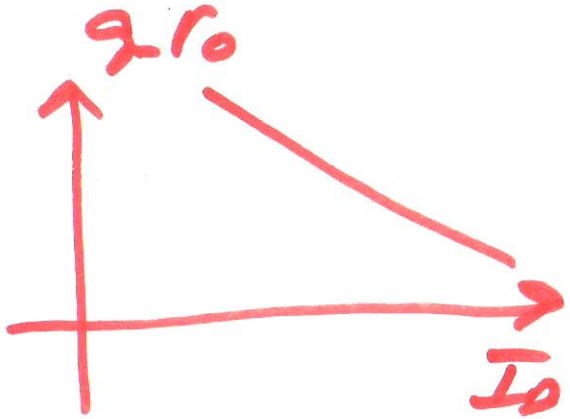
Study Session

3/29/13

EE 422 / ECG 622

$$f_T \propto \frac{V_{GS}}{L}$$

$$g_m r_o \propto \frac{1}{\sqrt{I_D}}$$



$$r_o \propto \frac{L}{I_D \cdot \lambda}$$

$$g_m \propto \sqrt{I_D}/\sqrt{L} \qquad g_m \propto \frac{V_{GS}}{L}$$

$$g_m = \sqrt{2 \cdot KP \cdot \frac{W}{L} \cdot I_D} = 2KP \cdot \frac{W}{L}\left(V_{GS} - V_{THN}\right)$$

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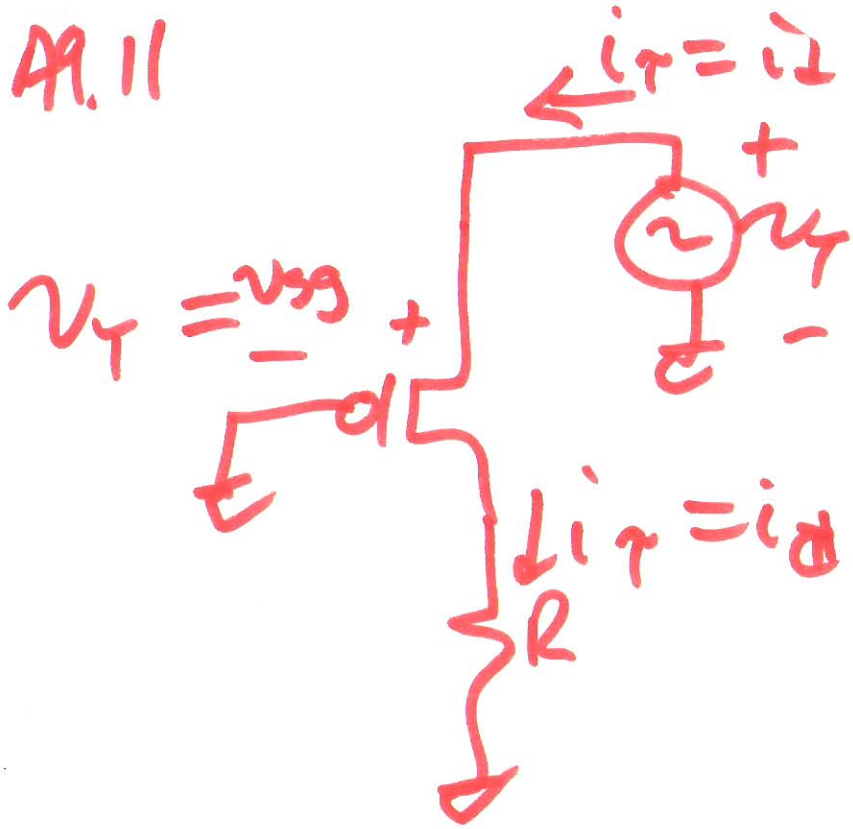
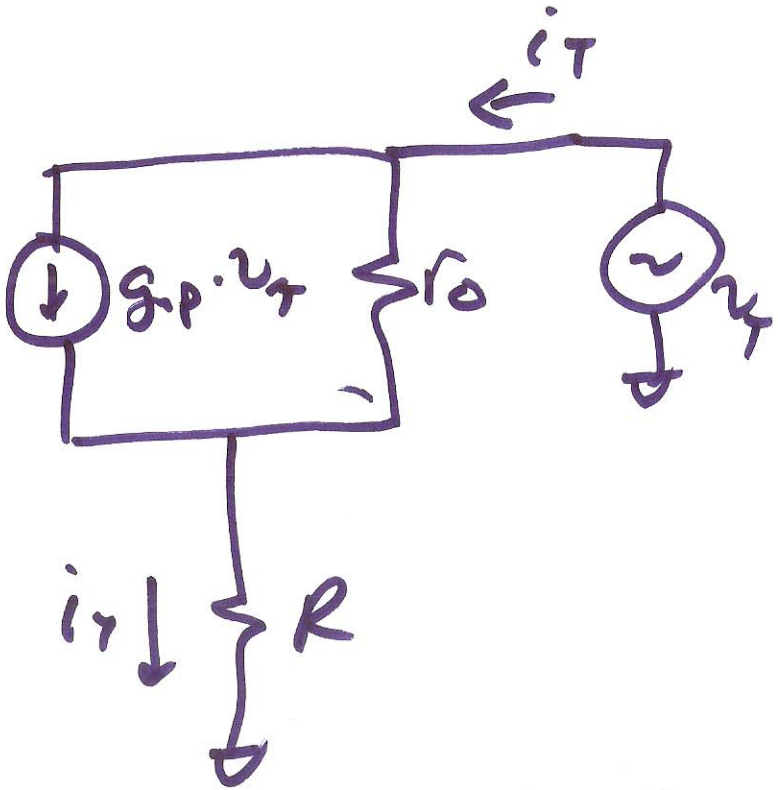
1)

