



PERFORMING ARTS TECHNOLOGY

Reminder: please visit the [University Registrar's Office Schedule of Classes](#) for the most up-to-date information on course offerings!

PAT 100: Music in Technology (3 credits)

This course is a survey of the symbiotic relationship between music and technology. With a primary focus on popular music styles, we will trace the evolution of music technology and explore how musicians influenced technological developments and how developments in music technology have influenced artists; ushering in new music styles and ways of making and performing music. *Typically offered Fall, Winter*

PAT 101: First Year Seminar in Media Arts (3 credits)

This seminar presents perspectives in the performing and media arts from the early twentieth century to the present. Students develop critical analytical skills contextualized by the historical, cultural and technological underpinnings that have influenced the media arts. Students complete readings, writings, viewings and listening assignments as well as participate in group discussions. *Typically offered Fall*

PAT 102: Acoustics and Psychoacoustics (3 credits)

An introduction to the principles of acoustics and psychoacoustics that are relevant to the recording engineer, music technologist, and composer. Topics include introduction to sound, human hearing, perception and measurement of sound, room acoustics, and the acoustics of musical instruments and the human voice. *Typically offered Winter*

PAT 150: Experiential Music Theory (3 credits)

An introductory music theory class that teaches fundamental concepts through embodied practice. With an emphasis on improvisation, deep listening, and composition, the class develops core skills in rhythmic, timbral, acoustic, and harmonic analysis. A wide range of music from around the world is studied. *Prerequisite: Theory 139 and Theory 140 with a grade of C- or better. Instructor permission required; typically offered Winter*

PAT 200: Introduction to Electronic Music (3 credits)

This course is for students not majoring in Performing Arts Technology who are interested in developing a contextually-informed artistic practice in the area of electronic music composition, production, and performance. Through a series of composition exercises, students build skills in sequencing, audio and MIDI recording and editing, mixing, sound synthesis, sampling, effects processing, and live electronic music performance with real-time controllers. *Non-PAT majors only; typically offered Fall, Winter*

PAT 201: Introduction to Computer Music (3 credits)

This course is an introduction to electronic musical instruments, MIDI, and digital audio systems. Students create several original compositions for presentation and discussion. The aesthetics of electroacoustic composition are discussed through study of selected repertoire. *Instructor permission required; typically offered Fall, Winter*

PAT 202: Computer Music Composition and Arranging (3 credits)

Builds on tools and techniques developed in PAT 200/201, with an emphasis on composition, remixing and arranging. Students use digital audio workstations, controllers, and professional music production software to create music in diverse styles and genres. Contemporary compositional issues and practices are explored through classroom discussion, critiques, reading, and listening. *Prerequisite: PAT 201. Instructor permission required; typically offered Fall, Winter*

PAT 204: Creative Coding for Music (3 credits)

An introduction to principles and practices of computer programming for musical applications. Students learn visual, procedural, and object-oriented programming in general-purpose and music-specific languages. Projects address important musical programming concepts including algorithmic composition, real-time interaction, and audio buffer processing. Emphasis is on creative and artistic uses of code. *Typically offered Fall, Winter*

PAT 220: Songwriting Workshop (2 credits)

This course is designed to nurture student songwriting in a supportive workshop environment. New songs, written for the class, will be performed and critiqued as we strive to illuminate songwriting fundamentals, define personal vision and expand artistic boundaries. Course work will include an exploration of the American songwriting tradition. *Typically offered Fall, Winter*

PAT 280: Sound Reinforcement (1 credit)

Students will assist with live sound reinforcement and production for music, opera, and musical theatre productions. Students learn the fundamentals of microphone selection and placement,

mixing, monitoring, and signal processing for particular types of performances and performance venues. *Prerequisite: PAT 201. Typically offered Fall, Winter*

PAT 300: Research and Scholarship (1-3 credits)

Students will learn the fundamentals of dissemination of research and scholarship through recording, editing, mastering and encoding of mixed media content such as lectures, recitals, and performances. Electing this course at the 300 level requires more leadership and responsibility from the student. *Instructor permission required; typically offered Fall, Winter*

PAT 305/505: Video Game Music (2 credits)

