

ECE101F19 Lecture 8 Oct. 22, 2019
 Operational Amplifier (OP Amp) pp. 183-194

Midterm Exam on Oct 29

- Covers all topics up to 1/2 lecture
- 1 page of formulas allowed, but no solved problems
- Ohm's Law, KCL, KVL, power, Energy
- Loop/Mesh analysis, Nodal Analysis
- Δ -Y & Y- Δ transformations
- Equivalent circuits, Max Power Transfer theorem
- Thevenin's & Norton's equivalent circuits
- op amp

Quiz 2

Average 7. 76

a 2. 78

Many got 10/10 (congrats)

But, someone said $I_f = 4I_X$
 although $4I_X$ is a CCVS
dependent voltage source

Get HELP from tutors. Also visit me ↗

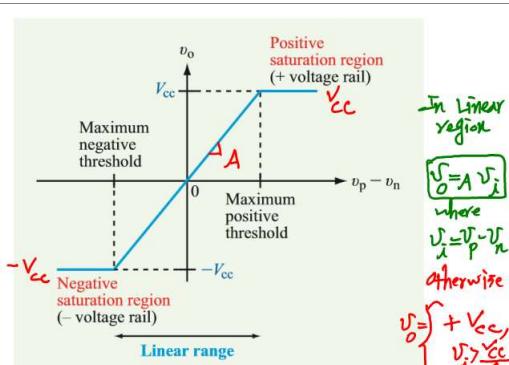
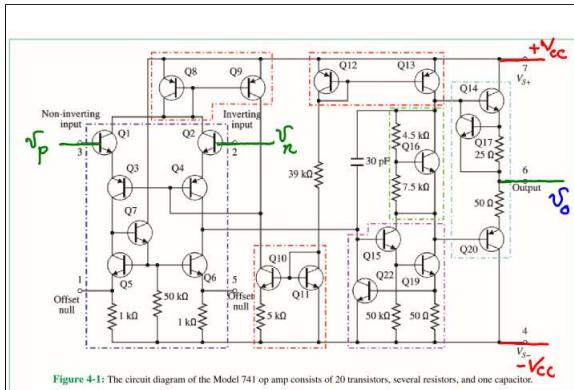
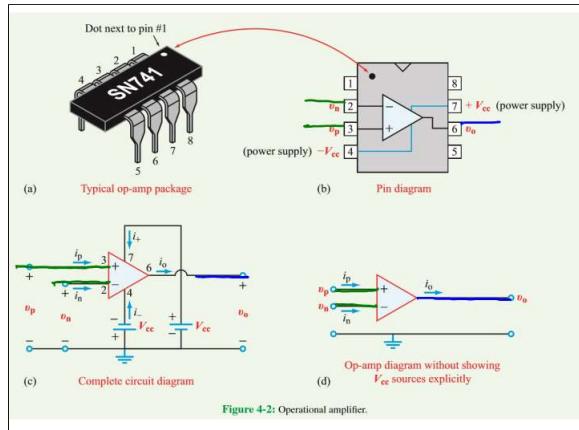


Figure 4-3: Op-amp transfer characteristics. The linear range extends between $v_o = -V_{cc}$ and $+V_{cc}$. The slope of the line is A .

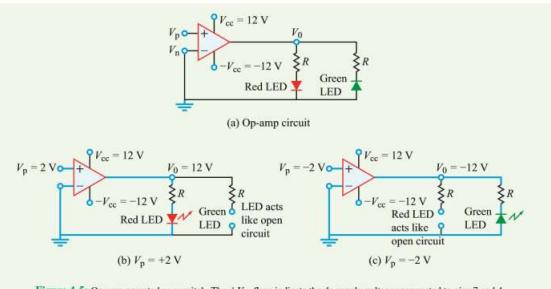


Figure 4-5: Op-amp operated as a switch. The $\pm V_{cc}$ flags indicate the dc supply voltages connected to pins 7 and 4.

