Exam 1 will have a written part (counting about 60% of the exam grade) and a practical part (counting about 40% of the exam grade).

Written part of exam 1: Expect about 5 short-answer conceptual questions, which will be completely closed-book (no notecard or calculator) and about 3 problems, similar to homework problems, on which you may use one 3”x5” index card (or equivalent) with anything you want written on both sides (as well as a calculator). The exam will be designed to fit into half the class period.

Practical part of exam 1: You will be allowed to use your lab notebook (only). Expect me to ask you to build a circuit (similar to but not necessarily exactly the same as one you’ve already built in lab) from scratch using a breadboard, measure various quantities using meters and/or oscilloscopes, interpret the results, and answer questions about how it works and about the lab equipment. This part will be scheduled individually.

Topics for exam 1:
- Current and voltage, series and parallel
- Ohm’s law
- Power supplied/dissipated
- Voltage dividers \( V_{in}, V_{out} \)
- Thévenin model: What does equivalent circuit look like? Determining values of \( R_{Th} \) and \( V_{Th} \)
- 10x rule, voltage droop
- Use of and characteristics of meters (V, A)
- Input, output impedances of meters, voltage sources: desired characteristics, how to measure
- Use of and characteristics of oscilloscopes and function generators
- 10x probe for scope: what its purpose is, how it works
- Charging and discharging capacitors; time constant RC
- Relationship between angular frequency \( (\omega) \) and frequency \( (f) \)
- Capacitors (C), inductors (L): reactance (impedance)
- Reading resistor and capacitor values
- Phase relationships: ELI the ICEman; phasor diagrams
- Impedances of series combinations of \( R, L, C \)
- Voltage amplitude, peak-to-peak, and rms relationships
- Gain or attenuation in decibels
- RC filters (high-pass, low-pass): \( V_{in}/V_{out} \) vs. frequency; -3dB (cutoff) frequency; limiting phases; RL filters
- non-sinusoidal signals and Fourier analysis (qualitative: which features come from low-frequency terms and which come from high-frequency terms)
- Diodes: I vs. V characteristics; simple rules (“diode drop” when in forward conduction, no conduction in reverse)
- What p-type and n-type semiconductors are; use in diode
- Simple diode circuits (clipping, limiting; voltage dropper, voltage regulator)—finding the output for a given input
- Half-wave, full-wave rectifiers: how they work, \( V_{in} \) vs. \( V_{out} \); filter capacitors and ripple estimations
- Voltage references/regulators: Zener diodes, IC voltage regulators