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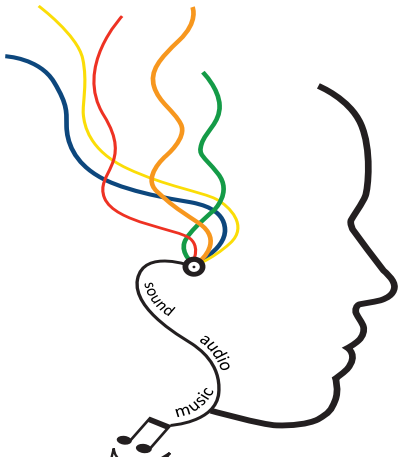

Audio and Music Engineering Curriculum Guide
Classes 2025 - 2028

The Hajim School of Engineering and Applied Sciences
University of Rochester

Fall/Spring 2024/2025

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PROGRAM OVERVIEW

The Department of Electrical and Computer Engineering coordinates the program in Audio and Music Engineering. Currently the Bachelor of Science and a Minor in AME are offered. The AME major combines studies in engineering and applied sciences with music and audio production to give students a technically rigorous, design-based education in the field of audio, music, and sonic engineering. The curriculum is built on a foundation of basic math and science and integrates elements of music, audio content production, acoustics, fundamental engineering science, signal processing hardware and software, electronics, and software engineering. Through a series of design and project courses integrated with their other course work, students build a project portfolio throughout their studies capped by a senior design project. Our students can also participate in research, working closely with faculty members in department research programs during the academic year and in summer internships.

The field of audio and music engineering extends far beyond the traditional music recording industry. Career paths for program graduates span industries including: audio software development, music and audio recording and production, core audio and signal processing technologies and component manufacturing, musical instruments and audio equipment manufacturing, video game development, automotive and architectural acoustics, industrial noise monitoring and control, consumer product design, and research and development in acoustics.

Students planning to pursue a double degree should consult their advisor early in their studies to plan their program. Multiple student advising resources are available including: the primary faculty advisor assigned to each AME student in their first year, the AME Program Undergraduate Coordinator (Barbara Dick), the AME Program Director (Mark Bocko). Students requiring assistance should first consult their primary faculty advisor or the AME Program Undergraduate Coordinator. Faculty advisors are available to help students plan their programs of study, declare a major or minor, drop and add courses, transfer credits from another institution, register for independent study credits, explore study abroad options, arrange internships and fellowships, and to petition for cluster exceptions. The AME Program Director must review and approve all transfer courses.

PROGRAM OBJECTIVES AND STUDENT OUTCOMES

Bachelor of Science in Audio and Music Engineering - Program Objectives

- Graduates of the University of Rochester's Bachelor of Science program in Audio and Music Engineering will, within a few years of graduating, be on paths to becoming leaders in their chosen professions.
- Our graduates will be valued for their creativity, technical proficiency, teamwork, and ability to communicate effectively.
- Throughout their careers our graduates will demonstrate their commitment to professional growth through the pursuit of advanced degrees, continued education and training, and adaptability within their work environments.
- Our graduates will appreciate the many ways that engineering skills may be applied to solve a wide range of problems, both within and outside of engineering, and will be equipped to explore alternate career paths that align with their interests and maximize their contributions to society.
- Our graduates appreciate their ethical responsibilities and the relationship and obligations of engineering and science to the public and the environment.