AP. 11





$$\frac{v_T}{i_T} = \frac{r_o + R}{1 + g_m r_o}$$

$R = 0, \; r_o = \infty$

$$= \frac{1}{\frac{1}{r_o} + g_m}$$

$$= \frac{1}{g_m}$$

$$i_T = g_p \cdot v_T + \frac{v_T - i_T \cdot R}{r_o}$$

$$i_T r_o = g_p \cdot v_T r_o + v_T - i_T \cdot R$$

$$i_T (r_o + R) = v_T (1 + g_m r_o)$$

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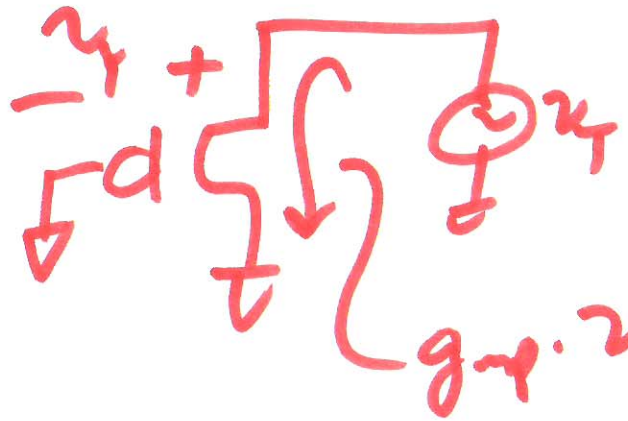
2)



