EE 251 Electronics I Spring, 2019

Text: Donald A. Neamen, *Microelectronic Circuit Analysis and Design*, 4th ed., McGraw Hill
Recommended: Tront, *PSpice for Mircoelectronics*, McGraw Hill" (simulation software)
Scheduled class times: TR at 1:00-2:30 Room SLC222
Instructor: John B. Gilmer Jr. Office hours: TBD Office:SLC220
Prerequisite: EE211 Phone: x4885

Catalog description:
EE-251. Electronics I
Credits: 3
Circuit concepts involving non-ideal components, particularly diodes, bipolar transistors, and MOS transistors. Bias, load line and signal amplification principles. Analysis and design of power supply and amplifier circuits, including power amplifiers. Simulation of circuits for design and analysis.
Pre-Requisites EE-211.

Course Objectives: (draft)

1. Be able to design and analyze circuits using diodes, bipolar transistors, and MOSFET transistors.
2. Understand issues and principles for power supply design.
3. Calculate component values to meet a given DC operating point.
4. Perform singe transistor amplifier analysis and design for common transistor types.

Background:

This course is one of the most important in the Electrical Engineering curriculum. Increasingly even very basic electrical products include electronic components. For example, the simple light switch has been replaced in many applications with an electronic "dimmer" which allows control over brightness, a significant increase in functionality for a very small increase in cost. This has become a rather pervasive pattern as the cost of electronic components has become small relative to the rest of a product. As a consequence, computers are being embedded into products from automobiles to microwave ovens, often adding significantly to the functionality and profit of a product at little cost.

With this course, your study of electrical engineering begins to shift from mostly analysis toward design. Analysis is the process by which we gain an understanding of what a system does. In our case, that system is an electronic circuit, consisting of passive components (resistors, capacitors, inductors and such) and active components (diodes, transistors) which make the circuit "electronic" rather than just "electrical". You have learned to analyze circuits already, and in physics and circuit theory you gained an understanding of the basic passive components and how they work in simple circuits such as an RLC network. We will deal with more complex circuits that perform a function such as amplification, filtering, or rectification.

Design is the process of creating a circuit out of components to achieve a larger purpose. That purpose can be as simple as providing power at a given Voltage, or as complicated as presenting a viewer with a television image. Design calls for not just understanding of components, but of how these can be interconnected to accomplish the purpose sought. There are often several ways this can be done, choices to be made, each with its own benefits and costs. A design process often utilizes well known approaches and standard ways of doing things, but also calls on the designer's creativity. The goal, after all, is not just to design a circuit to accomplish the purpose. That design should also perform better, be less expensive, or be more versatile, than those of your company's competition. Your pay ultimately comes from the success of your company in the marketplace. Your job is to contribute your part to that economic success.

So, as we approach design problems, we need to learn standard ways of solving set problems. But we also need to learn the underlying principles, so that we can recognize how to choose among different approaches, and also modify or deviate from them when the need and opportunity is present. Technology is not static. As time goes by, new techniques and components will present new opportunities. An understanding of principles will allow us to readily use these.

It is important at this point to recognize the distinction between hacking and engineering. When I was in high school, I could hack out circuits to do amplification, supply power, and even receive radio signals. If one component didn't work out, I would try another. Some designs could be copied or kluged to get the job done. But the results of these hacks would not be viable commercial products. An engineer is expected to produce a product that is reliable, near optimum in terms of cost, power consumption and size, and conforms to various standards ranging from regulatory restrictions to safety and ergonomics. The key distinction is that an engineer is a professional with a comprehensive understanding, a systematic way of doing things, an ability to later analyze and assess what has been designed, and ultimately a responsibility to the public for products designed, sold, and put to use.

The functional goals we will approach in this course are relatively simple ones: provide power, and to amplify and filter signals. These are basic but essential. We are laying the foundation for how to approach larger problems later in Electronics 2, when we will be designing larger systems made up of sub-circuits, using many transistors, such as multistage audio amplifiers.

Structure of the Course:

This semester we are using the Neamen text. It was selected after considerable experience with other texts, and it is believed to be a good text with an appropriate level of examples, yet without excess repetition. It seems to be one of the better texts for Electronics 1. It is identified in the title as a “Microelectronics” text. But our goals are broader than just microelectronics. We will be addressing some power handling issues that go beyond microelectronics in both Electronics 1 and 2. The text for this course contains way more material than we can cover in one semester; we will be using roughly the first half. This book will also be used for EE252, which will generally follow with the second half of the book. We will necessarily be selective in what we will be able to cover, even within the first half. We will cover in Electronics 1 primarily the issues that are not greatly focused on frequency response, and reserve most of frequency response issues to Electronics 2. That means we will not cover the chapters in the order given in the book. We also are going to go light on semiconductor principles, since that material will be covered in much greater depth in EE271 and EE381.