Bachelor of Science in Audio and Music Engineering - Student Outcomes

To prepare our graduates to enter the professional practice of engineering the Bachelor of Science in Audio and Music Engineering program of the University of Rochester will attain the following outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

ADMISSION

Students wishing to declare a major in AME must file a completed "AME Curriculum Planning Form" along with the Concentration Approval Form. This usually is completed during the fourth semester of study. The minimum requirements for admission to the AME BS program are completion of the following:

1. AME 140, AME 141, AME 191, ECE 113 with a minimum cumulative GPA of 2.3.
2. MATH161, 162, 164, and 165 or equivalent math sequence such as MATH 141,142,143,165,164
3. PHYS 121 and 122 or PHYS 113 and 114
4. University primary writing requirement, usually satisfied by taking WRT 105.
5. Students may not be admitted to the major if they are on Academic Probation in the College

Students who have not completed all the requirements for admission to the AME program by the end of their sophomore year may qualify for conditional admission to the program by submitting a petition form available from the AME Undergraduate Coordinator. This typically occurs when a student has changed their intended major or transferred from another institution. The petition must present a realistic plan, approved by the student's advisor, for completion of all AME program admission requirements within one year. Failure to meet the requirements within one year will result in removal from the major.

Only the Administrative Committee of the Hajim School of Engineering and Applied Sciences can make exceptions from the general degree requirements published in the Official Bulletin of the University. Petition forms for Administrative Committee consideration may be obtained from the AME Program Coordinator.

BS AME PROGRAM REQUIREMENTS

The BS AME program is built on a foundation of basic math, science, programming, and music and includes advanced course work in fundamental engineering science, audio content production, audio hardware and audio software. The credit hour requirements for the BS AME degree, along with the corresponding course list, are given in the following table and described below:

PROGRAM REQUIREMENTS CONTINUED

Course / Course Area	Credits
Basic Science and Mathematics	**32**
MATH 161: Calculus I	4
MATH 162: Calculus II	4
MATH 165: Linear Algebra	4
MATH 164: Multivariable Calc	4
PHYS 121: Physics I (or PHYS 113)	4
PHYS 122: Physics II (or PHYS 114)	4
AME 233: Musical Acoustics	4
ECE 270 or STATS: Probability*	4
Writing Requirement	**6**
WRTG 105: Primary Writing	4
WRTG 273: Professional Writing	2
Humanities and Social Sciences	**20**
Music	10
Cluster	12
H/SS Electives	Up to 8
Free Electives	**12**
Total Credits	**130**

Course / Course Area	Credits
Engineering	**60**
ECE 114: Intro to C/C++	4
ECE 113: Systems	4
ECE 241: Signals	4
AME 140: Intro to AME	4
AME 141: Fundamentals of Digital Audio	4
AME 191: The Art and Tech of Recording	4
AME 242: Critical Listening for Audio	4
AME 193: Sound Design	4
AME 223: Audio Electronics	4
AME 262: Audio Software Design I	4
AME 264: Audio Software Design II	4
AME 272: Audio Signal Processing	4
AME 292: Acoustics Portfolio	2
AME 294: Audio DSP Portfolio	2
AME 295: Audio Electronics Portfolio	2
AME 386: Senior Design Project I	2
AME 387: Senior Design Project II	4

BASIC SCIENCES

Mathematics (Complete one calculus sequence)
MATH161,162,164,165 or MATH171,172, 173, 174
MATH141,142,143 may be substituted for MTH161,162

NATURAL SCIENCES

ECE 270
STATS 180 or 190
PHYSICS (2 courses) PHYS 121, PHYS 122; PHYS 113, 114 or PHYS 141, PHYS 142

ENGINEERING COURSES

The BS AME major requires completion of courses and Portfolio projects in 5 subject areas: Recording Arts and Sound Design, Acoustics, Audio Electronics, Signal Processing and Software Design. The required courses for the BS AME degree are listed below. All courses are 4 credits unless indicated otherwise.