This course surveys game music from the first synthesized “bleeps” and “bloops” to modern orchestral compositions. Techniques are learned to aurally analyze game music. Students will create compositions using computer software as a final project. Course is designed for non-music majors; the ability to read standard music notation is not needed. *Typically offered Fall, Winter*

PAT 313: The Art of Electronic Music (3 credits)

This course integrates historical, technological, and musical approaches to the study of electronic music. Students learn the techniques and aesthetics underlying a spectrum of recording and production techniques in order to investigate the dialogue between technological and creative innovations in a wide variety of electronic genres. *Typically offered Fall*

PAT 314: Electronic Music & Social Justice (3 credits)

This course investigates artistic responses to and interventions in struggles for social justice made by electronic musicians from the 1970s to the present day. Students learn specific artistic and technological techniques which inform music concerned with representation, protest, and activism, and develop critical perspectives on this repertoire. *Typically offered Winter*

PAT 315/525: Diversity in Music Technology (3 credits)

The field of music technology, encompassing such practices as electronic music composition, music production, DJing, and audio engineering, has historically been male-dominated. Despite the foundational work of women, non-binary practitioners, and people of color in this field, their role in transforming music technology has traditionally been overlooked. This course focuses on the contributions of women, transgender and gender nonconforming artists and people of color in music technology and the social barriers they confront. *Fulfills the Race and Ethnicity requirement for SMTD majors only; dual degree students should take an approved course under LSA.*

PAT 331: Sound Recording and Production I (3 credits)

Students receive instruction on the theory and practice of sound recording. Topics include microphones, microphone techniques, equalization, preparing for a recording session, recording consoles, digital audio workstations, loudspeakers, and critical listening. The course includes a required lab section for hands-on experience in a recording studio. *Prerequisites: PAT 101, PAT 102, PAT 201, and PAT 202. Instructor permission required; typically offered Fall*

PAT 332: Sound Recording and Production II (3 credits)

This course is a continuation of PAT 331. The course explores philosophies and techniques in sound recording theory and practice, including microphone techniques, dynamics processing, equalization, reverberation, mixing in stereo and surround, critical listening, and selected topics in audio electronics. The course includes a required lab section for hands-on experience in a recording studio. *Prerequisites: PAT 331. Instructor permission required; typically offered Winter*

PAT 380: Sound for Theatre (2 credit)

Students work as a member of a theatre production team with emphasis on sound effects and sound design for theatre. *Prerequisites: PAT 280; typically offered Fall, Winter*

PAT 407: Directed Individual Studies (1–3 credits)

Students receive individual instruction, consultation, and guidance from the instructor. Course emphasis is on developing individual research skills that culminates in a final project or paper. *Instructor permission required; typically offered Fall, Winter*

PAT 412: Digital Music Ensemble (1-2 credits)

Digital Music Ensemble (DME) is a technology-based interdisciplinary performance troupe that collaborates in the creation and performance of new works of art or performs historically innovative works. DME uses methods of open-ended critical inquiry to challenge meaning in the creation, realization and performance of art. The fall semester is usually focused on readings concerning the Labyrinth tradition in many cultures, culminating in the recurring work “Gypsy Pond Music,” a sonic, site-specific installation involving sculpture and algorithmic computer music. *Instructor permission required; typically offered Fall, Winter*

PAT 413: Electronic Chamber Music (1-2 credits)

Small ensembles of musicians are formed to create and perform contemporary chamber music. Various approaches to composition and group collaboration are explored through the integration of various categories of instruments including acoustic, electronic, electro-acoustic hybrids, performance controllers, and computers. *Prerequisite: PAT 202. Typically offered Fall, Winter*

PAT 421: Advanced Psychoacoustics (3 credits)

This course will focus on psychoacoustics, the study of how we perceive sounds. Topics covered will include the anatomy and physiology of the ear, the perception of simple and complex sounds, ecological acoustics and auditory scene analysis. Qualifies for Upper Level Writing Requirement for undergraduates. *Prerequisite: 102 or permission of instructor. Typically offered Fall*

PAT 422 Technical Ear Training and Critical Listening (3 credits)