We will make considerable use of circuit simulation in this course. The Tront book, now dated but still an excellent reference, is available on the secondary book markets. It is a very good aid to learning to use PSpice, the circuit simulator software to be used in this course, in EE252, and widely in industry. (You are free to use LTSpice instead if you wish, but I can’t promise support.)

You are responsible for reading the text. Class time is limited, and we will not be able to cover everything in the lecture. Specifically, those sections that are relatively straightforward will not be covered in class in any detail, but you will still be responsible. I will sometimes be making points that the book does not cover, and providing motivation and examples. As the class proceeds, some specific guidance will be given concerning degree of coverage of each chapter.

Week	Dates	Topics covered	Reading	Tests
1	Jan 15-17	Introduction, semiconductors, and diodes	Chapter 1	
2	Jan 22-24	Transformers, Diode circuits, Rectification	Chapter 2	
3	Jan 29-31	Diodes: Power supply circuits, filtering, regulation	Chapter 2 (cont.)	
4	Feb 5-7	Field Effect Transistors (FET's)	Chapter 3	
5	Feb 12-14	Field Effect Transistors (FET's) (continued)	Chapter 3 (cont.)	
6	Feb 19-21	Basic FET Amplifiers	Chapter 4	
7	Feb 26-28	Basic FET Amplifiers (continued)	Chapter 4 (cont.)	test#1
8	Mar 12-14	Basic FET Amplifiers (continued)	Chapter 4 (cont.)	
9	Mar 19-21	Bipolar Transistors (BJT's)	Chapter 5	
10	Mar 26-28	Bipolar Transistors (BJT's) (continued)	Chapter 5 (cont.)	
11	Apr 2-4	Basic BJT Amplifiers	Chapter 6	
12	Apr 9-11	Review of transistor amplifiers	Chapter 6 (cont)	test #2
13	Apr 16	Frequency Response (overview)	Chapter 7 (initial sections)	
14	Apr 23-25	Power amplifiers, Thermal considerations	Chapter 8 (initial sections)	
15	Apr 30	Review		

Grading:

Tests will cover all material through the previous week. Tests will generally be on Thursday of the week listed, unless an announcement is made setting the date differently. All tests are open-book, open-notes. The use of calculators is allowed. The use of computers and communications equipment (e.g. cellular telephones) is not allowed. Test questions will include a variety of short answer, short essay, and design and analysis problems. They will be hard. You will not have time to open your book very much, and still complete the test. Come well organized and prepared. One to three pop quizzes may be given. These will be similar in character to the tests but much shorter. You should be sure to bring your book, calculator (with healthy batteries), and notes to each class in order to be prepared for the possibility of a pop quiz. There will be about eight homework assignments. Some will involve simulation assignments; others may require some small-scale projects. Grading for class participation will include both attendance and an assessment of effort put into the homework. The grading allocation is:

2 tests at 25% each :	50%	final examination:	40%
up to 3 pop quizzes totaling:	6%	class participation:	4%

All material will be graded on a basis of 0-100, with most graded material allowing for grades higher than 100 with bonus questions (usually up to 10% extra) considered. On tests and the examination some questions may be "compensated" if large numbers of students miss them (indicating possibly a badly posed question or inadequate coverage of the topic in class). On such questions, some proportion of the "lost" credit will be returned. This is the only form of "curving" of grades in the course. All written work is expected to be neat and well presented. A penalty of up to 10% will be assessed for poor presentation on any written work. The grades from all work will be weighted as given in the above table, totaled, and converted into the Wilkes 4.0 scale grading system using the following conversion:

90+:	4.0	80-86:	3.0	70-76:	2.0	60-64:	1.0
87-89:	3.5	77-79:	2.5	65-69:	1.5	below 60:	0.0

Homework and Class Participation:

Homework will be assigned, and collected about a week later usually. On the due date, the homework will be collected and a solution set passed out. (No credit will be given for late homework unless there are extenuating circumstances. Don't miss class to do homework!) Questions and discussion concerning the homework will follow during the class when homework is collected. The submitted homework will not be graded. It will be reviewed, and on a selective basis some students or some questions may be examined in detail. The effect on a student's grade from homework is in the "class participation" category. I will be tracking who does the homework and the degree of seriousness with which it is taken, including evidence of whether the solutions may have been copied. Along with class attendance and tardiness, homework submission will be considered when assigning a number for a subjective 4% of the grade for "class participation."

Web site:

I will be setting up a web site for materials relevant to this course. As of this writing that has not yet been done. The materials posted will be for information and reference only, including things like this syllabus.