$g_m \cdot v_T = i_T$

$\frac{v_T}{i_T} = \frac{1}{g_m}$

$r_o = \infty$

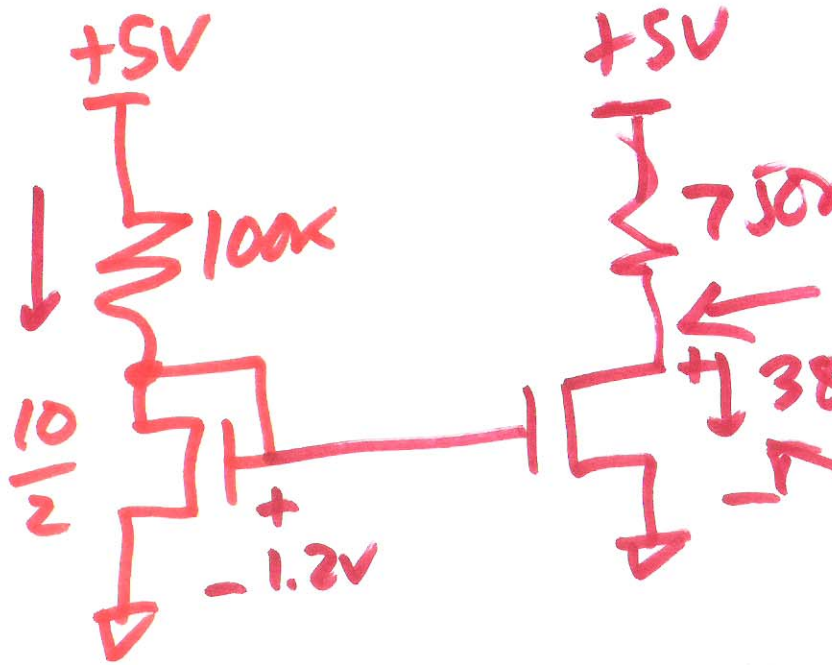
$R = 0$

A20.1)

$ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$5 - 750K \cdot 38\mu A > 5V$$



$\frac{5-1.2}{100K} = I_D$

$\frac{3.8}{100K}$

$\frac{3.8}{\frac{1}{10} \cdot 10^6}$

$\$38\,\mu A$

NOT in SAT!

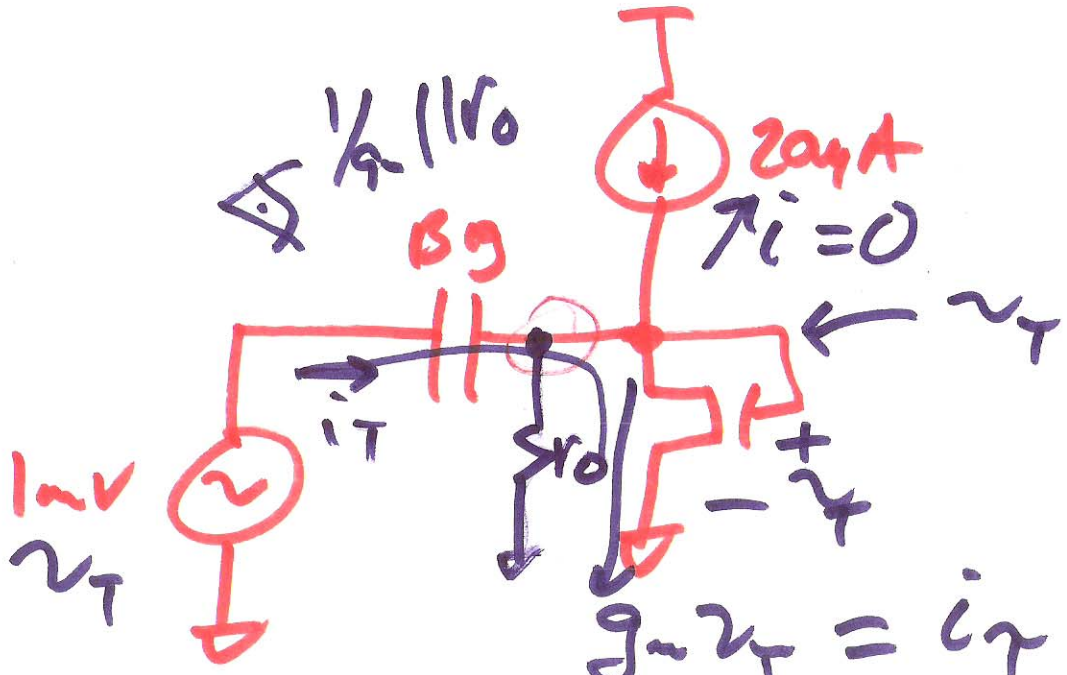
use triode Eq.!

