bosun Xie.

A User's Guide to Spherical Harmonics, by Martin Mohlenkamp.

Immersive Sound: The Art and Science of Binaural and Multi-Channel Audio, edited by Agnieszka Roginska and Paul Geluso.

Spatial Hearing, by Jens Blauert.

Virtual Auditory Space: Generation and Applications, by Simon Carlile.

Immersive Audio Signal Processing, Sunil Bharitkar and Chris Kyriakakis

The specific course topics can change from year to year in such a way that provides current applications within the framework of audio programming, audio design and implementation. The following topics represent material covered in the course over the years 2018-2022, and are a sampling of the type of topics covered in this course but not necessarily in this particular semester.

TENTATIVE WEEKLY TOPICS:

Week	Dates	Topics
1	Sep 3 - Sep 6	Introduction to Audio Projects, requirements and topics
2	Sep 9 - 13	Introduction to Machine Learning for Audio DSP Review
3	Sep 16 - 20	Short-Time Fourier Transform (STFT), various implementations of STFT
4	Sep 23 - 27	Audio Segmentation and Tensors in Python and PyTorch
5	Sep 30 - Oct 4	Microphone arrays and First Order Ambisonics (FOA), Auditory events of multi-loudspeaker playback
6	Oct 7 - 11	2D/3D Ambisonic Panning and Decoding, Vector-Based Amplitude Panning (VBAP)
7	Oct 14 - 18	SH encoding/decoding, Binaural Ambisonic decoding
8	Oct 21 - 25	Dynamic processing and reverb effects for Ambisonics
9	Oct 28 - Nov 1	Higher Order Ambisonics (HOA), Microphones
10	Nov 4 - Nov 8	Intro to Statistical DSP, Discrete-time random processes
11	Nov 11 - 15	Random variables, mean and variance, Gaussian and Stationary processes
12	Nov 18 - 22	Introduction to mathematical music theory, chord sequences on a torus, the Tonnetz
13	Nov 25 - 29	Seventh chord sequences, geometry and Hamilton cycles
14	Dec 2 - Dec 6	Spline modeling of digital signals, cycle interpolation
15	Dec 9 - 13	Final Exams