Foundations of Audio and Music Engineering
- AME 140 – Intro to Audio and Music Engineering
- AME 141 – Fundamentals of Digital Audio

Recording Arts and Sound Design – The focus is on audio and music recording and production, audio content creation and sound design:
- AME 191 – Art and Technology of Recording
- AME 242 – Critical Listening for Audio Prod
- AME 193 – Sound Design

Acoustics – Studies in acoustics range from fundamental acoustics, architectural acoustics, acoustic design, the acoustics of musical instruments, hearing and auditory perception:
- AME 233 (PHY 283) – Musical Acoustics
- AME 292 – Acoustics Portfolio (2)

Audio Electronics – Analog and digital electronics for audio - from vacuum tubes to custom integrated circuits:
- ECE 113 – Circuits and Signals
- AME 223 – Audio Electronics
- AME 295 – Audio Electronics Portfolio (2)

Signal Processing – Digital signal processing is the core of digital audio.
- ECE 241 - Signals
- AME 272 – Audio Signal Processing
- AME 294 – Audio DSP Portfolio (2)

Software Design – The principles and practice of programming and software development for audio:
- ECE 114 – Intro to C/C++ Programming
- AME 262 – Audio Software Design I
- AME 264 – Audio Software Design II

Senior Design – All AME BS students must complete a one-year senior design project
- AME 386– Senior Design Project I (2)
- AME 387 – Senior Design Project II

OTHER COURSES

Basic Music Competency (10 credits) All AME students must take **a minimum of 10 credits of music courses**, either from the River Campus Music Department or at the Eastman School of Music. **This includes 8 credits of music theory and 2 credits of musicianship.** The minimum requirement is completion of MUR101 and MUR111, however students with appropriate background and demonstrated proficiency in music theory may begin in a higher-level course. The appropriate starting course is determined by placement exam administered by the River Campus Music Department. To meet the musicianship requirement, students normally complete two one-credit courses from the following choices: MUR109, MUR113, MUR114, or MUR115, or one 2 credit course from MUR 201 or 202, or two credits of Private Lessons from the Eastman School. **Courses taken to fulfill the AME music requirement also may be counted toward a Music Cluster to meet the general AME Humanities or Social Science cluster requirement.**

Humanities/Social Science Requirement – All AME majors must take a minimum of 5 humanities and/or

social science (H&SS) courses. This includes the three courses taken to satisfy the University Cluster requirement, and the AME music competency requirement. These five courses can be chosen from any recognized Humanities and/or Social Science field listed below. Students also are expected to take some of these courses beyond the introductory level. Ordinarily, H&SS Clusters will count for three of the five required courses, but if questions arise, students should consult their advisors. Language courses at the 101 level are only accepted when followed by another, more advanced course in the same language.

Minors
A minor of 5 or more courses in one area will satisfy the H/SS requirement. Refer to the overlap policy https://www.rochester.edu/college/ccas/handbook/overlap.html

If pursuing a music cluster, some required music courses may count toward the 12 credit cluster requirement. In this case, additional electives in H /SS are needed to reach the 20 credit requirement.

Acceptable Humanities Courses: Any humanities course as outlined by the School of Arts and Sciences: https://www.sas.rochester.edu/departments-programs.html

Acceptable Social Sciences Courses: Any social science course as outlined by the School of Arts and Sciences: https://www.sas.rochester.edu/departments-programs.html

Ordinarily, courses taken at the University of Rochester to meet the requirements in H&SS are 4 credit hour courses. Consult your advisor concerning 2 or 3 credit courses (including transfer courses). You may need to petition the Undergraduate Committee to use such courses for the H&SS distribution requirement.

The following restriction applies to all courses used to satisfy the distribution requirement: **Two 2-credit courses may be combined to fulfill one 4-credit distribution requirement only if both courses are from the same discipline. No more than two courses may be combined to count toward a distribution requirement.** However, any number of two, 2-credit courses from different disciplines may be substituted for other 4-credit free electives.

Upper Level Writing – The University's Upper-level Writing Requirement applies to all majors. Within the BS Audio and Music Engineering major the requirement is met through work in **AME 242, AME193, AME 233, AME 262 and AME 386, WRTG 273 or 277**. Students who transfer credit for any one or more of these courses from another institution to the UR must consult with the AME Program Coordinator to determine if their program satisfies the writing requirement.