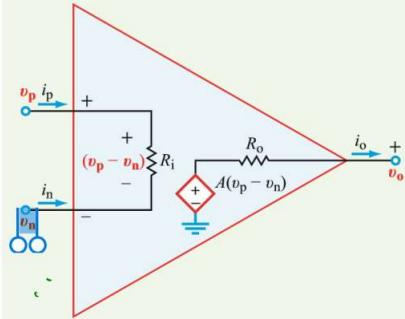
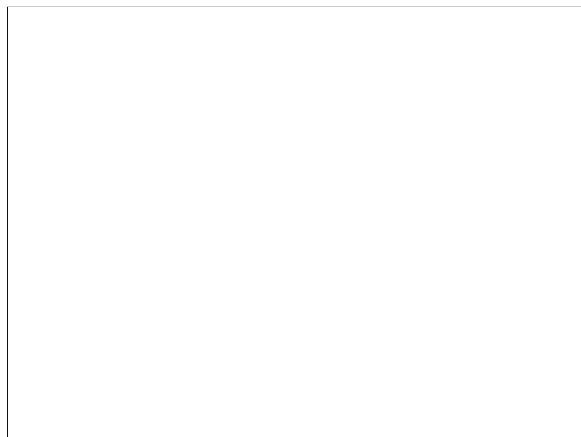


Figure 4-6: Equivalent circuit model for an op amp operating in the linear range ($v_o \leq |V_{cc}|$). Voltages v_p , v_n , and v_o are referenced to ground.

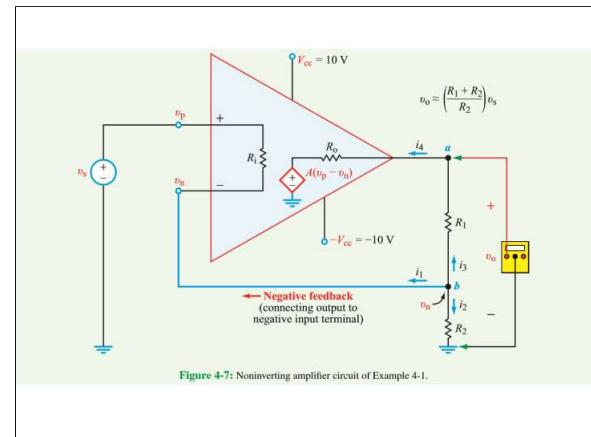
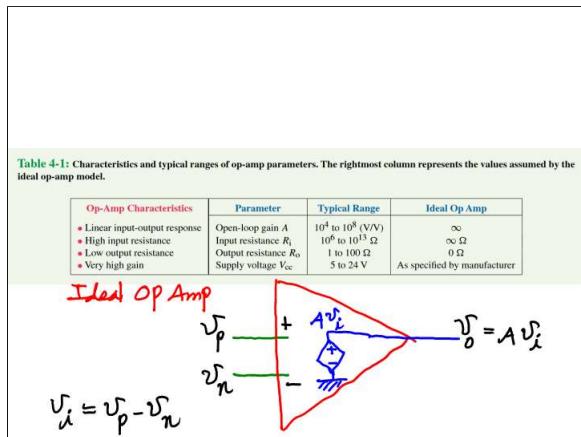


Figure 4-7: Noninverting amplifier circuit of Example 4-1.

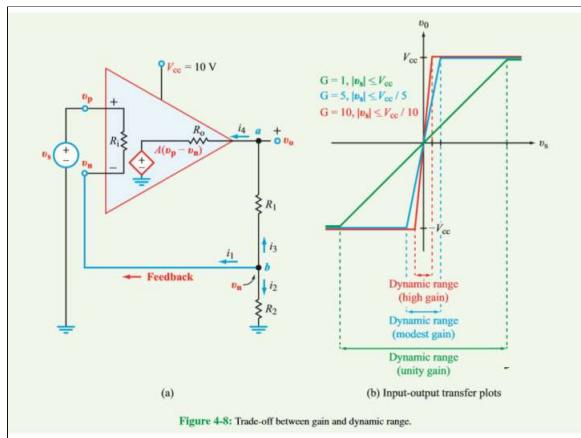
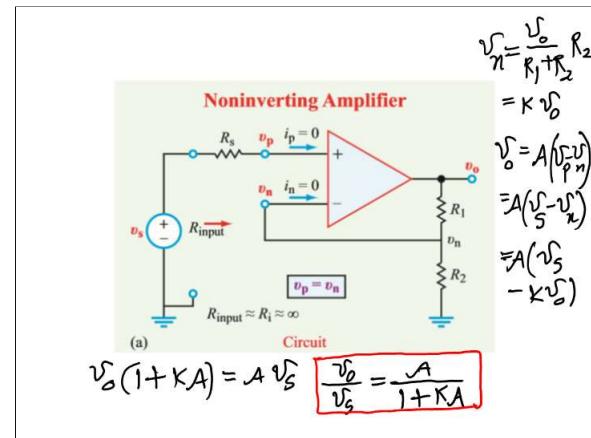