This course is an introduction to the concept of translating between timbres and frequency resonances produced by parametric equalization. Students learn to aurally identify different timbres through their corresponding spectral envelopes. Critical listening exercises will also be explored with a focus on dynamics processing, spatial characteristics, spectral balance, and recording, mixing, and production techniques. *Typically offered Winter*

PAT 431: Contemporary Practices in Studio Production I (3 credits)

The advanced study of theory and practice of recording techniques, mixing, and production for multi-channel audio systems through guided projects. *Prerequisites: PAT 331 and PAT 332. Typically offered Fall*

PAT 432: Contemporary Practices in Studio Production II (3 credits)

This course focuses on the development of the producer's role as techno-artistic interpreter and creative collaborator. Critical listening and discussion investigate the evolution from the "illusion of reality" aesthetic to the "reality of illusion" point of view. Producers studied include Gaisberg, Spector, Martin, Eno, Reznor and Dr. Dre. Students sharpen their creative, technical, and production skills through the realization of complex recordings. *Prerequisite: PAT 431. Typically offered Winter*

PAT 441: Sound for Film and Games (3 credits)

This course will cover a wide range of topics and techniques that are unique and specific to film and video game audio. These will include using audio-video synchronization for both sound design and musical score. This course will discuss musical score as it relates to the overall emotion of a work of visual audio, as well as the concept of interactive audio for games and multichannel sound for film. The course will discuss the history of, and techniques to perform and edit Foley, creating custom sound effects including the use and processing of library sound effects, recording, and editing ADR, field recording, and using various software programs to edit, process, and implement audio. *Typically offered Fall*

PAT 442: Practicum in Music and Sound for Film (3 credits)

Students work on original film and animation projects, in roles such as composers, sound designers, dialog editors, mix engineers, or production audio crew on advanced student productions. Class sessions include script analysis, screenings, discussion of readings, and in-class critiques of works-in-progress. The emphasis is on developing an awareness of the multiple ways that music and sound can interact with the moving image to create meaning. While this is an advanced course that assumes a familiarity with computers and audio production tools, it does include some direct instruction in relevant techniques such as syncing to picture, spotting music, dialog editing, and on-set recording. *Prerequisite: music composition. Typically offered Winter*

PAT 443: Immersive Media (3 credits)

Practice-based investigation of immersive media technologies, including virtual reality platforms, spatial audio systems, and game engines. Lectures cover methods and tools employed in the design of multimodal virtual and augmented realities. During lab activities, students implement interactive systems using modern immersive media platforms. Projects involve prototyping and realization of immersive media artworks and performances. Combining critical and historical discourse with hands-on experience, students develop comprehensive skills in the use of immersive media as performing arts tech. *Typically offered Fall*

PAT 451: Interactive Media Design I (3 credits)

This course introduces the technological and theoretical foundations of designing physically interactive media experiences. Students develop interactive sensing systems and program embedded computing devices as well as real-time auditory, visual and tangible displays. Through exercises that draw on theory and techniques of interaction design, students create technological sketches and prototypes for novel devices and artworks. *Prerequisites: PAT 202, computer programming, and music composition. Typically offered Fall*

PAT 452: Interactive Media Design II (3 credits)

The course focuses on the application of skills and techniques developed in Interactive Media Design I to design and implement physically interactive performance systems and media installations. Incorporating advanced sensing and interaction techniques, students create fully realized works that are exhibited before a public audience. Seminal works of interactive art and interactive performance are discussed and critiqued. *Prerequisites: PAT 451. Instructor permission required; typically offered Winter.*

PAT 455/555: Sound Installation and Art (3 credits)

This course delves into the relationship between sound and space through installation art. Students will explore theoretical frameworks, compositional processes, and innovative technologies to develop engaging and interactive environments. The course guides students in

designing installations that are performative and re-performable with thematic explorations. The course concludes with a collaborative sound installation project, and the works are displayed at the end-of-semester exhibition. We will engage with various perspectives on this art form through reading, listening, viewing, and discussing works and writings by artists, curators, art historians, and critics. This exploration will serve as a foundation for creating our own installation ideas. *Offered every other year and open to all U-M students.*

PAT 461: Performance Systems (3 credits)

