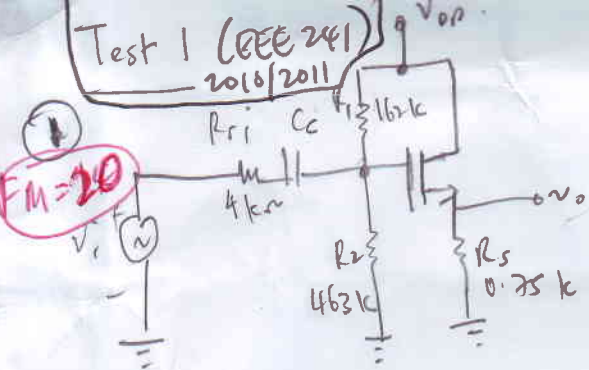
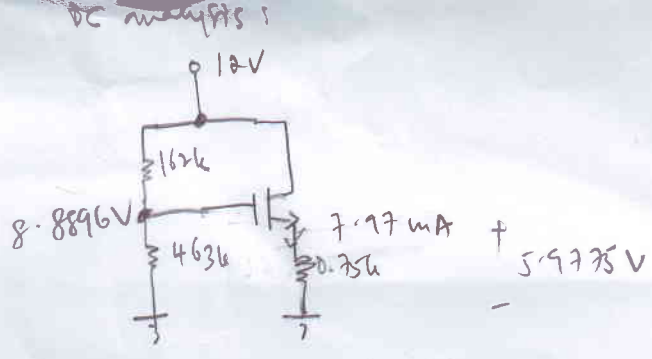


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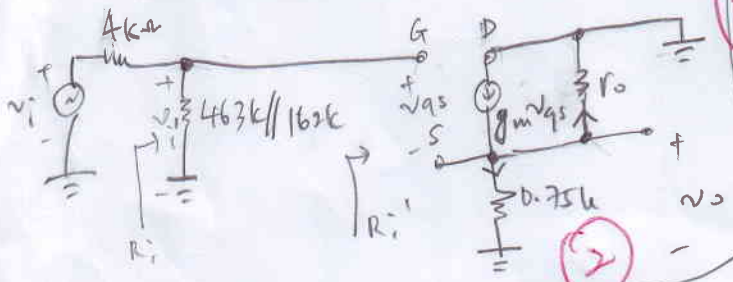
FM=20



$V_{DD} = 12V$   
 $R_1 = 162k\Omega$   
 $R_2 = 463k\Omega$   
 $R_S = 0.75k\Omega$   
 $I_{DQ} = 7.97mA$   
 $R_{S1} = 4k\Omega$   
 $V_{TN} = 1.5V$   
 $K_n = \frac{\mu_n C_{ox}}{2} \frac{W}{L} = 4mA/V^2$   
 $\lambda = 0.01V^{-1}$



$-8.8896 + V_{GS} + 5.9775 = 0$   
 $\therefore V_{GS} = 2.9121V$



$g_m = 2K_n (V_{GS} - V_{TN})$   
 $= 2(4m)(2.91 - 1.5)$   
 $= 0.01128$

KCL at node S:  
 $g_m v_{gs} = \frac{v_o}{r_o} + \frac{v_o}{0.75k}$

$r_o = \frac{1}{\lambda I_{DQ}} = \frac{1}{0.01(7.97m)} = 12,547.0514$

$v_{gs} = \frac{v_o}{g_m} \left( \frac{1}{r_o} + \frac{1}{0.75k} \right)$   
 $R_{i'} = \infty$   
 $R_i = 463k \parallel 162k = 120,009.6$

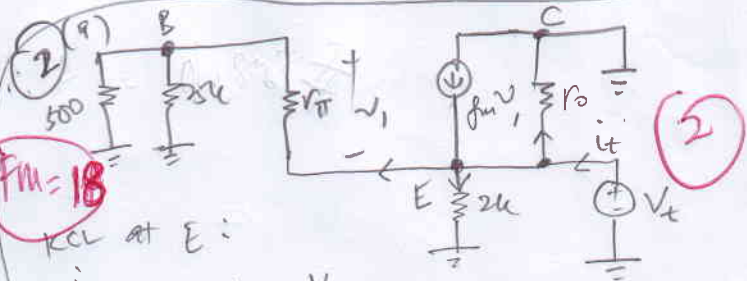
$v_i = v_{gs} + v_o = \frac{120,009.6 v_o}{120,009.6 + 4000}$

$\left[ \frac{1}{g_m} \left( \frac{1}{r_o} + \frac{1}{0.75k} \right) + 1 \right] v_o = 0.9677 v_i$

$A_v = \frac{v_o}{v_i} = \frac{0.9677}{\left[ \frac{1}{g_m} \left( \frac{1}{r_o} + \frac{1}{0.75k} \right) + 1 \right]}$   
 $= 0.9677$

$\frac{0.9677}{\left( \frac{1}{0.01128} \right) \left( \frac{1}{12,547.0514} + \frac{1}{0.75k} \right) + 1} = 0.86$

FM=18



KCL at E:  
 $i_t + g_m v_i = \frac{v_t}{r_o} + \frac{v_t}{2k} + \frac{v_t}{r_{\pi} + 500 \parallel 25k}$   
 $i_t + g_m v_i = v_t \left[ \frac{1}{r_o} + \frac{1}{2k} + \frac{1}{r_{\pi} + 490.1961} \right]$   
 $v_i = -r_{\pi} v_t$

$g_m = \frac{I_C}{V_T}$   
 $r_{\pi} = \frac{\beta}{g_m}$   
 $r_o = \frac{V_A}{I_C}$

$-2.5 \frac{I_C}{25k} (25k) + 0.7 + (\beta + 1)(2k) I_B = 0$   
 $207000 I_B = 1.8$   
 $I_B = 7.9295 \mu A$   
 $I_C = \beta I_B = 0.793mA$

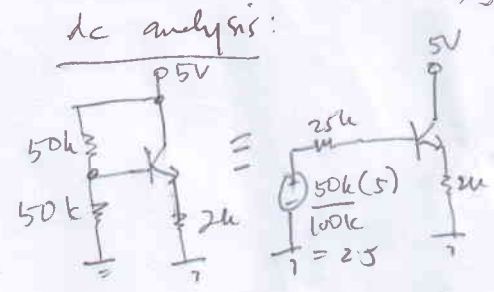
$g_m = 0.0305 A/V$   
 $r_{\pi} = \frac{100}{0.0305} = 3278.6885$   
 $r_o = \frac{0.0305}{\frac{100}{0.793m}} = 100.8827k\Omega$

$i_t - g_m r_{\pi} v_t = v_t \left[ \frac{1}{r_o} + \frac{1}{2k} + \frac{1}{3768.8846} \right]$   
 $r_{\pi} + 490.1961$

$i_t = v_t \left[ \frac{1}{100.8827k} + \frac{1}{2000} + \frac{1}{3768.8846} + \frac{100}{3768.8846} \right]$   
 $= v_t [0.0273]$

$R_o = v_t / i_t = 36.6189\Omega$   
 $= 0.86$

(b) The circuit is of the common C type



Working

Working

Working

Working

Working