Lecture 7

Feb. 6, 2015

EE 320 *Extra*

$v_I = 10\,\mu V$ Rms → peak → 14.14 V

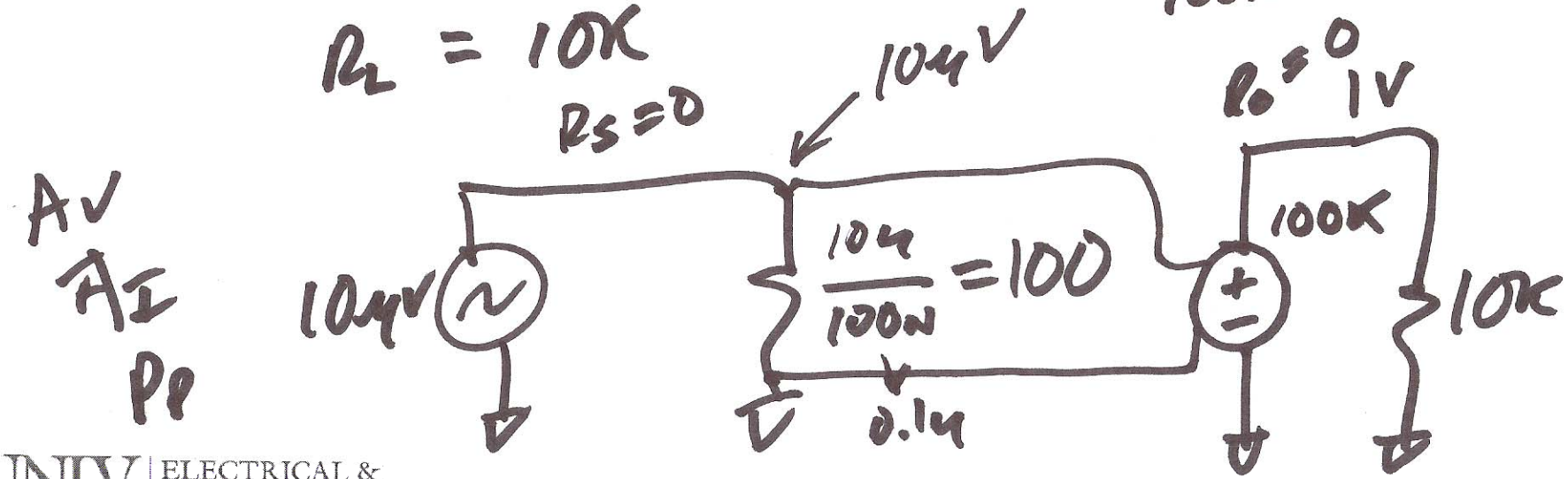
$i_I = 100\,nA$ Rms → peak → 140 nA

$v_o = 1V$ Rms

$R_L = 10K$

$10\,\mu V = 10^{-5}$

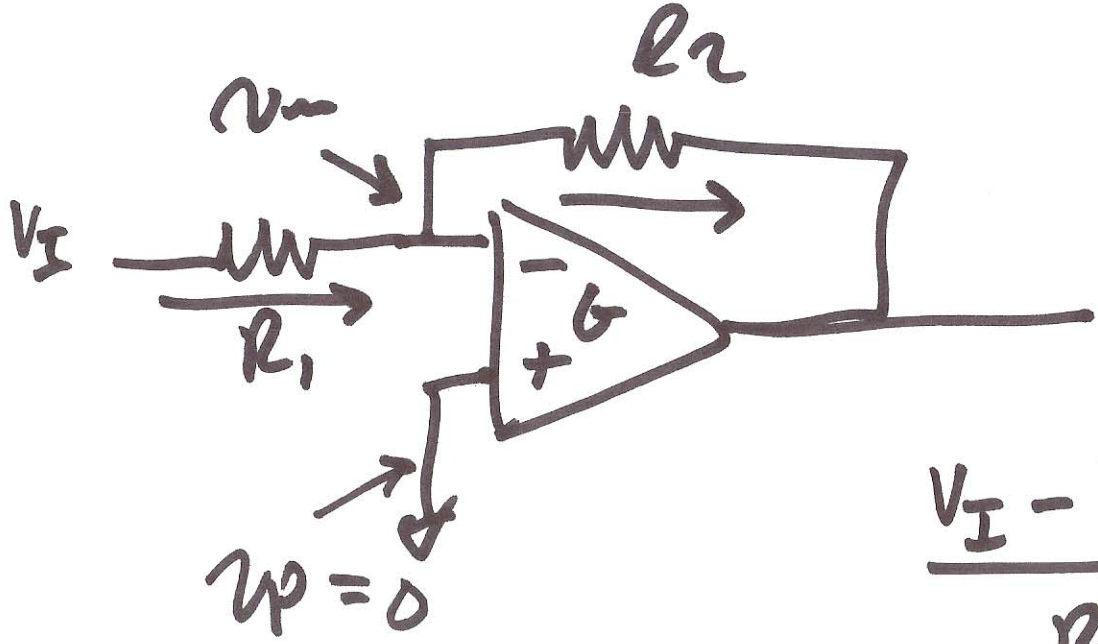
$100K = 10^5$



AV

AI

PP



$$V_{OUT} = G(V_p - V_m)$$

$$\frac{V_I - V_m}{R_1} = \frac{V_m - G(\overset{0}{V_p} - V_m)}{R_2}$$

$$\frac{V_{OUT}}{V_I} = \frac{-1}{\frac{1}{G} + \frac{R_1}{G R_2} + \frac{R_1}{R_2}}$$

$$V_I - V_m = \frac{R_1}{R_2} V_m + G\frac{R_1}{R_2} V_m$$

$$V_I = V_m\left(1 + \frac{R_1}{R_2} + \frac{R_1}{R_2 G}\right)$$

$$(1 + \frac{R_1}{R_2} + \frac{R_1}{R_2 G}$$

$$V_{OUT} = \frac{-G\ V_I}{1 + \left\{\frac{R_1}{R_2} + \frac{R_1}{R_2}\right\} G}$$

$$V_I = V_m\left(1 + \frac{R_1}{R_2} + G\frac{R_1}{R_2}\right)$$

$$V_m = \frac{V_I}{1 + \frac{R_1}{R_2} + G\frac{R_1}{R_2}}$$

$$V_{OUT} = G(\cancel{V_P^0} - V_m)$$