This course explores contemporary technologies that support musical performance. Topics include the goals of technology-enhanced performance, instrument interfacing, system design, programmable systems, and sound reinforcement design for playback of electronic and acoustic ensembles. Students create original compositions using performance systems that they have designed and built and direct performances that use these systems. *Prerequisites: PAT 202, computer programming. Typically offered Winter*

PAT 462: Digital Sound Synthesis (3 credits)

An introduction to digital sound synthesis and signal processing theory with an emphasis on sound design and compositional applications. Topics include additive synthesis, amplitude modulation, ring modulation, frequency modulation, subtractive synthesis, granular synthesis, physical modeling synthesis, heterodyne filter analysis/resynthesis, linear predictive coding, and phase vocoding. *Prerequisites: PAT 202, music composition. Typically offered Fall*

PAT 463/563: Music and AI (3 credits)

An introduction to the emerging field of AI music. This course introduces students to AI applications in music from analysis, creation, retrieval to processing. Example topics include music transcription, optical music recognition, music source separation, automatic music composition, music synthesis, music recommendation and auto-making. Students will gain hands-on experience on using AI tools through open-ended assignments and a final project on a relevant topic of their choice. *Prerequisites: Prior computer programming experience is recommended. Typically offered Fall*

PAT 464/564: Generative AI for Music and Audio Creation (3 credits)

An introduction to generative AI and its applications to music and audio creation. Topics include music generation, audio synthesis and assistive music creation tools. Students work on a semester-long group project to gain hands-on experience on creating music using AI tools.

PAT 472/572: Business of Music (3 credits)

A survey of professional opportunities in performing arts management, the recording industry and arts entrepreneurship, with a focus on building business skills for the personal development of a career in music. Students will learn basic skills that may serve any of the Business of Music

areas of concentration: leadership, planning, budgeting, financial analysis, marketing, fund-raising and development (and/or seeking investors). Assignments will include: analysis of case studies, writing a grant proposal, and working in teams to create a model arts enterprise that will need a business plan and marketing materials. The course also features a number of guests from various businesses and music disciplines. *Typically offered Winter*

PAT 481: Independent Study (1–4 credits)

Students receive individual instruction, consultation and guidance from the instructor. Course emphasis is on developing individual research skills that culminates in a final project or paper. *Undergraduate PAT majors only; instructor permission required; typically offered Fall, Winter*

PAT 490 Senior Thesis Seminar (1-3 credits)

This capstone course introduces students the fundamentals of creative and/or scholarly research. Students will formulate a thesis topic accompanied by objectives and methodologies, requires resources, and a timeline and/or production schedule. Weekly seminars promote sharing among students. Each student is required to complete a thesis that may be a research paper, recordings, website, or DVD. *Instructor permission required; typically offered Fall, Winter*

PAT 498/598 Special Topics (1 - 3 credit hours)

Periodic offering on topics of special interest in Performing Arts Technology. *Typically offered Fall, Winter*

Fall 2025 Sections

PAT 498/598.001:

Prof. Ozcan

T/TH 1:30 - 3:00 pm

376 Moore

This course delves into the relationship between sound and space through installation art. Students will explore theoretical frameworks, compositional processes, and innovative technologies to develop engaging and interactive environments. The course guides students in designing installations that are performative and re-performable with thematic explorations. The course concludes with a collaborative sound installation project, and the works are displayed at the end-of-semester exhibition. We will engage with various perspectives on this art form through reading, listening, viewing, and discussing works and writings by artists, curators, art historians, and critics. This exploration will serve as a foundation for creating our own installation art pieces. Conceptual assignments will help students enhance their capacity to generate creative ideas.

PAT 498/598.002: Spatial Audio

Prof. Camci

T/TH 9:00 - 10:30 am

376 Moore

This is a practice-based course on artistic and technical considerations in spatial audio. Students learn about modern spatial audio techniques such as Dolby Atmos, Binaural Audio, and Ambisonics through hands-on exercises in the Tech Suite facilities. Course activities include composing and mixing for spatial audio, and implementing spatial sound for visual media such as film and virtual reality. These activities are supported with discussions on auditory perception, exploring how humans localize sound in space and how this contributes to our senses of presence and immersion. The course also engages in critical discussions on the aesthetics and history of spatial audio with a focus on landmark developments and foundational literature from the early 20th century to the present day. The students complete the course with a portfolio of spatial audio projects. This course counts as an upper-level elective for PAT students.

