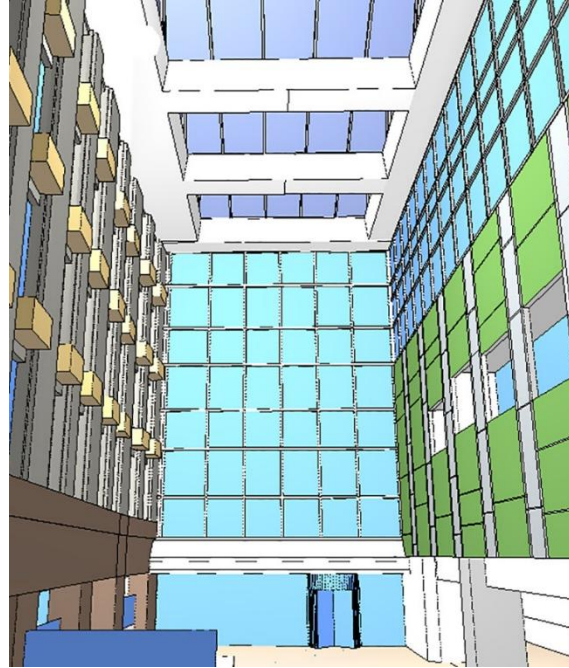


4.431 – Architectural Acoustics

Architectural acoustics entails architectural design, human perception, material properties, and building systems. This seminar will address how buildings respond and enhance our aural experiences, and how new technologies and analytical tools can assist designers to achieve their goals.



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Credits: By arrangement. Typically, 3-0-6 = 9 G. (Undergraduates also welcome.)

Prerequisites

All undergraduate and graduate students interested in architectural acoustics are welcome to join the class, though prior completion of 4401/4.461 (Architectural Building Systems) is recommended.

Class Meetings: Wednesdays, 11:00am to 2:00pm
Class meetings at MIT Room 5-231

Learning Objectives

This course is primarily a seminar to develop an understanding of the basic principles of architectural acoustics, and acoustical criteria and design/planning approaches for the built

environment. Key areas of focus include noise control, sound isolation/transmission and privacy, and the acoustical character and design of rooms. Students will learn how we hear and perceive sound both indoors and outdoors, how the properties of material absorb, transmit and reflect sound, how layout and design determine our acoustics environment, and how we can use modeling and simulation technologies to enhance the dissemination of design goals and ideas. Students who successfully complete the course will be able to evaluate and analyze the acoustical characteristics of spaces and designs, and will be able to use computational acoustics modeling and simulation as part of such analysis.

Course Description

The course is a seminar to develop a basic understanding of the principles of architectural acoustics: how we hear and perceive sound both indoors and outdoors, appropriate criteria for listening environments and privacy, and how architectural decisions of layout, materials, room shape, and design impact what we hear in and about a space. Topics include techniques for good hearing conditions, control of noise in buildings, privacy, mechanical equipment noise, electroacoustics, material properties (acoustic reflection, absorption, and diffusion), acoustics of critical listening spaces (like concert halls and studios), and acoustical design tools available to architects.

Integrated with this seminar will be a parallel study to understand the role of computer modeling as a tool to enhance the design process. This part of the course will delve into how computer programs can model the sound in a space. Students will have hands-on experience in creating these models, gaining through experience and reinforced during lecture an appreciation for their strengths and their shortcomings. As a culmination of the class, students will build acoustical models and develop auralizations (acoustical simulations) of an engaging space of their choosing, and will compare their simulations to acoustical measurements and real aural experience.

The course includes a series of lectures, problem sets, reading assignments, case studies, computer modeling exercises, field trips for listening and observations and presentations by students, with extensive opportunities for class participation throughout the course. Students will have opportunities to make measurements with sophisticated acoustical analyzers, attend field trips to performance spaces and other spaces of interest on and off MIT's campus, and create their own acoustical models and simulations. Students will be graded on the problem sets, assignments, and final project, and their contributions to class discussions. There will not be a final exam.

Required Work, Reading Assignments, Grading, and Exams

There will be lectures, field trips, in-class demonstrations, and extensive opportunities for class participation. Readings, required most weeks, will be from material to be provided by the instructor or on reserve in Rotch Library. There will be weekly homework problem sets, computer modeling exercises, or field reports, and one major final project incorporating acoustical modeling and analysis which will be due, along with a presentation in class, on the final days of class. Students will be graded on the weekly assignments (totaling 60%), the final project (25%), and their contributions to class discussions (15%). Everyone in the class is expected to participate in the class discussions most weeks.