$5 - I_D \cdot 100K - V_{GS} = 0$

$V_{GS} = 1.2V$

$$5 - \frac{KP}{2} \cdot \frac{10}{2} \left(V_{GS} - V_{THN}\right)^2 \cdot 100K - V_{GS} = 0$$

$V_{GS} = 1.2V$ (for example)



$$i_T = \frac{v_T}{r_o} + g_m v_T$$

$$\frac{v_T}{i_T} = \frac{1}{\frac{1}{r_o} + \frac{1}{g_m}}$$

$$g_m v_T = i_T = i_1 \quad (r_o = \infty)$$

$$\frac{v_T}{i_T} = \frac{1}{g_m} \quad (r_o \neq \infty)$$

$$\frac{v_T}{i_T} = \frac{1}{g_m} \| r_o$$

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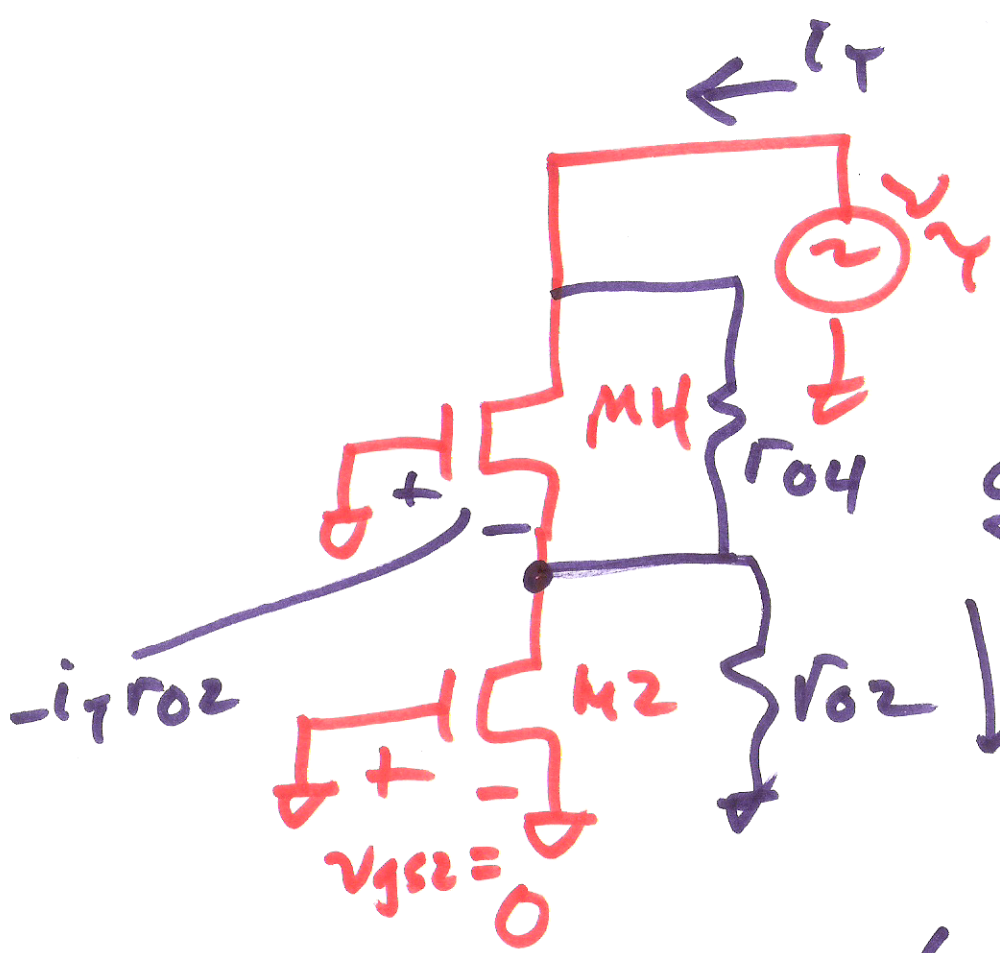
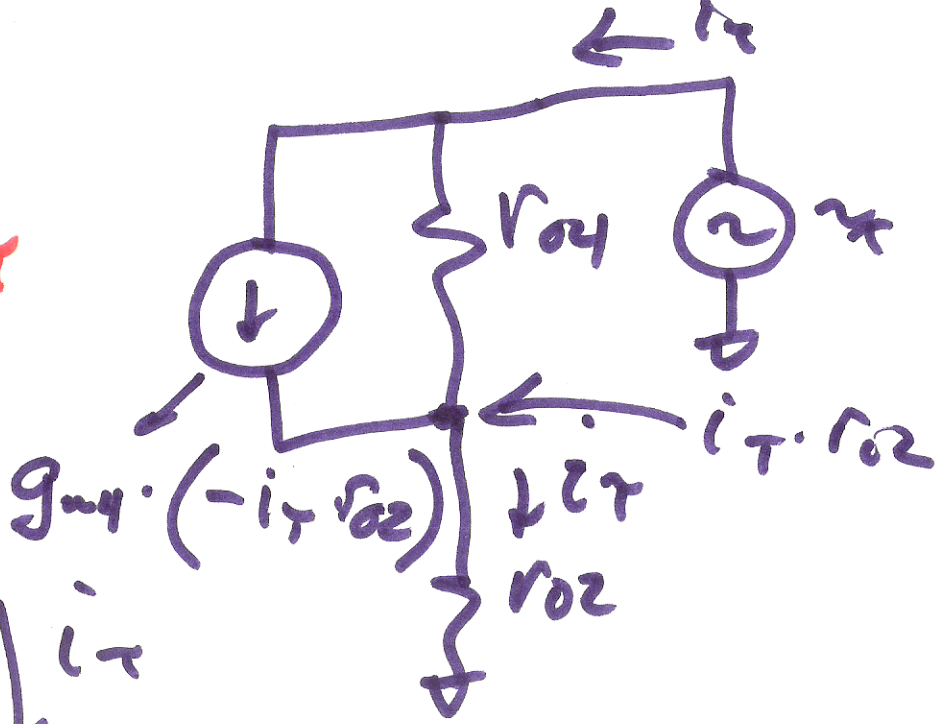




