

۱- ترزیب صحیح است.  $v_{g_{d1}} = v_{D1} - v_{D1} = 0 = -\epsilon < v_{p1} = -\epsilon$

اتباع  $M_1$

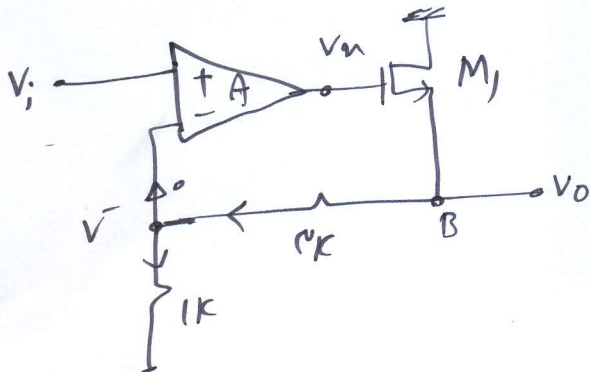
$i_{D_r} = i_{D_{SS_r}} \Rightarrow v_{g_{S1}} = v_{p1} \left( 1 - \sqrt{\frac{I_{D1}}{I_{D_{SS1}}}} \right) = -\epsilon \left( 1 - \sqrt{\frac{I_{D1}}{\epsilon}} \right)$

$I_{D1} = I_{D_r} = i_{D_{SS_r}} \Rightarrow v_{g_{S1}} = -\epsilon \left( 1 - \sqrt{\frac{I_{D_{SS_r}}}{\epsilon}} \right)$

$v_{g_{d1}} = v_{g_{S1}} < v_{p1} = -\epsilon \Rightarrow -\epsilon \left( 1 - \sqrt{\frac{I_{D_{SS_r}}}{\epsilon}} \right) < -\epsilon$   
 شرط اتباع

$1 - \sqrt{\frac{I_{D_{SS_r}}}{\epsilon}} > \frac{1}{\epsilon} \Rightarrow \sqrt{\frac{I_{D_{SS_r}}}{\epsilon}} < \frac{1}{\epsilon} \Rightarrow I_{D_{SS_r}} < 1 \text{mA}$

۲- ترزیب صحیح است.



kcl

$\frac{V_o - V^-}{R} = \frac{V^-}{1} \Rightarrow V_o = \epsilon V^-$

$V^- = \frac{V_o}{\epsilon}$

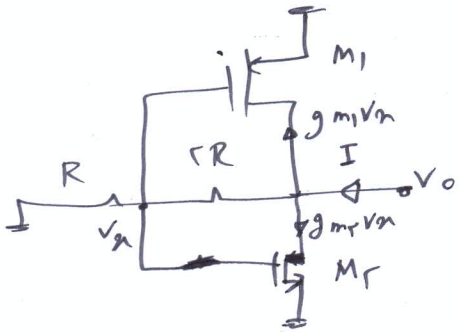
$(V_i - V^-) A = V_{gs} \Rightarrow V_{gs} = \left( V_i - \frac{V_o}{\epsilon} \right) A$

kcl<sup>B</sup>  $(V_{gs} - V_o) g_m = \frac{V_o - V^-}{R} = \frac{V_o - \frac{V_o}{\epsilon}}{R} = \frac{V_o}{\epsilon}$

$V_{gs} - V_o = \frac{V_o}{\epsilon} \Rightarrow V_{gs} = \frac{\Delta V_o}{\epsilon}$

$V_{gs} = \frac{\Delta V_o}{\epsilon} = A \left( V_i - \frac{V_o}{\epsilon} \right) \Rightarrow \frac{V_o}{\epsilon} = V_i \Rightarrow \frac{V_o}{V_i} = \epsilon$

۳- گزینش صحیح است.



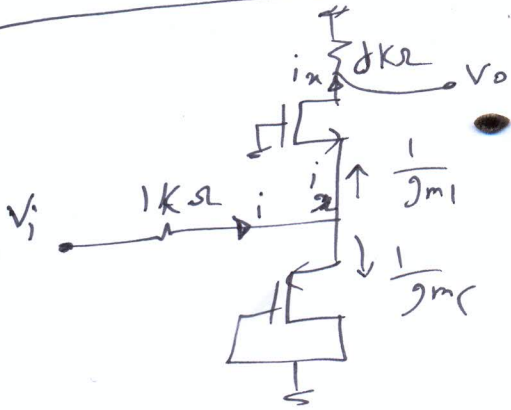
$$v_x = \frac{v_o \times R}{r_e} = \frac{v_o}{\beta}$$

$$I = \frac{v_o}{r_e} + g_m v_x + g_m v_x$$

$$I = \frac{v_o}{r_e} + \beta g_m v_x = \frac{v_o}{r_e} + \frac{\beta g_m v_o}{\beta} = \frac{v_o}{r_e} + \frac{\beta g_m v_o}{\beta}$$

$$I = v_o g_m \Rightarrow R_{out} = \frac{v_o}{I} = \frac{1}{g_m}$$

۴- گزینش صحیح است.



$$i_x = i \frac{\frac{1}{g_m r}}{\frac{1}{g_m} + \frac{1}{g_m r}}$$

$$v_o = \Delta i x$$

$$v_i = 1(i) + \frac{1}{g_m r} i_x = i + \frac{\frac{1}{g_m} \frac{1}{g_m r}}{\frac{1}{g_m} + \frac{1}{g_m r}} i$$

$$v_i = i + \frac{1}{g_m + g_m r} i \Rightarrow v_o = \Delta i x = \Delta i \frac{g_m}{g_m + g_m r}$$

$$\frac{v_o}{v_i} = \frac{\Delta i \frac{g_m}{g_m + g_m r}}{i \left(1 + \frac{1}{g_m + g_m r}\right)} = \frac{\Delta g_m}{g_m + g_m r + 1} = \frac{\Delta (r)}{r + 1 + 1} = \frac{1 \Delta}{\Delta} = r$$

(موفق باشی عزیز)