$$V_{OUT} = \frac{-G V_I}{1 + \frac{R_1}{R_2} + G\frac{R_1}{R_2}}$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{-1}{\frac{1}{G} + \frac{R_1}{GR_2} + \frac{R_1}{R_2}}$$

$$G = \frac{R_2}{R_1} \qquad A = \text{Open loop gain}$$

$$\frac{R_c}{R_1} = \frac{A-G}{1+G}$$

$$\frac{V_{out}}{V_{in}} = \frac{-1}{\frac{1}{A} + \frac{R_1 \| R_c}{A \cdot R_2} + \frac{R_1 \| R_c}{R_2}}$$

$$R_1 \| R_c = \frac{1}{\frac{1}{R_1} + \frac{1}{R_c}}$$

$$+\frac{R_2}{R_1} = \frac{+1}{\frac{1}{A} + \frac{R_1 \| R_c}{A \cdot R_2} + \frac{R_1 \| R_c}{R_2}}$$

$$\frac{1}{A} + \frac{1}{A R_2 \left(\frac{1}{R_1} + \frac{1}{R_c}\right)} + \frac{1}{R_2 \left(\frac{1}{R_1} + \frac{1}{R_c}\right)} = \frac{R_1}{R_2} \frac{1}{G}$$

$$\frac{1}{A} + \frac{1}{A\left(G + \frac{R_2}{R_c}\right)} + \frac{A}{A\left(G + \frac{R_2}{R_c}\right)} = \frac{1}{G}$$

$$\frac{1}{G} - \frac{1}{A} = \frac{A - G}{AG} = \frac{1 + A}{A\left(G + \frac{R_2}{R_c}\right)}$$

