

Introduction

The point of this class is to have a good time learning the fundamentals of electronics and acoustics. Most high school students never learn much about electronics, and those who do might find it uninteresting without exploring an exciting application like audio. A good plan is to build an actual audio-related project as a class.

Last year, our class designed and built two different speaker designs with only \$60 per pair of parts. This year we will be open to a wide range of project ideas, from subwoofers to horns and 3-way systems, from inexpensive speakers for every student to a single elaborate system for the class.

HSSP is a 10-week Saturday program; this year it's running from March 8th to May 10th. Our class of 8-12 students from 10th-12th grades will run from 10AM-12PM every Saturday. We teach in a small comfortable classroom and Room 4-409, the "student project laboratory" at the MIT Edgerton Center.

The class is centered around a speaker project that is completely up to the students; we will design and build whatever we want. The students will also learn how music reproduction works, how to understand and build simple circuits, and how to use audio electronics and software. We won't be afraid to use the latest technology in computer-aided design and speaker components.

The web site for this class is: <http://pricem.mit.edu/hsspaudio/>. Some materials are also available on MIT OpenCourseWare, at <http://ocw.mit.edu/OcwWeb/hs/ase/ase/index.htm>.

Schedule and location

The class will run from 10 AM to 12 PM every Saturday. I'll teach in a comfortable MIT classroom; the location is yet to be determined. When working on projects we may move to Room 4-409, the "student project laboratory" at the MIT Edgerton Center.

Day-by-day

Take a look at this tentative plan for what we do each week. If it sounds like a lot, that's because it is! Please contact me (e-mail pricem@mit.edu) if you have any questions or comments.

Day 1: March 8th

What you really need to know

1. What sound is, and how it's represented electrically
2. Music in the time and frequency domain
3. How a speaker driver works
4. Experience the effect of basic passive filters
5. Discuss plans for rest of semester

Day 2: March 15th

The basics of audio electronics

1. Understanding voltage, current, and circuit diagrams
2. Impedances (and passive components: resistors, capacitors, inductors)
3. Learn to solder, and solder a simple circuit

Day 3: March 22nd

Crossover experimentation

1. Test several different speaker drivers
2. Split into two teams
3. Wire up filters for combinations of drivers
4. See who can make a better sounding system

Day 4: March 29th MATLAB activity: crossover design

1. Learn how to use MATLAB
2. Load speaker measurements from the Internet
3. Generate impedance data for common circuit branches
4. Simulate effect of connecting circuits to drivers
5. Create your own crossover design

Day 5: April 5th Speaker project research

Homework due: Project proposal

1. Dream up speakers
2. Identify and compare drivers online
3. Make concept drawings
4. Debate and choose a design to build

Day 6: April 12th Enclosure design and planning

1. Speaker sizes and shapes
2. Physics of sealed and vented enclosures
3. Thiele/Small enclosure modeling
4. Compute enclosure parameters for chosen speakers
5. Make drawings of cabinet parts

Day 7: April 19th Crossover planning

1. Discuss design priorities
2. Try crossover topologies in simulation
3. Come up with candidate crossover designs

Day 8: April 26th Building crossovers

1. Measure drivers in test enclosure
2. Wire up and test candidate designs
3. Tweak component values
4. Solder final crossovers

Day 9: May 3rd Assembling speakers

1. Speaker connectors and wiring
2. Woodworking stuff: finishes
3. Stuffing and enclosure damping
4. Measure frequency responses on- and off-axis, and distortion

Day 10: May 10th Testing, music and advanced topics

1. Students' choice; possible topics include:
 - Distortion
 - Unusual/absurd enclosures
 - Driver design
 - Room acoustics
2. Enjoy music and food
3. Talk about future projects