BS AME SAMPLE COURSE SCHEDULE (w/ MATH 161)

MATH 160 SERIES:

First Year

Fall Semester		Spring Semester	
Math 161: Calculus 1a	4	Math 162: Calculus IIa	4
AME 140: Intro to AME	4	PHYS 121: Physics I	4
WRTG 105: Primary Writing	4	AME 141: Fund. of Digital Audio	4
MUSC 111: Music Theory I	4	AME 191: Art and Tech of Recording	4
MUSC 109: Musicianship I	1	MUSC 113	1
Total Credits	**17**	**Total Credits**	**17**

Second Year

Fall Semester		Spring Semester	
Math 165: Diff Equations and Linear Algebra	4	Math 164: Multidimensional Calculus	4
PHYS 122: Physics II	4	AME 233: Musical Acoustics	4
AME 242: Critical Listening for Audio Prod.	4	ECE 113: Circuits and Systems	4
AME 193: Sound Design (or ECE 114 C/C++)	4	Elective	4
WRTG 273: Professional Writing	2		
Total Credits	**18**	**Total Credits**	**16**

Third Year

Fall Semester		Spring Semester	
AME 223: Audio Electronics	4	AME 272: Audio Signal Processing	4
ECE 241: Signals	4	AME 262: Audio Software Design I	4
ECE 114: C/C++ Programming (or AME 193)	4	AME 292: Acoustics Portfolio	2
ECE 270 or STAT 180, 190, 262	4	AME 295: Audio Electronics Portfolio	2
		MUSC 112: Music Theory II	4
Total Credits	**16**	**Total Credits**	**16**

Fourth Year

Fall Semester		Spring Semester	
AME 264: Audio Software Design II	4	AME 387: Senior Design Project II	4
AME 294: Audio DSP Portfolio	2	Elective	4
AME 386: Senior Design Project I	2	Elective	4
Elective	4	Elective	2
Elective	4		
Total Credits	**16**	**Total Credits**	**14**

To meet graduation requirements, BS-AME majors must achieve a minimum cumulative grade-point average of 2.0 in the required AME courses. In addition, 130 total credits are required for graduation with an overall cumulative grade point average of 2.0.

BS AME SAMPLE COURSE SCHEDULE (w/ MATH 141)

MATH 140 SERIES

First Year

Fall Semester		Spring Semester	
Math 141: Calculus I	4	Math 142: Calculus II	4
AME 140: Intro to AME	4	PHYS 113: Physics I	4
WRTG 105: Primary Writing	4	AME 141: Fund. of Digital Audio	4
MUSC 111: Music Theory I	4	AME 191: Art and Tech of Recording	4
MUSC 109: Musicianship I	1	MUSC 113	1
Total Credits	**17**	**Total Credits**	**17**

Summer	
Math 143: Calculus III	4

Second Year

Fall Semester		Spring Semester	
Math 165: Diff Equations and Linear Algebra	4	Math 164: Multidimensional Calculus	4
PHYS 114: Physics II	4	AME 233: Musical Acoustics	4
AME 242: Critical Listening for Audio Prod.	4	ECE 113: Circuits and Systems	4
AME 193: Sound Design (or ECE 114 C/C++)	4	Elective	4
WRTG 273: Professional Writing	2		
Total Credits	**18**	**Total Credits**	**16**

Third Year

Fall Semester		Spring Semester	
AME 223: Audio Electronics	4	AME 272: Audio Signal Processing	4
ECE 241: Signals	4	AME 262: Audio Software Design I	4
ECE 114: C/C++ Programming (or AME 193)	4	AME 292: Acoustics Portfolio	2
ECE 270, or STAT 180, 190, 262	4	AME 295: Audio Electronics Portfolio	2
		MUSC 112: Music Theory II	4
Total Credits	**16**	**Total Credits**	**16**

Fourth Year

Fall Semester		Spring Semester	
AME 264: Audio Software Design II	4	AME 387: Senior Design Project II	4
AME 294: Audio DSP Portfolio	2	Elective	4
AME 386: Senior Design Project I	2	Elective	4
Elective	4	Elective	2
Elective	4		
Total Credits	**16**	**Total Credits**	**14**

To meet graduation requirements, BS-AME majors must achieve a minimum cumulative grade-point average of 2.0 in the required AME courses. In addition, 130 total credits are required for graduation with an overall cumulative grade point average of 2.0.

