Physics 334, Winter Quarter 2012
Electric Circuits Laboratory I
Reading Assignments

Week 1 Assignment 3-6 January
Textbook pp. 1-13 (through power transfer), Lab manual pp. 3-23. This introduces the basics of voltage, current and power, plus resistors and resistors in parallel and in series. This reading includes the voltage-divider, probably the most important resistor circuit you'll need to know, plus voltage and current sources, and the concept of the "Thévenin" and "Norton" equivalent circuit. This culminates in the concept of input and output impedances. The lab-manual reading goes over this again, and includes how to measure voltages and currents given the imperfections in voltage- and current-sources, and volt- and current-meters.

Week 2 Assignment 9-13 January
Textbook pp. 13-35 (through power in reactive circuits), Lab manual pp. 32-50. The lecture this week is to go over the Thévenin and Norton equivalent-circuit concepts again, and start an overview of resistor and diode circuits. We'll also start the discussion of frequency-dependent circuits with capacitors and simple capacitor circuits. Reading this week anticipates next week's topics of "reactance", including phase shifts and complex-number notation.

Week 3 Assignment 16-20 January
Textbook pp. 35-53 (through diodes). Lab manual pp 64-74. This week will focus on tools that allow understanding how circuits process time-dependent input signals. On Thursday, "reactance" is defined, as is the generalized Ohm's Law using impedance. We'll apply this to simple circuits containing capacitors and inductors. The Tuesday lecture goes over the RC differentiator, you might want to look at the similar integrator in the text. The lab this week will look at simple filters made up of single-capacitor networks.

Week 4 Assignment 23-27 January
We cancelled the last-week Thursday lecture and 3 of 4 labs due to snow and ice. Our schedule is therefore somewhat disrupted. This week we'll review complex-number notation; if this is new to you, see the textbook page 31 "voltages and currents as complex numbers". We'll then go over textbook pp 32-39 and 41-42: the concepts of impedance and reactance, generalized Ohm's law, and simple filters. Also, look at the lab #2 and those sections in the lab manual for the low-pass and high-pass filters.

Week 5 Assignment 30 January – 3 February
We're finishing up filters and heading into more diode power circuits. The reading includes textbook pp. 41-42 (resonant circuits "notch" and "bandpass" type), 42-47 (power circuits through section 1.28); we won't be covering diode power circuits in lecture since they're well covered in the lab 3. For those with lab this Thursday, look this lab 3 material over before exam 1. Notice the lab manual has a useful worked example of designing a ½-wave rectifier power supply pp 71-74.

Week 6 Assignment 6–10 February
You should begin to look at pp. 61-77 ("bipolar" transistors through section 2.07). The transistor material will run into next Tuesday. Key topics include emitter-follower and common-emitter single-transistor circuits.

Week 7 Assignment 13-17 February
We'll be leaving emitter-followers behind and moving to the common-emitter amplifier, the classic voltage amplifier. Along the way you'll see this amplifier contains a current source. Take a look at the transistor current source textbook pp 72-74, then the common-emitter amplifier pp 76-77. If you'd like to know how a PN junctions (diodes and transistors) operate at a deeper level, you might want to look at the Ebers-Moll model pp 79-81. We'll then move on to Field-Effect-Transistors. FET's are more complicated in some ways: look at the FET basics PP 113-122: this discussion will go into week 8 and start to be covered in lab.

Week 8 Assignment 20-24 February
We'll study op-amps in lecture and lab. Look at the introductory idealized op-amp discussion in sections 4.01 through 4.03. The "golden rules" are particularly important. Notice that the two op-amp inputs are at equal voltage if the feedback is properly negative. You should understand the two basic circuits: the inverting amplifier sec 4.04 and the non-inverting amplifier sec 4.05. The many and various op-amp circuits in later sections are mainly variations of the basic inverting and non-inverting amplifiers; two such useful circuits are the differential and summing amplifier pp 184-185. We'll also likely cover other variants in lecture.

Week 9 Assignment 27 February – 2 March
This week starts with more op-amps, then Thursday we'll start to look at comparators and oscillators. In lab, you'll be looking at op-amp rectifiers (see textbook section 4.10 on "active rectifier"). You should look at non-ideal op-amp parameters (section 41. "input current", "input offset voltage" and "slew rate"). In lab you'll assemble the "active clamp" 4.17, integrator 4.19 and differentiator 4.20.

Week 10 Assignment 5 - 9 March
This week is closing out comparators, oscillators and timers. Read the textbook oscillator introduction 5.12. In lab you'll use the "311" comparator: for that, see the comparator overview 4.23, especially the "311" circuit in fig 4.60 and the "311 with hysteresis" fig 4.62. The "311" is an unusual comparator in that the output has two pins consisting of the collector and emitter of a transistor switch driven within the 311 chip at the base by the comparator. This configuration allows, as you'll see in lab, great flexibility in configuring the output-voltage swing. We'll look at the op-amp oscillator in fig 5.29, then we'll start on looking at the classic "555" timer chip 5.14. Figure 5.33 is particularly important as it shows the 555 in its basic oscillator configuration. In lab, you'll configure the 555 as an "equal duty factor" oscillator, and as a saw-tooth and triangle generator.

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