

Circuits Midterm Review Suggestions

Week 4, 4/21/15

- **IMPORTANT: you are responsible for everything in the assigned reading and problem sets.**
 - Mazur Ch 31
 - AOE Lab Manual Ch 1 worked examples
 - AOE Text, Ch 1
- Material from problems sets – or especially from class – will be more likely to be on the test.
- The comments that follow are a guide to what I think is most important. **As noted above other things may/will also be on the test.**

What will the exam look like?

- 3 hours. No calculators. No notes.
 - I will design the exam so that two hours is sufficient (i.e., so I can write the solutions in 30 - 40 minutes)
 - If there is something nasty, like $\sin(38^\circ)$, you can just leave it in that form – after all, $\sin(38^\circ)$ is a number. In general, I will try to have the numbers work out cleanly.
 - I expect you to know that $\sin(\theta) \sim \theta$ and roughly what θ is in radians. If I give you sine of 10 degrees, you should be able to get the actual value.
- Section 1: Introductory easy questions – material from these slides and things I've covered repeatedly in lecture. Be sure to know your formulas, etc. That includes Ohm's law, the formulas for power, voltage divider, the exponential growth etc.
 - Likely problems: figuring power dissipated in different components of some (DC) circuit. Possibly lightbulbs...
 - **Simplifying a whole mess of resistors and capacitors by combining series and parallel ones until the final equivalent circuit is much easier to understand.**
 - Examples: AOE text Fig 1.9, p. 11, and Fig 1.11, p. 12
- Section 2: Several increasingly involved questions, very likely including:
 - A low- or high-pass filter, possibly in conjunction with a Thevenin equivalent
 - a problem involving why the impedance of something matters – e.g. the output or input impedance of an instrument. For instance, what if I hook a voltage divider consisting of two 1k resistors up to a meter that has a 1k input impedance? Will my reading be correct? Why or why not?
 - Something with a diode somewhere
- An extra credit question

What should I review?

- Lab Manual:
 - pp. 1-8, covering Thevenin circuits, voltage dividers
 - **ESPECIALLY p 7-8.**
 - **pp. 19 -22 Thevinin and input impedance**
 - (start at (3) on p19; do not worry about the problem they show with the middle example, p19 – 20% is close enough (i.e., estimated $V_{out} \sim 9-10\%$ of V_{in}); I care more that you get the general idea here.)
 - For part (4), p 22, assume the VOM (a voltage meter, like the orange ones you used in class) has an input impedance of 10k. What will happen? Similarly, the example on p 23 is a very good one – what would happen?
 - Review of capacitors, inductors, & low/high pass circuits, pp 32-44.
 - I especially like the examples on p38.
 - **Look at p 40** on the input and output impedance of an RC circuit.
 - **pp 47-50, worked examples of low- and high-pass filters.** Highly relevant to the exam.
 - Diode examples, p 65
 - Optional (may or may not be an extra credit question): I like the worked power-supply example on p. 71-74. Notice that I demonstrated this in class.

What should I review?

- Math:

- Complex numbers – review the posted appendix and section from your calculus book.
 - be able to take $C = a + ib$ and convert it to $|C|e^{i\theta}$ form. What is $|C|$ in terms of a , b ? what is θ ?
- Exponential growth/decay.
 - I am quite likely to ask you to derive, showing all steps, either of the formulas for V on p 23 of the textbook. To be clear, I don't expect you to get the differential equation (though in fact that isn't hard); rather, if you have

$$C \frac{dV}{dt} = -\frac{V}{R}, \text{ with } V(t=0) = V_0$$

Or

$$C \frac{dV_{out}}{dt} = -\frac{V_{in} - V_{out}}{R}, \text{ with } V_{out}(t=0) = 0 \text{ and } V_{in} = \text{constant, starting at } t = 0.$$

- You can solve to get the equations shown in the text on p 23, and graph them both showing the $1/e$ point = 37% at $t = 1/RC$.
- **Be sure you know how to do those – memorize them if you're not sure. I will assume you can write it down fast, and will not have to think about how to solve it for even a minute before you start writing.**

- Homework / textbook:

- Any of the homework problems are fair game, especially those that involve working with voltage dividers, figuring out a Thevenin equivalent, finding a complex impedance, etc.