OTHER PROGRAM CONSIDERATIONS

TRANSFER CREDITS

If a student wishes to take a course at another institution to satisfy an AME degree requirement, **PRIOR APPROVAL** is strongly recommended. Proper supporting documentation about the course should be submitted to the AME Undergraduate Program Coordinator before taking any courses for transfer. An electronic approval from will need to be submitted with approvals from the instructor and the ECE department. Students are strongly advised to seek the guidance and feedback from their advisor before registering for a course at another institution. Completed forms will be forwarded to the Undergraduate Committee for action. Seeking approval after the fact may result in delays, and refusal to allow a student to take advanced courses for lack of prerequisites.

INTERNSHIPS AND PRACTICUM

AME majors are strongly encouraged to participate in internships with local or nationally based engineering firms for professional development. Only in a few cases can internship experiences be used for academic credit. Students who wish to obtain such credit for an internship must obtain prior approval from the ECE Undergraduate Committee.

The Engineering Practicum program, supervised jointly by the Hajim School of Engineering and Applied Sciences and the Gwen M. Greene Career and Internship Center, is a way to gain valuable work experience. A student in this program takes one semester and the preceding or following summer to work for a company. Academic credit is not granted, but the work experience and references obtained are valuable in students' career development. Usually graduation will be delayed by one semester but students with Advanced Placement credit or summer classes may still graduate in four years. Additional information, including example programs, is available from the Hajim School of Engineering and Applied Sciences office in Lattimore Hall, or from the Gwen M. Greene Career and Internship Center.

TRANSITIONING TO THE MSEE PROGRAM

AME Seniors contemplating earning their Master's degree may wish to consider the Master's program offered by the department. This program provides the advantage of a smooth transition between undergraduate and graduate study. Program enrollment is competitive and students are encouraged to apply for admission in their Senior year. Applicants may begin to take graduate level courses in their Senior year with the intent to transfer up to 10-credits of graduate level credits. These credits cannot be used toward the BS degree. (Transfer Credit Policy) Successful applicants will be granted a tuition scholarship for the Master's year of study. Conferral of the BS degree is required in order to matriculate into the Master's program. Please visit the Master's Program webpage for up-to-date information: http://www.hajim.rochester.edu/ece/graduate/ms.html

AME MINORS

The AME Minor consists of 18-20 credit hours of study in AME or closely related fields. Note that the AME Minor Tracks specified below that require only 18 credit hours each include a design/portfolio component. The other AME Minor Tracks require 20 credit hours of regular courses.

Students must choose one of the following AME Minor Tracks and corresponding course sequences:

Recording and Sound Design (20 Credits Total)
- AME 140: Introduction to Audio and Music Engineering
- AME 191: The Art and Technology of Recording
- AME 242: Critical Listening for Audio Production
- AME 193: Sound Design
- AME 227: Hear UR - Podcasting History (Can also fulfill upper-level writing if taken as HIST 227W)
- AME 244 – Music for Visual Media
- One additional track course

Audio Signal Processing (18 Credits Total)
- AME 140: Introduction to Audio and Music Engineering
- AME 141: Fundamentals of Digital Audio
- ECE 241: Signals
- AME 272: Audio Signal Processing
- AME 294: Audio DSP Portfolio (2 credits)

Audio Electronics (18 Credits Total)
- AME 140: Introduction to Audio and Music Engineering
- AME 141: Fundamentals of Digital Audio
- ECE 113: Circuits and Signals
- AME 223: Audio Electronics
- AME 295: Audio Electronics Portfolio (2 credits)

