



Course Syllabus

ENEE 159b: Start-Up 101, Electric Guitar Design
Prof. Bruce Jacob

Basic Information

Time & Place

Lecture/Lab: Wed 1:00–3:00 pm, AVW-1344

Professor

Bruce L. Jacob: AVW-1325, blj@ece.umd.edu
 Office hours: Open-Door Policy (for now ...)

Teaching Assistant

Joseph Gross, joegross@umd.edu

Class Home Page

<http://www.ece.umd.edu/courses/enee159b/>

Class Email List

enee159b-0101-spr08@coursemail.umd.edu

Class Schedule

This is a weekly schedule of my hours, including class time and scheduled office hours, but also including other things that make me unavailable. It is subject to change.

	MON	TUE	WED	THU	FRI		
9–9:30							
9:30–10							
10–10:30							
10:30–11							
11–1:30							
11:30–12							
12–12:30		ENES 100 Lecture JMP-1116	ENEE 359a Disc EGR-2112	ENES 100 Lecture JMP-1116	Meetings with graduate students		
12:30–1							
1–1:30							
1:30–2							
2–2:30		ENEE 359a Lecture EGR-3114	ENEE 159b Lab AVW-1344				
2:30–3							
3–3:30							
3:30–4							
4–4:30							
4:30–5							

Course Overview

This class will teach the skills necessary for good product design and development in the real world, using as a motivating example the electric guitar.

The class will be structured as a start-up company's research & development department: students will be given design specs and some latitude in the choice of implementation. Students will be taught the fundamentals of sound, audio signals, amplification and equalization, wiring, soldering, circuit-board design and assembly, and, perhaps most importantly, good design principles. Students will design circuits and circuit boards; they will have those boards manufactured; they will assemble the boards, solder the parts, and wire them into prototype guitars.

Class projects will explore different aspects of guitar design; the final project will build upon the earlier projects in a student-defined direction.

Prerequisites

There are no official prerequisites, though a familiarity with the operation and physical structure of an electric guitar is essential. Students will be taught how to wire the guitar; a student need not have wired up a guitar before coming into the class (though, of course, that would help).

Class Projects

Five projects will be assigned during the term, which form the bulk of the course grade and each of which will require a substantial time commitment on your part.

- Project 1: *Soldering and wiring basics*
Students will solder together a set of wires and components, including a battery and a simple “on” switch. The result will be submitted to an electrical test.
- Project 2: *Switching between coils*
Students will design and implement a circuit that switches between a set of circuit components, putting the various components in series, parallel, in-phase, and out-of-phase. The result will be submitted to an electrical test.
- Project 3: *Potentiometers and capacitors*
Students will design and implement a volume and tone-control circuit that uses bypass caps to ensure frequency response and also reduce audio hum. The result will be submitted to an electrical test.
- Project 4: *Active electronics: An on-board preamp and EQ*
Students will design and implement a preamp based on either a transistor or an op-amp, as well as a graphical or simple parametric EQ. The result will be submitted to an electrical test.
- Project 5: *Student design*
Students will propose an idea and implement it. The project can be theory-based (e.g., characterization of materials, components, or techniques), or it

could be engineering-based (e.g., implementation of a new idea and comparison with previous implementations).

You will find the workload in this course to be extremely heavy. Start each project the day it is assigned, not the weekend before it is due.

Exams

There will be one midterm covering the technical material of sound, audio, and basic circuit design, and a presentation of the student's final project.

Grading Policy

Final grades will be based on the total of points earned on the projects and exams. The tentative point breakdown is as follows:

- Projects 1–4: 40%
- Project 5: 30%
- Midterm Exam: 30%

Tentative Lecture Schedule

Week of	Subject	Lab	Projects
Jan. 28	Intro to course		P1 out
Feb. 4	The physics of sound	Waves, volts, amps	
Feb. 11	Audio electronics: Fundamentals	Wiring & soldering	P1 due, P2 out
Feb. 18	Electric guitar circuits: Coils and switching	Switches	
Feb. 25	Audio electronics: Resistors and capacitors	Electromagnets	P2 due, P3 out
Mar. 3	Electric guitar circuits: Volume and tone	Potentiometers	
Mar. 10	Midterm (in class)		P3 due, P4 out
Mar. 17	SPRING BREAK		
Mar. 24	Audio electronics: Amplification	Circuit design tools	
Mar. 31	Audio electronics: Equalization	PCB design tools	
Apr. 7	Electric guitar circuits: Active elements	PCB design tools	P4 due, P5 out
Apr. 14	Advanced topics: Pickup construction	Pickup assembly	
Apr. 21	Advanced topics: Capacitance	Circuit components	
Apr. 28	Advanced topics: Characterization of materials	Woods	
May 5	Advanced topics: Construction techniques	Sound examples	
May 12	Advanced topics: Hardware	Sound examples	
Exams	Final Presentations (Mon May 19 1:30)		P5 due

Special Needs

If you have a documented disability that requires special needs, please see me as soon as possible, and certainly no later than the third week of classes.