MUS 471 Syllabus

Semester:	Spring 2025
Course title:	Audio Design Project IV (Lecture)
Instructor:	Matt Klassen
Time/Place:	lectures: Monday 12:00-12:50 in Blanc
Office hours:	T,W 2:00-3:00 in Teams, or by appointment

COURSE DESCRIPTION:

This course continues to explore 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: MUS 470, MUS 470L

Corequisites: MUS 471L

COURSE GOALS AND OBJECTIVES:

1) Students learn the basic definitions and low-level algorithms in audio physical modeling

2) Students will become familiar with mid-level components and plugins

3) Students gain experience with user interface design for audio applications

4) Students will implement an application related to audio engine design, physical modeling, or digital signal processing

EXAMS:

There are no exams in this course.

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 students need assistance in the event of an evacuation, they should let the instructor know.

GRADING:

Attendance	20%
Project Presentations	80%

Grades will be determined based on total course percentage. Note: Unexcused absence or lateness will result in 10 percent penalty per occurrence applied to the Attendance portion of the grade (max penalty is 20 percent of course grade). 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.

MATERIALS:

Reference Materials: (not required)

Physical Audio Signal Processing, by Julius Smith.

Immersive Audio Signal Processing, Sunil Bharitkar and Chris Kyriaskakis

Analysis, Synthesis, and Perception of Musical Sounds, James W. Beauchamp, editor.

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

Numerical Sound Synthesis, by Stephan Bilbao.

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.

GUEST SPEAKERS:

Guest speakers may be invited to speak on various topics relating to audio for games, machine learning and audio, audio for virtual and augmented reality, and spatial audio. Such guest speakers may come from DigiPen or from the audio community including academia and industry professionals. Since 2022 we are engaging with the Machine Learning program, sharing information with both faculty and students, and learning about techniques used in projects in that program. Audio students are encouraged to use this opportunity to attempt to employ some of these techniques in their projects.

TENTATIVE WEEKLY TOPICS:

The following represents a proof of concept listing of topics with a chosen emphasis on physical modeling of sound. The emphasis, or central topic, may vary each semester that the course is taught.

Week	Dates	Topics
1	Jan 6 - 10	Introduction to sound modeling
2	Jan 13 - 17	Acoustic modeling with delay: digital waveguides, delay lines, comb and allpass filters
3	Jan 20 - 24	Feedback delay networks (FDN) for reverb simulation
4	Jan 27 - Jan 31	Interpolation of signals: from sample-rate conversion to windowed sinc interpolation
5	Feb 3 - Feb 7	User Interfaces for musical instrument modeling
6	Feb 10 - 14	Mass-spring systems, finite differences and numerical modeling
7	Feb 17 - 21	Modeling of transfer functions, resonators, and phasing
8	Feb 24 - Feb 28	audio plugins: models, design and implementation
9	Mar 3 - Mar 7	Modeling of brass and woodwind instruments, plucked and hammered strings
10	Mar 10 - 14	Nonlinear models for strings, plates, and tubes
	Mar 17 - 21	Spring Break
11	Mar 24 - 28	Finite differences and direct numerical simulation of models
12	Mar 31 - Apr 4	Frequency tracking analysis, vibrato modeling
13	Apr 7 - 11	Commuted synthesis, body-model factoring
14	Apr 14 - 18	Real-time timbre morphing, continuous timbre control space
15	Apr 21 - 25	Final Exams