Figure 4-8: Trade-off between gain and dynamic range.



$$\frac{v_o}{v_s} = \frac{A}{1 + KA}, \quad K = \frac{R_2}{R_1 + R_2}$$

when $A \rightarrow \infty$ (very large)

$$\frac{v_o}{v_s} = \frac{1}{K + \frac{1}{A}} \Big|_{K \gg \infty} = \frac{1}{K} = \frac{R_1 + R_2}{R_2}$$

$$v_o = \left(\frac{R_1 + R_2}{R_2} \right) v_s$$

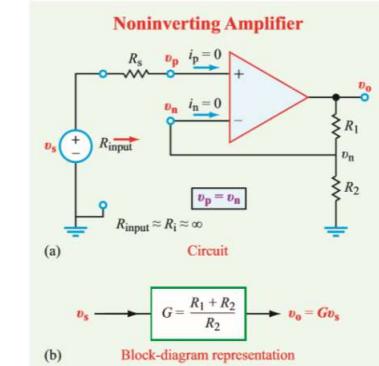


Figure 4-10: Noninverting amplifier circuit: (a) using ideal op-amp model and (b) equivalent block-diagram representation.

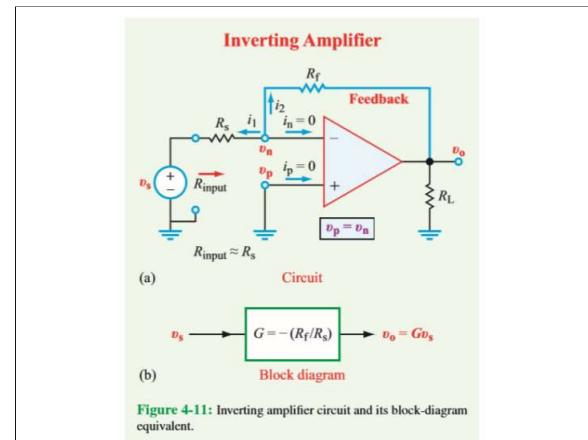
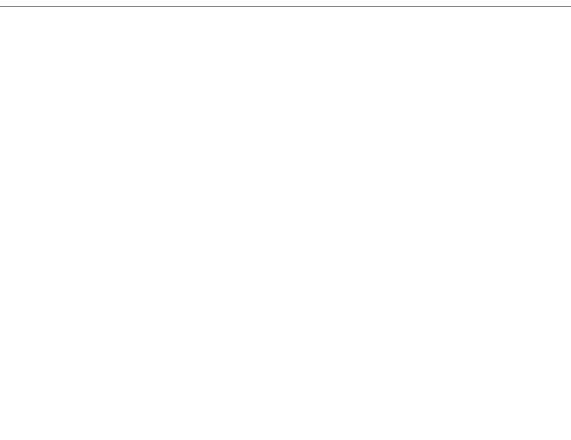
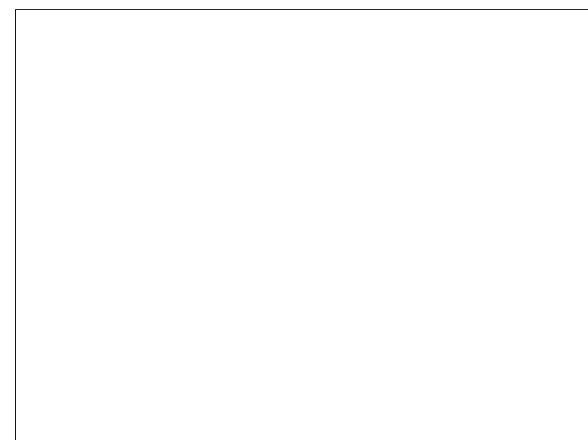
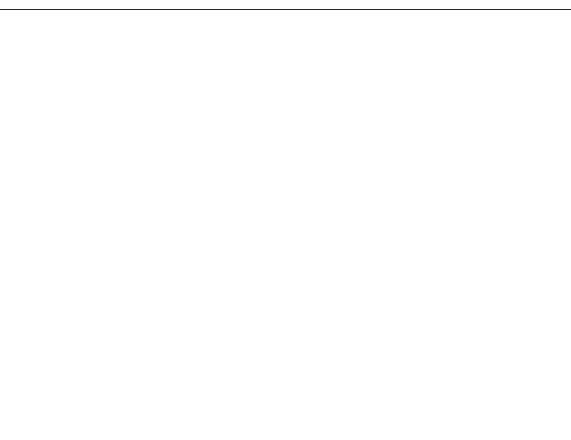
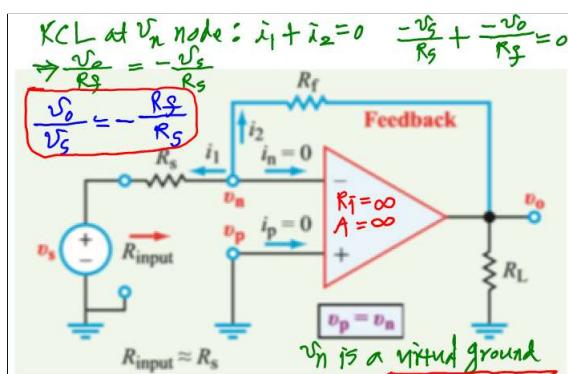


