8.6 CHAPTER SUMMARY

- An op amp is a circuit that provides a high voltage gain and an output proportional to the *difference* between two inputs.
- Due to its high voltage gain, an op amp producing a moderate output swing requires only a very small input difference.
- The noninverting amplifier topology exhibits a nominal gain equal to one plus the ratio of two resistors. The circuit also suffers from a gain error that is inversely proportional to the gain of the op amp.
- The inverting amplifier configuration provides a nominal gain equal to the ratio of two resistors. Its gain error is the same as that of the noninverting configuration. With the noninverting input of the op amp tied to ground, the inverting input also remains close to the ground potential and is thus called a "virtual ground."
- If the feedback resistor in an inverting configuration is replaced with a capacitor, the circuit operates as an integrator. Integrator find wide application in analog filters and analog-to-digital converters.

- If the input resistor in an inverting configuration is replaced with a capacitor, the circuit acts as a differentiator. Due to their higher noise, differentiators are less common than integrators.
- An inverting configuration using multiple input resistors tied to the virtual ground node can serve as a voltage adder.
- Placing a diode around an op amp leads to a precision rectifier, i.e., a circuit that can rectify very small input swings.
- Placing a bipolar device around an op amp provides a logarithmic function.
- Op amps suffer from various imperfections, including dc offsets and input bias currents. These effects impact the performance of various circuits, most notably integrators.
- The speed of op amp circuits is limited by the bandwidth of the op amps. Also, for large signals, the op amp suffers from a finite slew rate, distorting the output waveform.