Audio Computing and Software Design (20 Credits Total)
- AME 140: Introduction to Audio and Music Engineering
- AME 141: Fundamentals of Digital Audio
- ECE 114: Introduction to Computers and Programming (or CSC 171)
- AME 262: Audio Software Design
- AME 264: Audio Software Design II

Musical Acoustics (18 Credits Total)
- AME 140: Introduction to Audio and Music Engineering
- AME 191: The Art and Technology of Recording
- AME 233: Musical Acoustics
- AME 292: Acoustics Portfolio (2 credits)
- One additional track course

Acceptable MUR Classes: MUR 101, MUR 110, MUR 111, MUR 112, MUR 201, MUR 202, MUR 211, MUR 212, MUR 234, or equivalent courses offered at the Eastman School of Music. If a student wishes to make course substitutions in any of the above tracks they should contact the AME Program Coordinator to seek approval prior to taking any alternative classes.

COURSE DESCRIPTIONS

AME 140 Introduction to Audio and Music Engineering This course provides an introduction to the science and technology of audio. Students will learn about the vibration of strings, musical tuning systems, overtones and timbre, modes of oscillation through the concept of a guitar. Fourier analysis, transducers and passive electrical components and circuits will be introduced when discussing amps and audio components. Hands on projects introduce the fundamental concepts of electronics, including voltage, current, resistance and impedance, basic circuit analysis, ac circuits, impedance matching, and analog signals. The course then introduces basic digital signal processing concepts, where they will use Arduinos and Pure Data to learn about conversion of sound to digital format, frequency analysis, digital filtering and signal processing and musical sound synthesis. AME140 is recommended as an introduction to the Audio and Music Engineering major but is accessible to students of music or other non-technical disciplines who wish to learn the fundamentals of music technology. **F**

AME 141 Fundamentals of Digital Audio This course covers the fundamentals of manipulating and encoding sound in a digital format. Mathematical representations of digital signals are introduced and the effects of simple filters are analyzed in the context of audio. This course further provides students with an introduction to programming in Matlab through a series of assignments exploring sound synthesis algorithms and audio effects processing. **S**

AME 191 The Art and Technology of Recording This course covers the fundamentals in becoming an audio engineer. Topics covered include: Acoustics, Psychoacoustics, Microphones, Signal Processing, Tape Recording, Digital Audio Theory, Signal Flow, Studio Etiquette, Digital Audio Workstations, Music Business, Recording Audio, and Mixing Audio. You do not need any previous experience in recording, however some familiarity with music and how it is created is needed.
There are four group recording projects that make up the bulk of the course, each with their own guidelines and challenges. This course requires considerable time to be spent on projects outside of the lecture and lab times. The labs are required to take this course. **INSTRUCTOR PERMISSION ONLY. F & S**

AME 242 Critical Listening for Audio Production This course builds on knowledge gained in AME191. Fundamental topics covered include Advanced Mixing and Mastering Techniques, Drum Replacement, Impulse Responses and Reverb, Advanced Concepts of Signal Processing, Analog Tape Recording, Music Business Ethics and Taxes, and Hybrid Analog/Digital Mixing Techniques.
Emphasis is on the development of critical listening skills through ear training exercises and active listening assignments. These drills will develop your ability to hear width and depth in audio, mixing techniques in various musical genres, specific instruments used in a recording, and recognition of various effects including reverb, delay, compression, phasing and distortion.