Figure 4-11: Inverting amplifier circuit and its block-diagram equivalent.



4.5 For the op-amp circuit shown in Fig. P4.5:

- (a) Use the model given in Fig. 4-6 to develop an expression for the current gain $G_i = i_L/i_s$.
- (b) Simplify the expression by applying the ideal op-amp model (taking $A \rightarrow \infty$, $R_i \rightarrow \infty$, and $R_o \rightarrow 0$).

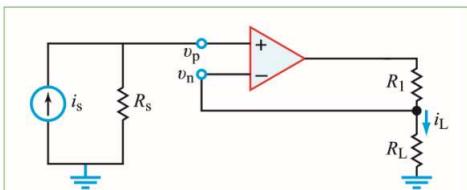
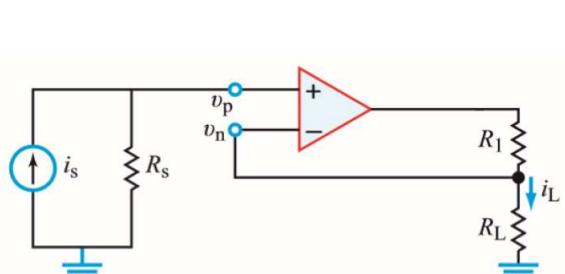


Figure P4.5: Circuit for Problem 4.5.



4.7 For the circuit in Fig. P4.7:

- (a) Use the op-amp equivalent-circuit model to develop an expression for $G = v_o/v_s$.
- (b) Simplify the expression by applying the ideal op-amp model parameters, namely $A \rightarrow \infty$, $R_i \rightarrow \infty$, and $R_o \rightarrow 0$.

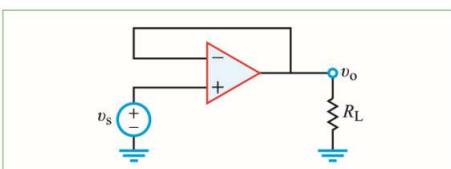


Figure P4.7: Circuit for Problem 4.7.