PAT 498/598.003: NOISE

Prof. Zhu

M/W 11:30 am - 1:00 pm

3213 Moore

NOISE is a seminar in Performing Arts Technology (PAT) about the slippery idea of noise. Its etymology comes from "nuisance" or "nausea" yet noise is so personal—what is noise to one is music to another. Noise is rebellion, noise is discord, noise is all of the sounds, together. Whatever noise is, we will find our own definition in this class. From Japanoise to Elizabethan "noyso" musical ensembles, to what noise means to Edgar Allan Poe (The Tell-Tale Heart) or Don DeLillo (White Noise), we will discuss the ethical implications of noise/music. We will also make noise music, with no-input mixers and noise generators, as well as learn how noise removal algorithms work. We will touch upon politics and environmental noise, on the rise or decline depending upon our historical scope. Finally, we will relate art to mathematics—looking at statistical noise in machine learning and AI algorithms and the discourse on whether the noise in data is human or inhuman.

PAT 500: Introduction to Electronic Music (3 credits)

This course is for students not majoring in Performing Arts Technology who are interested in developing a contextually-informed artistic practice in the area of electronic music composition, production, and performance. Through a series of composition exercises, students build skills in sequencing, audio and MIDI recording and editing, mixing, sound synthesis, sampling, effects processing, and live electronic music performance with real-time controllers. *Non-PAT majors only; typically offered Fall, Winter*

PAT 501: Introduction to Computer Music (3 credits)

This course is an introduction to electronic musical instruments, MIDI, and digital audio systems. Students create several original compositions for presentation and discussion. The aesthetics of electroacoustic composition are discussed through study of selected repertoire. *Instructor permission required; typically offered Fall, Winter*

PAT 502: Computer Music Composition and Arranging (3 credits)

This course is a continuation of PAT 201 with an emphasis on composition and arranging using MIDI, software samplers, and digital audio systems. Compositional issues are explored by

classroom discussion, critiques, and lectures. *Prerequisite: PAT 501. Instructor permission required; typically offered Fall, Winter*

PAT 507: Directed Individual Study (1-3 credits)

Students receive individual instruction, consultation and guidance from the instructor. Course emphasis is on developing individual research skills that culminates in a final project or paper. *Graduate students only; instructor permission required, typically offered Fall, Winter*

PAT 510: Media Arts: Immersion and Enculturation (3 credits)

The course details the theory and practice of music technology, interactive art forms that use technology, models of human computer interaction, and digital video and animation. Students will perform analyses of contemporary works in the media arts from aesthetic, production, technological, and artistic points of view. Students will examine the roles in the collaborative process. *Typically offered Fall*

PAT 511: Engineering Applications of Media Technology (3 credits)

Algorithm design and analysis with applications in the sonic and visual arts; fundamental knowledge representation, formal reasoning, and search algorithms. An emphasis on fundamental computational problems in the media arts and a discussion of the introductory issues in encoding and processing style. *Typically offered Fall*

PAT 512: Interdisciplinary Collaboration I (3 credits)

Students form teams to realize computer-based multimedia works that integrate technology, music, sound, art, and moving image. Students analyze the work as an individual, as well as a member of a group. The analysis details aspects of the design, role development, collaboration, aesthetic goal, artistic statement, production values, and the role of technology in the creative process. *Typically offered Fall*

PAT 513: Interdisciplinary Collaboration II (3 credits)

A continuation of Interdisciplinary Collaboration I with an emphasis on large-scale multimedia interactive installations. *Typically offered Winter*

PAT 522 Technical Ear Training and Critical Listening (3 credits)

This course is an introduction to the concept of translating between timbres and frequency resonances produced by parametric equalization. Students learn to aurally identify different timbres through their corresponding spectral envelopes. Critical listening exercises will also be explored with a focus on dynamics processing, spatial characteristics, spectral balance, and recording, mixing, and production techniques. *Instructor permission required; typically offered Winter*

PAT 531: Contemporary Practices in Studio Production I (3 credits)

The advanced study of theory and practice of recording techniques, mixing, and production for multi-channel audio systems through guided projects. *Instructor permission required; typically offered Fall*