$$i_T = g_{m4}(-i_T \cdot r_{o2}) + \frac{v_T - (i_T r_{o2})}{r_{o4}}$$

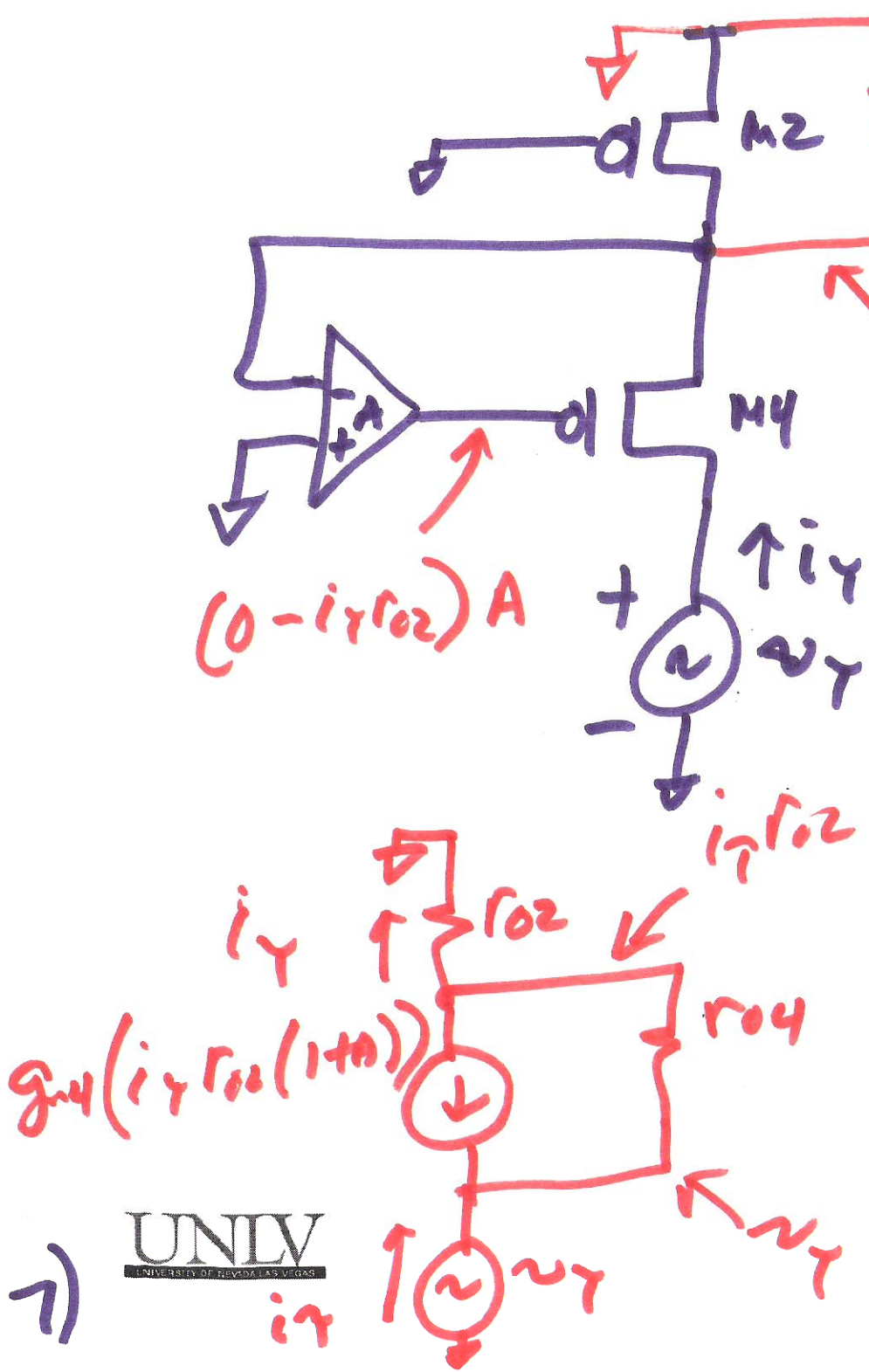
$$i_T(r_{o4} + g_{m4} r_{o2} \cdot r_{o4} + r_{o2}) = v_T$$

$$R_{ocas} = \frac{v_T}{i_T} = r_{o4}(1 + g_{m4} r_{o2}) + r_{o2}$$

$$\simeq g_{m4} r_{o2} r_{o4}$$

6)

Regulated drain



$$v_{sg4} = v_{s4} - v_{g4}$$

$$= i_T \cdot r_{o2} - (-i_T r_{o2} A)$$

$$= i_T r_{o2}(1+A)$$

$$i_T + g_{m4}(i_T r_{o2}(1+A)) + \frac{i_T \cdot r_{o2} - v_T}{r_{o4}}$$

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$$i_4\left(r_{o4} + g_{m4} r_{o2}(1+A) + r_{o2}\right) = v_T$$

$$\frac{v_T}{i_T} = r_{o4} + r_{o2} + g_{m4} r_{o2}(1+A) r_{o4}$$