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Electronic II

HW 1

① $g_{mo} = \frac{2I_{DSS}}{|V_p|}$ $g_{mo} = \frac{2(4mS)}{4}$

$g_{mo} = 6mS$

5) $g_m = g_{mo}\left(\frac{1-V_{GSQ}}{V_p}\right)$

$= \left(\frac{2I_{DSS}}{|V_p|}\right)\left(\frac{1-V_{GSQ}}{V_p}\right)$

$6\times10^{-3} = \frac{2I_{DSS}}{2.5}\left(1-\frac{-1}{-2.5}\right)$

$I_{DSS} = 12.5mA$

9) $z_o = \frac{1}{Y_s} = \frac{1}{25\times10^{-6}} = 40k\Omega$

$z_o = r_d = 40k\Omega$

$A_V(FET) = -g_m r_d$

$= -(4.5\times10^{-3})(40\times10^3)$

$A_V(FET) = -180$

11a) $g_{mo} = \frac{2I_{DSS}}{|V_p|}$, $g_{mo} = \frac{(2)(0.010)}{5}$

$= 4mS$

b) $g_m = \Delta I_D/\Delta V_{GS}$

$g_m = \frac{0.010-0.0064}{0-(-1)}$

$= 3.6mS$

c) $g_m = g_{mo}\left(\frac{1-V_{GS}}{V_p}\right)$

$g_m = 0.004\left(1-\frac{-0.05}{-5}\right)$

$= 3.6mS$

d) $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$

$g_m = \frac{0.0081-0.005}{-0.5-(-1.5)} = 3.1mS$

e) $g_m = g_{mo}\left(1-\frac{V_{GS}}{V_p}\right)$

$= 0.004\left(1-\frac{-1}{-5}\right)$

$= 3.2mS$

13a) $g_m = y_{fs}$

$g_m = 750\mu S$

$= 0.75mS$

b) $r_d = 1/y_{os}$

$= \frac{1}{10\times10^{-6}}$

$r_d = 100k\Omega$

17) $Z_i = R_G$, $Z_i = 1M\Omega$

$z_o = R_D \| r_d$

$= (11.8\times10^3)\,//\,(40\times10^3)$

$z_o = 1.722k\Omega$

$A_V = -g_m(R_D \| r_d)$

$g_m = \frac{(2)(10.010)}{6}\left(1-\frac{-1.5}{-6}\right) = 2.5mS$

$A_V = (-0.0025)(1722) = -7.305$

21) $Z_i = 10M\Omega$

$z_o = \frac{4+(3\times1.1)+(1.1/20)(3.3\times10^3)}{1+(3\times1.1)+\frac{3.3+1.1}{20}}$

$z_o = \frac{3179.15\Omega}{4(3)(3.3)}$

$A_V = \frac{}{1+(3)(1.1)+\frac{3.3+1.1}{20}} = -2.19$

0.0.0.4

23) b) $V_{GS} = -5.366\,V$

$R_S = \frac{V_{GS}}{-I_D} = \frac{-5.366}{-0.976\times10^{-3}}$

$= 5.498\,k\Omega$

b) $I_D = 1.158\,mA$

$V_{GS} = -5.13\,V$

$R_S = \frac{V_{GS}}{-I_D} = \frac{-5.13}{-1.158\times10^{-3}}$

$= 4.43\,k\Omega$

25) $Z_i = R_1 \| R_2 \quad Z_o = r_d \| R_D$

$Z_i = 11 \| 82 \quad , \quad Z_o = 50 \| 2$

$Z_i = 9.7\,M\Omega \quad , \quad Z_o = 1.92\,k\Omega$

$A_V = -g_m Z_o$

$A_V = -g - (5.47\times10^{-3})(1.92\times10^{3})$

$= +10.5 \Rightarrow Z_o = 1.96\,k\Omega$

$V_o = A_V V_i$

$= (-10.5)(20\times10^{-3}) = -210\,mV$

$V_o = -210\,mV \Rightarrow V_o = -214.4\,mV$

27) $Z_i = A_V \| R_D$

$Z_i = 11 \| 82$

$Z_i = 9.7\,M\Omega$

$Z_o = r_d \| R_D$

$Z_o = 20 \| 2 = 1.821\,k\Omega$

$V_o = (-9.94)(20\times10^{3}) = -198.8\,mV$

29) $Z_i = R_S \| \frac{1}{g_m} \Rightarrow Z_i = 1500 \| \frac{1}{2.14\times10^{-3}}$

$= 356.3\,\Omega$

$Z_o = R_D = 33\,k\Omega$

$V_o = (7.06)(4\times10^{-3}) = 28.24\,mV$

31) $Z_i = R_S \| \frac{1}{g_m}$

$Z = 100 \| \frac{1}{2.63\times10^{-3}} = 275.5\,\Omega$

$Z_o = 2.2\,k\Omega, \quad Z_o = R_D$

$A_V = g_m R_D$

$= (2.63\times10^{-3})(2200) = 5.79$

32) $Z_i = A_V \| R_{xx} \quad Z_i = 10\,M\Omega$

$Z_o = R_S \| \frac{1}{g_m}$

$Z_o = (2.2\times10^{3}) \| \frac{10^3}{1.511}$

$= 508.7\,\Omega$

$A_V = \frac{g_m R_S}{1+g_m R_S} = \frac{(1.511)(2.2)}{1+(1.511)(2.2)}$

$= 0.77$

36) $Z_i = 10\,M\Omega$

$Z_o = r_d \| R_D = 1.8\,k\Omega$

$A_V = -g_m R_D = -(5.4)(1.8) = -9.72$

39) $Z_i = 10 \| 91 \quad , \quad Z_i = 9\,M\Omega$

$Z_o = 451 \| 1.11 \frac{1}{4.13} = 197.6\,\Omega$

$A_V = \frac{(4.13)(1.074)}{1+(4.13)(1.074)} = 0.816$

41) $Z_i = \frac{R_f + r_d \| R_D}{1+g_m(r_d \| R_D)}$

$= Z_i = 1.73\,M\Omega$

$Z_o = 10000 \| 100 \| 2.2 = 2.15\,k\Omega$

$A_V = -g_m (R_S \| r_d \| R_D)$

$= -(2.22)(2.15) = -4.77$

45) $V_o = V_i A_V \Rightarrow V_o = (0.8)(-4.097)$

$= -3.28\,mV$

$A_v = -g_m (r_d \| R_D)$

$A_v = -(1.344)(4011 \| 3.3) = -4.097$

47) $R_3 = \frac{-V_{GSQ}}{I_{DQ}} = \frac{-1}{5.33 \times 10^{-3}}$

$= 187.62\ \Omega$

$40R_D = 1.876R_D + 75.04$

$R_D = 1.97k\Omega$

$R_D \approx 2k\Omega$