PAT 532: Contemporary Practices in Studio Production II (3 credits)

This course focuses on the development of the producer's role as techno-artistic interpreter and creative collaborator. Critical listening and discussion investigate the evolution from the "illusion of reality" aesthetic to the "reality of illusion" point of view. Producers studied include Gaisberg, Spector, Martin, Eno, Reznor, and Dr. Dre. Students sharpen their creative, technical, and production skills through the realization of complex recordings. *Prerequisite: PAT 531. Instructor permission required; typically offered Winter*

PAT 541 Making Music on Film (3 credits)

In this course, students and faculty will collaborate in the creation of a professional-quality work of musical cinema. Under the leadership of a faculty director, and with the guidance of working film professionals, students may participate as singers, dancers, actors, designers, audio engineers, or film crew. This advanced class will be open by audition to students in Musical-Theatre, Theatre, Voice, Dance, Performing Arts and Technology, Art and Design, or Screen Arts. The finished film will be screened at film festivals, distributed nationally, and will be credited on IMBD. *Typically offered Fall*

PAT 542: Practicum in Music and Sound for Film (3 credits)

Students work on original film and animation projects, in roles such as composers, sound designers, dialog editors, mix engineers, or production audio crew on advanced student productions. Class sessions include script analysis, screenings, discussion of readings, and in-class critiques of works-in-progress. The emphasis is on developing an awareness of the multiple ways that music and sound can interact with the moving image to create meaning. While this is an advanced course that assumes a familiarity with computers and audio production tools, it does include some direct instruction in relevant techniques such as syncing to picture, spotting music, dialog editing, and onset recording. *Prerequisite: PAT 541. Typically offered Winter*

PAT 543: Immersive Media (3 credits)

Practice-based investigation of immersive media technologies, including virtual reality platforms, spatial audio systems, and game engines. Lectures cover methods and tools employed in the design of multimodal virtual and augmented realities. During lab activities, students implement interactive systems using modern immersive media platforms. Projects involve prototyping and realization of immersive media artworks and performances. Combining critical and historical

discourse with hands-on experience, students develop comprehensive skills in the use of immersive media as performing arts tech. *Typically offered Fall*

PAT 551: Interactive Media Design I (3 credits)

This course introduces the technological and theoretical foundations of designing physically interactive media experiences. Students develop interactive sensing systems and program embedded computing devices as well as real-time auditory, visual and tangible displays. Through exercises that draw on theory and techniques of interaction design, students create technological sketches and prototypes for novel devices and artworks. *Typically offered Fall*

PAT 552: Interactive Media Design II (3 credits)

The course focuses on the application of skills and techniques developed in Interactive Media Design I to design and implement physically interactive performance systems and media installations. Incorporating advanced sensing and interaction techniques, students create fully realized works that are exhibited before a public audience. Seminal works of interactive art and interactive performance are discussed and critiqued. *Instructor permission required; typically offered Winter*

PAT 561: Performance Systems (3 credits)

This course explores contemporary technologies that support musical performance. Topics include the goals of technology-enhanced performance, instrument interfacing, system design, programmable systems, and sound reinforcement design for playback of electronic and acoustic ensembles. Students create original compositions using performance systems that they have designed and built and direct performances that use these systems. *Prerequisite: PAT 501. Typically offered Winter*

PAT 562: Digital Sound Synthesis (3 credits)

An introduction to digital sound synthesis and signal processing theory with an emphasis on sound design and compositional applications. Topics include additive synthesis, amplitude modulation, ring modulation, frequency modulation, subtractive synthesis, granular synthesis, physical modeling synthesis, heterodyne filter analysis/resynthesis, linear predictive coding, and phase vocoding. *Instructor permission required; typically offered Fall*

PAT 581: Independent Study (1 - 4 credits)

Students receive individual instruction, consultation, and guidance from the instructor. Course emphasis is on developing individual research skills that culminates in a final project or paper. *Instructor permission required; typically offered Fall, Winter*

PAT 590 Thesis (1 - 9 credit hours)

Supervised work on a research topic in the Media Arts approved by the student's thesis committee. *Typically offered Fall, Winter*