$$A - G = \frac{G(1 + A)}{G + \frac{R_2}{R_c}}, \quad G = \frac{R_2}{R_1}$$

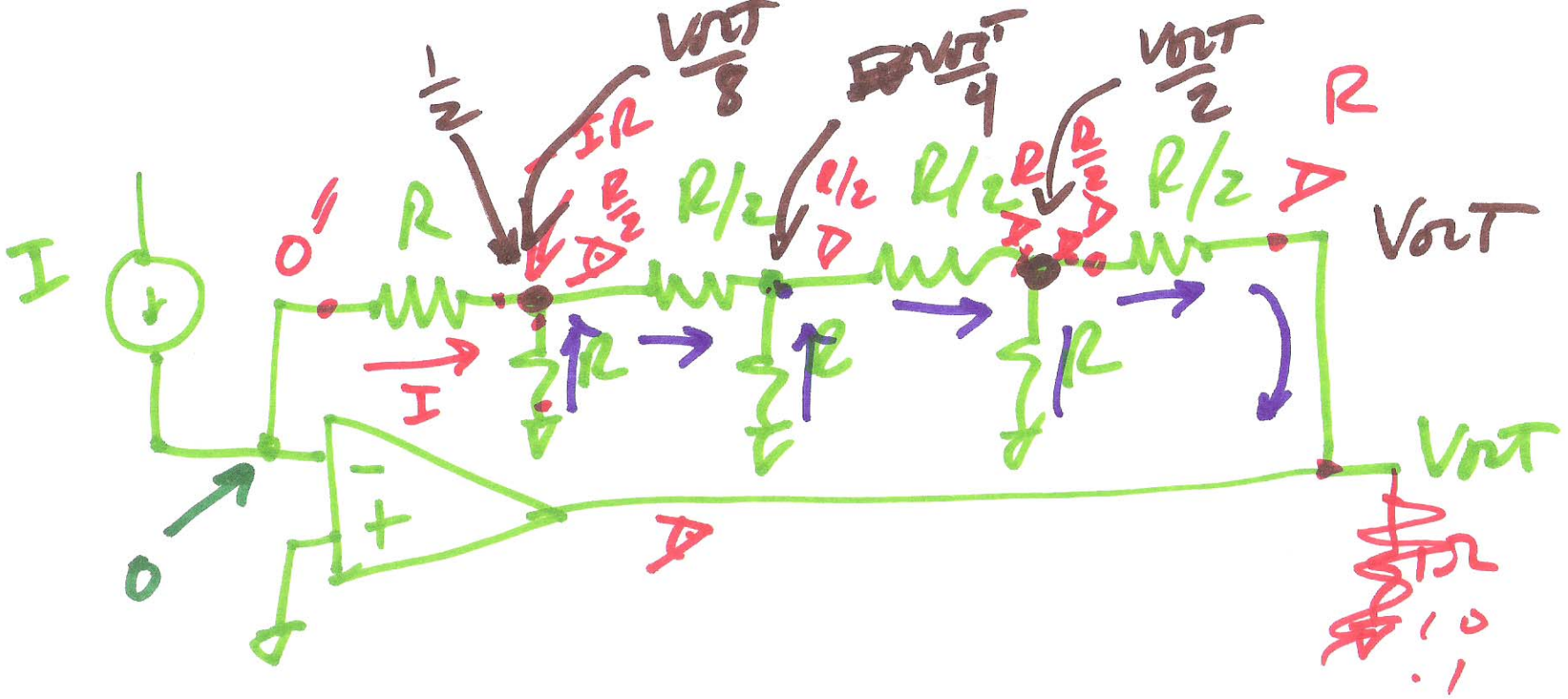
$$\frac{1 + A}{1 + \frac{R_1}{R_c}} = = \frac{\frac{R_2}{R_1} + A\frac{R_2}{R_1}}{\frac{R_2}{R_1} + \frac{R_2}{R_c}} = \frac{\frac{R_2}{R_1} + A\frac{R_2}{R_1}}{\frac{R_2 R_c + R_1 R_2}{R_1 R_c}}$$

$$A-G = \frac{1+A}{1+\frac{R_1}{R_C}} \cdot \frac{R_C/R_1}{\frac{R_C}{R_1}}$$

$$A-G = \frac{\frac{R_C}{R_1} + A\frac{R_C}{R_1}}{\frac{R_C}{R_1}+1}$$

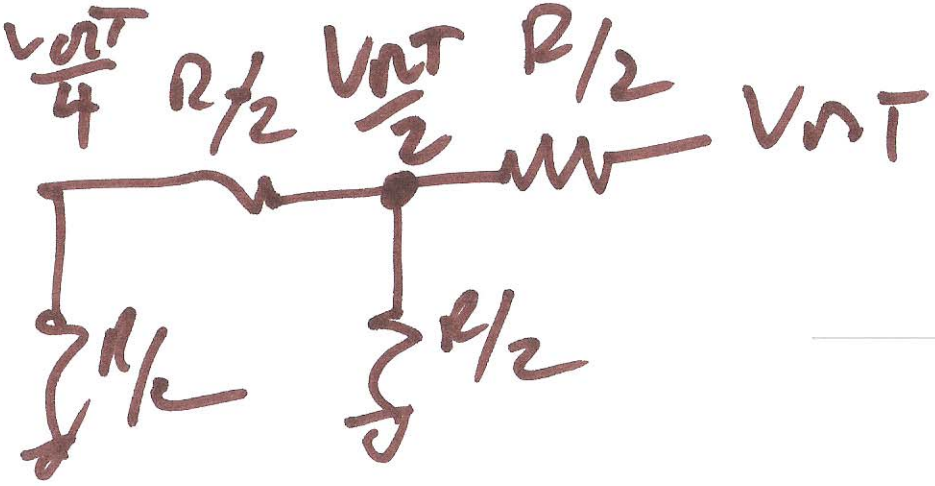
$$(A-G)\left(\frac{R_C}{R_1}+1\right) - A\frac{R_C}{R_1} = \frac{R_C}{R_1}$$