There are four group recording projects that make up the bulk of the course, each with their own guidelines and challenges. This course requires considerable time to be spent on projects outside of the lecture and lab times. The labs are required to take this course. Prerequisite: AME 191 **INSTRUCTOR PERMISSION ONLY. F & S**

AME 193 Sound Design The course is intended to provide students a basic understanding of sound design, audio recording, and working with sound for picture. The emphasis is on demonstrations and hands-on The course is intended to provide students a basic understanding of sound design, and working with sound for picture. The emphasis is on demonstrations and hands-on experience to enable students to gain a practical knowledge of sound and music production using computers. Topics include synthesizers & samplers; recording and editing with Pro Tools; sound effect creation; foley & automatic dialog replacement; basic soundtrack composition; and working to picture. Many techniques are explored employing software and hardware based sound creation tools throughout the course. Students will complete a major project at the conclusion of the course. **Instructor permission required**. **F & S**

AME 223 Audio Electronics The devices, circuits, and techniques of audio electronics are covered in this course. Included is a survey of small signal amplifier designs and small-signal analysis and characterization, operational amplifiers and audio applications of opamps, large-signal design and analysis methods including an overview of linear and switching power amplifiers. The course also covers the design of vacuum tube circuits, nonlinearity and distortion. Other important audio devices are also covered including microphones, loudspeakers, analog to digital and digital to analog converters, and low-noise audio equipment design principles. **F**

AME 233 Musical Acoustics Engineering aspects of acoustics. Review of oscillators, vibratory motion, the acoustic wave equation, reflection, transmission and absorption of sound, radiation and diffraction of acoustic waves. Resonators, hearing and speech, architectural and environmental acoustics. Prerequisites: Linear algebra and Differential Equations (MTH 165), Multivariable Calculus (MTH 164), and Physics (PHY 121) or equivalents. **S**

AME 262 Audio Software Design I In this course, students will develop skills for designing audio/music applications and creating computer music in C and Max. We will begin with the history of computer music, a survey of audio programming languages, and a review of C. Libsndfile, a C library for reading and writing sound files, will be used to explore topics in sound synthesis, analysis, and digital signal processing. Students will use PortAudio, a C library for real-time audio input/output, to design DSP applications. Max is a visual programming language for interactive audio/music and multimedia. Students are required to watch pre-recorded lectures to learn Max and attend recitations for reviews. They will also practice their programming techniques through a series of programming assignments, a midterm drum machine project in Max, and a final research/design project. Prerequisites: ECE 114 or instructor permission. **S**

COURSE DESCRIPTIONS CONTINUED

AME 264 Audio Software Design II This course is a sequel to Audio Software Design I. Students will learn how to create audio applications and plug-ins with Faust and C++. Faust is a high-level functional programming language designed for real-time digital signal processing (DSP), sound synthesis, and sound analysis. The Faust compiler can translate the same source code into other programming languages and export to audio applications or plug-ins running on various platforms, including Windows, MacOS, and Linux, iOS, and Android. JUCE is a cross-platform C++ application framework used to design audio applications, audio plug-ins, animated applications, and OpenGL applications. Many professional audio applications and plug-ins have been built with JUCE, mainly used for its GUI, plug-in, and DSP libraries. At the end of the semester, we will have an Audio Software Show demonstrating the audio applications or plug-ins designed by the students. Prerequisites: AME 262 or ECE 475 or Instructor Permission. **F**

AME 272 Audio Signal Processing This course is a survey of audio digital signal processing fundamentals and applications. Topics include sampling and quantization, analog to digital converters, time and frequency **domains**, spectral analysis, vocoding, digital filters, audio effects, music audio analysis and synthesis, and other advanced topics in audio signal processing. Implementation of algorithms using Matlab and on dedicated DSP platforms is emphasized. Prerequisites: ECE 114 and basic Matlab programming, ECE 241 or other equivalent signals and systems courses. **S**

AME 292 Acoustics Portfolio This is a follow on course to AME233, Musical Acoustics. In this course students will complete a major project in acoustics, such as the acoustical characterization of an architectural space, design or re-design of an architectural or studio space, development of acoustical computer simulation tools, design or characterization of acoustic musical instruments, design and fabrication of loudspeakers, design and implementation of a live sound or sound reinforcement system, or any other project in acoustics with the agreement of the instructor. Weekly meetings and progress reports are required. Prerequisite: AME 233 **S**

