

MAT120 Syllabus

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| Semester: | Fall 2023 |
| Course title: | Mathematics of Music and Sound |
| Instructor: | Professor Matt Klassen |
| Email: | mklassen@digipen.edu |
| Phone: | (425) 895-4423 |
| Office hours: | M,Th 3:00-4:00 or by appointment |
| Course Web Page: | http://azrael.digipen.edu/MAT120 |
| Time/Place: | lectures: T,Th 1:30-2:50, in Descartes |

WEB PAGES AND MOODLE:

The Moodle page for MAT120 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, as well as on the Moodle page. Additionally, the Moodle page will be used for chat, forums, and for submission of homework, projects, and quiz and exam scratch work.

COURSE MATERIALS: (Not Required)

There is no required textbook for this course.

Supplemental Course Materials:

- Musimathics: The Mathematical Foundations of Music, Volume 1, by Gareth Loy, MIT Press, 2006.
- The Theory and Technique of Electronic Music, by Miller Puckette (available as free pdf online at <http://crca.ucsd.edu/~msp/techniques/latest/book.pdf>)
- Precalculus, by Michael Sullivan (available in the DigiPen library)
- Programming Electronic Music in Pd, by Johannes Kreidler (html version available online: <http://www.pd-tutorial.com/english/>)
- Pd “Pure Data” software package (installed on lab computers)
- Other Pd documentation: <http://puredata.info/docs>, and <http://en.flossmanuals.net/pure-data>
- ChuckK Website: <http://chuck.cs.princeton.edu>

COURSE DESCRIPTION:

This course explores the mathematical foundations of music and sound. Topics include scale systems, just and tempered intervals, oscillations and trigonometry, sound waves, and basic discrete mathematics.

COURSE OBJECTIVES AND LEARNING OUTCOMES:

Students should be able to construct intervals and scales from their basic frequency ratios, understand the classical and modern scale constructions using logarithms, and arithmetic and geometric series, work with the trigonometric functions and their representations of sound waves, and compute with the basic counting functions of combinatorics and finite probabilities.

GRADING:

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| Homework | 20% |
| Quizzes | 20% |
| Project | 20% |
| Midterm Exam | 20% |
| Final Exam | 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

TEAMS and STREAMING:

Students may request that an individual class be streamed to accommodate an illness which requires that they be off campus. Such a request must be documented and be sent to the instructor before class starts. Streaming is not for convenience or for other situations than those which are officially documented. If a student has questions about this they should contact Student Services for the description and requirements for official accommodations which can be used to justify requests for streaming of classes. At the beginning of each class, I will check to see if there are any official accommodations for streaming to be in effect. If there are not, then I will not stream.

If a student misses class without an accommodation, there are still ways to recover the course content. For example, a student may have a classmate who takes notes, or records the lecture as audio or video or a sequence of photos during the class. All recording methods are approved by the instructor, for the purpose of personal study, and may be shared between students. The only request is to please not post such materials online with public access.

In the case that a lecture is being streamed, 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.

HOMEWORK ASSIGNMENTS:

Homework will be assigned and posted on the web page and collected roughly 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.

QUIZZES AND EXAMS:

Quizzes and Exams will be given in class during regular class times. Quizzes will usually be given during the first 20-30 minutes of class, so please come on time. Answers will be submitted online at the end of the quiz. Attendance is required for quizzes, and they will not be given online. The lowest two quiz scores will be dropped for the final grade. If a student misses a quiz for any reason, they will receive a zero and that quiz will be dropped. After two quizzes are dropped, make-up quizzes can be offered only in the case of well-documented illness or accommodation from DSS.

COMPUTATIONAL RESOURCES:

To illustrate various mathematical and musical concepts, we will be using the free software packages: Pd, written by Miller Puckette, and ChuckK, written by Ge Wang and Perry Cook.

You are also encouraged to do algebraic and other calculations for the homework using a calculator or symbolic package such as PARI. The symbolic algebra package PARI/GP is free and open-source.

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.

DISABLED STUDENT 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\[at\]digipen\[dot\]edu](mailto: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.

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 institutes policy for grievances is published in the course catalog.

TENTATIVE WEEKLY TOPICS: Fall 2023

| Week | Dates | Topics |
|------|-----------------|--|
| 1 | Aug 28 - Sep 1 | Overview of Numbers: rational, irrational, real, complex; Geometric and arithmetic series, frequency ratios, equal temperament |
| 2 | Sep 5 - 8 | Logarithms and exponentials; Frequency, pitch, and classical intervals and scales; Loudness, decibels |
| 3 | Sep 11 - 15 | Just intervals and the harmonic series, Meantone and tempered scales |
| 4 | Sep 18 - 22 | Cent interval measurements, logarithmic scales |
| 5 | Sep 25 - Sep 29 | Partch's just scale system and modern just intonation |
| 6 | Oct 2 - 6 | Trigonometric functions, unit circle, and graphs |
| 7 | Oct 9 - 13 | Midterm Exam; Amplitude, period, frequency and phase |
| 8 | Oct 16 - 20 | Interference, beats, addition and multiplication of graphs |
| 9 | Oct 23 - Oct 27 | Basic Fourier series, partials, harmonics, and inharmonicity |
| 10 | Oct 30 - Nov 3 | Damped and driven harmonic oscillations, resonance |
| 11 | Nov 6 - 9 | Combinatorics: enumeration, permutations and combinations |
| 12 | Nov 13 - 17 | Sets, subsets, and partitions |
| 13 | Nov 20 - 22 | Cyclical patterns, modular arithmetic |
| 14 | Nov 27 - Dec 1 | Probability theory, discrete distributions, stochastic processes |
| 15 | Dec 4 - 8 | Final Exams |