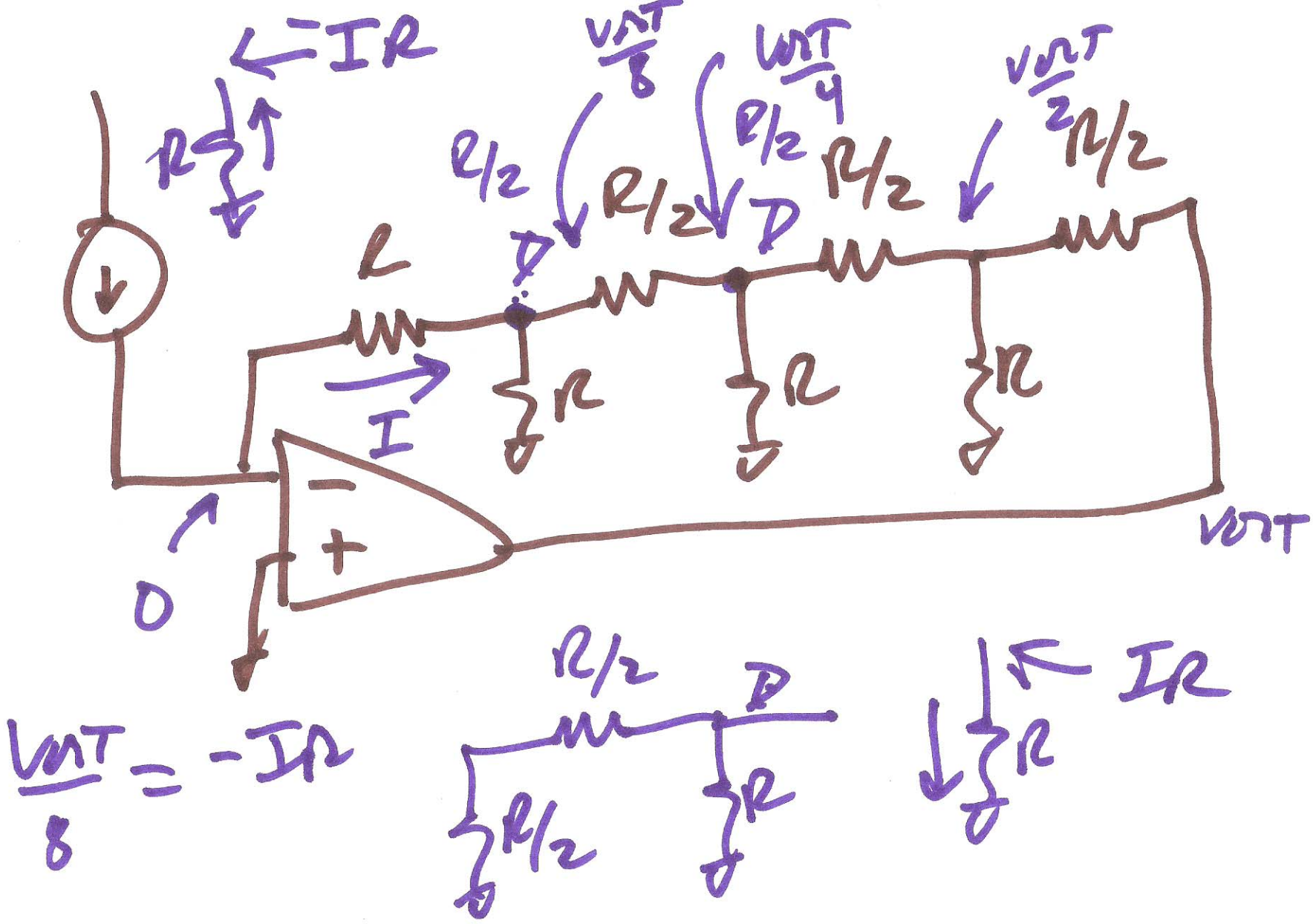
$$(A-G)\frac{R_C}{R_1} + A - G - A\frac{R_C}{R_1} = \frac{R_C}{R_1}$$



$$I \cdot R = -\frac{V_{OUT}}{8}$$

$$\frac{V_{OUT}}{I} = -8R$$




IR
R
R/2
R/2
R/2
R/2
R
R
R
R
D
D
D
I
VOUT/8
VOUT/4
VOUT/2
VOUT
0
VOUT/8 = -IR
R/2
R/2
R
R
IR