AME 294 Audio DSP (Digital Signal Processing) Portfolio his is a follow on course to AME272, Audio Digital Signal Processing. Students will complete a major design/build project in the area of audio digital signal processing in this course. Examples include a real-time audio effects processor, music synthesizer or sound analyzer or other projects of student interest. Weekly meetings and progress reports are required. Prerequisites: AME 272 strong MATLAB expertise, and C/C++ programming familiarity **F**

AME 295 Audio Electronics Portfolio This is a follow on course to AME 223, Audio Electronics. In this course students will complete a major design/build project in the area of audio electronics. Examples include a solid state or tube-based instrument amplifier, audio power amplifier, audio effects processor, audio analog/digital interface or any other audio electronic project with the agreement of the instructor. Weekly meetings and progress reports are required.Prerequisite AME 223. **S**

AME 386 Senior Design Project I Senior Design Project in Audio and Music Engineering. In this first semester of the year-long AME Senior Project course students will define their product, possibly in collaboration with an outside customer, and then develop product concept documentation, detailed requirements specifications, system level designs, detailed sub-system designs and hopefully build demonstration prototypes. Prerequisites: AME 223, AME 233 and AME 272 **F**

COURSE DESCRIPTIONS CONTINUED

AME 387 Senior Design Project II Senior Design Project in Audio and Music Engineering. In the second semester of the year-long AME Senior Project course students will complete their projects including final system level designs, detailed sub-system designs, prototype building, testing, evaluation, and final presentation to the customer. **S**

ECE 113 Circuits and Signals: The focus will be to provide background and insight into some of the most active security related research areas in the field of VLSI design methodologies, side-channel attacks and countermeasures, covert communication attacks and countermeasures, physical unclonnable functions, hardware Trojans, security versus power/performance/noise/area/cost tradeoffs for corresponding countermeasures, etc **PREREQUISITES: Concurrent registration in MTH 165 and PHY 122 S**

ECE 114 Introduction to C/C++ Programming - This course provides an introduction to the C and C++ programming languages and the key techniques of software programming in general. Students will learn C/C++ syntax and semantics, program design, debugging, and software engineering fundamentals, including object-oriented programming. In addition, students will develop skills in problem solving with algorithms. Programming assignments will be used as the primary means of strengthening and evaluating these skills. Each student also has to complete a game project in C++ at the end of the semester. **F/S**

ECE 241 Signals – Introduction to continuous and discrete time signal theory and analysis of linear time-invariant systems. Signal representations, systems and their properties, LTI systems, convolution, linear constant coefficient differential and difference equations. Fourier analysis, continuous and discrete-time Fourier series and transforms, properties, inter-relations, and duality. Filtering of continuous and discrete time signals. Sampling of continuous time signals, signal reconstruction, discrete time processing of continuous time signals. Laplace transforms. Laboratory. **PREREQUISTIES: MTH 165 and ECE 113 or ECE 210 or BME 210 F**

ECE 270 Probability for Electrical Engineers - Logic, introduction to proofs, set operations, algorithms, introduction to number theory, recurrence relations, techniques of counting, graphs. Probability spaces, independence, discrete and continuous probability distributions, commonly used distributions (binomial, Poisson, and normal), random variables, expectation and moment generating functions, functions of random variables, laws of large numbers. **F**

CONTACT INFORMATION

AME Program Chair

Prof. Mark F. Bocko	CSB 709	5-4879	mark.bocko@rochester.edu

AME Undergraduate Coordinator

Barbara A. Dick	CSB 510	5-5719	barbara.dick@rochester.edu

AME Advisors

CLASS 2025

Mark Bocko	CSB 709	5-4879	mark.bocko@rochester.edu

CLASS 2026

Zhiyao Duan	CSB 720	5-5302	zhiyao.duan@rochester.edu

CLASS 2027

Sarah Smith	CSB 617	5-8661	sarahsmith@rochester.edu

CLASS 2028

HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES
UNIVERSITY of ROCHESTER