Op-Amp Errors (Sedra & Smith, 6th edition)

		Static (DC)	**Dynamic (AC)**
Linear TRANSFER FUNCTION SUPERPOSITION	Error Source	*Offset Voltage* *DC Bias Current*	*Finite Bandwidth*
	Text	Sec. 2.6.1, 2.6.2	Sec. 2.7
	Analysis Strategy	1. Add DC sources to ideal op-amp to model errors 2. Analyze with superposition to find contribution of each error source to output voltage 3. Add in "worst case" fashion • Offset voltage can be either polarity • Bias current polarity known from type of op-amp input stage	Model closed loop behavior with first-order transfer function: • DC gain from ideal op-amp assumptions • Closed loop bandwidth (3-dB frequency) $f_{3\text{-dB}}$ from gain-bandwdith product relationship Gain-bandwidth product procedure: 1. Redraw circuit with all inputs suppressed (set = 0) 2. Find feedback factor β (fraction of output fed back to inverting input) 3. Closed loop bandwidth $f_{3\text{-dB}}$ will be unity gain frequency f_t multiplied by β
Non-Linear	Error Source	*Output voltage swing limit* *Output current limit*	*Slew rate limit*
	Text	Sec. 2.8.1, 2.8.2	Sec. 2.8.3
	Analysis Strategy	1. Determine maximum total v_{OUT}, i_{OUT}, excursion at op-amp output from linear system model 2. Compare maximum, minimum to op-amp limits	1. Determine $v_{OUT}(t)$ from linear system behavior (transfer function for sine wave, general exponential response for step) 2. Calculate time derivative $dv_{OUT}(t)/dt$ 3. Compare maximum positive and negative $dv_{OUT}(t)/dt$ to op-amp slew rate limit

Textbook: Sedra and Smith, Microelectronic Circuits, 6th ed.