Operational Amplifiers

Good Practice:
- Use common columns for V+ and V- (do not exceed +/- 15 Volts)
- Plug DIPs straddling the central groove
- Try to face all DIPs in same direction
- Write pin # on circuit diagram – do no "go from memory"

Equipment

- Protoboard Workstation
- Digital Oscilloscope

Objective

Understand operational amplifiers (op amps)
- Golden rules: circuit analysis
- Negative feedback: use in inverting and non-inverting setups

Conceptual (C-level)

- Read about the theory of Op Amps (Chapter 7)
- For an op amp with external feedback, what are the "golden rules"? HINT: There are only two golden rules. How do these rules relate to the three rules your book discusses in section 7.3?
- The 741 is a popular op amp. Draw the pin-outs for this op amp. Comment on:
  - The power requirements (V_+ and V_-).
  - The purpose of the offset nulls.
- Design a op amp circuit to add 3 voltages where the output will be $100V_1 + 10V_2 + V_3$. Show your circuit plus your analysis.

Basic Lab (B-level)

Construct an inverting amplifier with a gain of approximately 50 (see figure 7.11)
- Verify your circuit

Construct a non-inverting amplifier with a gain of approximately 50 (see figure 7.12)
- Verify your circuit

Use an appropriate circuit to amplify the signal from a transducer. Possible sensors are strain, temperature and light. You might need to use a buffer to condition (change the impedance) of your signal.

Advanced/Extended Lab (A-level)

Determine the common mode rejection ratio and slew rate for your op amp. Compare to expected.
- CMRR = 20 log (A_d/A_c) where A_d is the differential voltage gain and A_c is the common mode gain.
- The slew rate is measured in volts per second and gives the response time of the device.

Build, demonstrate and characterize more advanced op amp circuits using sensors from the lab.
- Electret microphone
- Driving a speaker

Substitutions may be considered.