The definition of grades will follow Institute guidelines (as follows):

A Exceptionally good performance demonstrating a superior understanding of the subject matter, a foundation of extensive knowledge, and a skillful use of concepts and/or materials.

B Good performance demonstrating capacity to use the appropriate concepts, a good understanding of the subject matter, and an ability to handle the problems and materials encountered in the subject.

C Adequate performance demonstrating an adequate understanding of the subject matter, an ability to handle relatively simple problems, and adequate preparation for moving on to more advanced work in the field.

D Minimally acceptable performance demonstrating at least partial familiarity with the subject matter and some capacity to deal with relatively simple problems, but also demonstrating deficiencies serious enough to make it inadvisable to proceed further in the field without additional work.

F Failed. This grade also signifies that the student must repeat the subject to receive credit.

Absence Policy

Please contact the instructor if you will be absent from class. Students are expected to make up homework and class exercises in a timely basis. Greater than two absences from class without medical excuse or personal emergency could result in a failing grade for the class.

Textbooks

Readings will be supplied by the instructor weekly; there is no required textbook. An excellent, but optional, reference textbook is *Architectural Acoustics* by Marshall Long, 2nd Edition, published by Academic Press.

Course Topics

Introduction to Sound and Perception
Properties of materials: absorption, reflection, transmission
Noise control
Acoustics of performance spaces, workplaces, education spaces,
and other acoustically sensitive environments
Computer Modeling and Auralization

Schedule/Outline (*subject to revision as discussed in class*)

Date	Topics	Activities/Lab	Homework
2/4/2026	Procedures, schedule; Basics: Sound waves, decibels, logarithms, frequency; inverse square law	Introductions; class discussion	HW#1: Mapparium, readings, problem set
2/11/2026	Perception v. measurement: A-weighting and Leq; power/pressure; Human hearing	Sound level meter measurement lab	HW#2: Measurement analysis
2/18/2026	Materials: Absorptive (fibrous, membrane, Helmholtz); Reflective and diffusive material	Material samples	HW#3: materials
2/25/2026	Room acoustics and absorption/reflection/diffusion; reverberation, speech acoustics	MIT tour; Walk-away test, classroom acoustics, etc.	HW#4: Room acoustics (RT, NRC)
3/4/2026	Small rooms: room modes and Schroeder Frequency	Measurement lab – impulse response measurement.	HW#5: small rooms (modes, f_s). Measurement.

	Room acoustics measurement.	Reverberation time and other metrics.	
3/11/2026	Transmission: TL, NR, composite TL, common constructions, STC, doors/windows, flanking, privacy, impact isolation	Practice Rooms visit, "noise box" demo, sound isolation product samples, tapping machine	HW#6: Sound isolation
3/18/2026	Noise Control: HVAC noise, vibration isolation; and acoustics & sustainability		HW#7: noise control
3/25/2026	MIT SPRING VACATION		
4/1/2026	Performance space acoustics - room acoustics parameters; loudness, quiet, RT, clarity, spaciousness	Killian Hall and/or new music building – tour, performance evaluation	HW#8: performance space evaluation
4/8/2026	Modeling - geometric acoustics, ISM and raytrace, wave acoustics, physical and computer models	Introduce final	HW#9: modeling basics
4/15/2026	Final project check-ins; performance space acoustics part two.	Potential Symphony Hall tour?	Final project check-in
4/22/2026	Acoustics modeling software , and Auralization . Anechoic sound, IR, convolution, HRTF, playback.	Auralization demos; modeling/auralization tutorial. Potential guest tutorial by Sam on Max software.	
4/29/2026	Case studies from professional practice.	Possible visit to Acentech offices.	
5/6/2026	Final Presentations of course projects		Final Project Presentation

Academic Integrity

Massachusetts Institute of Technology students are here because of their demonstrated intellectual ability and because of their potential to make a significant contribution to human thought and knowledge. At MIT, students will be given unusual opportunities to do research and undertake scholarship that will advance knowledge in different fields of study. Students will also face many challenges. It is important for MIT students to become familiar with the Institute's policies regarding academic integrity, which is available at [Academic Integrity at MIT: A Handbook for Students](#).

Student Performance Criteria (NAAB)

B8. Environmental Systems (Acoustics)