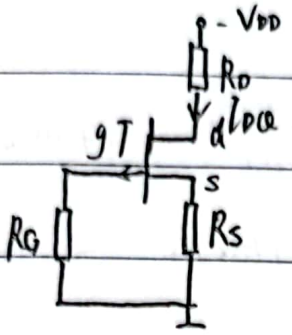
3.10

解：(1). 直流通路



输入方程 $U_{GSQ} = -I_{DQ}R_S = -I_{DQ}$

管子方程 $I_{DQ} = I_{DSS}(1 - \frac{U_{GS}}{U_{GS(off)}})^2$

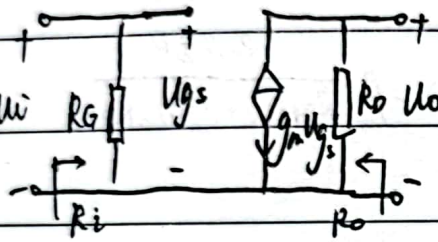
解得 $I_{DQ} = -2.3mA$、$I_{DQ} = -15.7mA$（舍）

$\therefore I_{DQ} = -2.3mA$　　$U_{GSQ} = -I_{DQ}R_S = 2.3V$

$U_{DQ} = -V_{DD} - I_{DQ} \cdot R_D = -12.4V$

(2) 作微变等效电路

$g_m = -\frac{2}{U_{GS(off)}}\sqrt{I_{DQ}I_{DSS}} = 1.23mS$



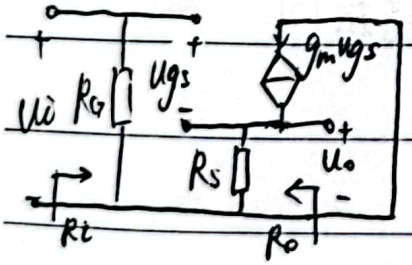
$A_u = \frac{U_o}{U_i} = -g_m(R_D // r_{ds}) = -11.4$

$R_i = R_G = 1M\Omega$

$R_o = R_D = 12k\Omega$

3.11

解：作微变等效电路



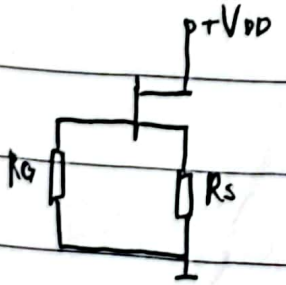
$g_m = 0.9mS$

$A_U = \frac{U_o}{U_i} = \frac{g_m R_S}{1 + g_m R_S} = 0.9$

$R_i = R_G = 1.1M\Omega$

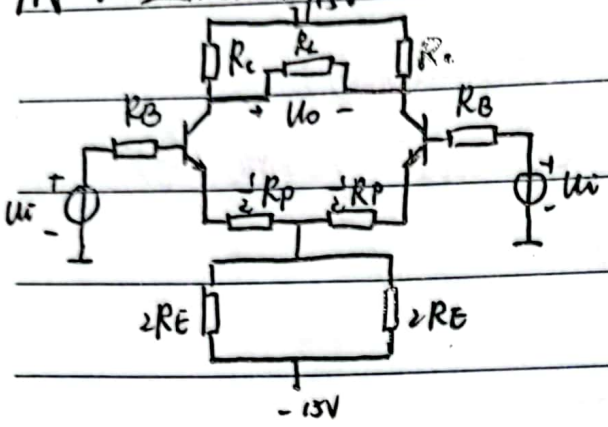
$R_o = R_S // \frac{1}{g_m} = 0.99k\Omega$

直流通路为



4.12.

解：(a) 直流分析



$$I_{EQ}=\frac{-V_{EE}-U_{BEQ}}{\frac{1}{2}R_P+2R_E}=1.4mA$$

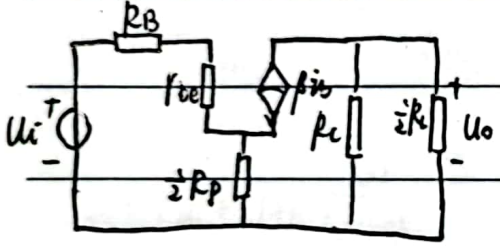
$$\therefore U_{CQ}\approx V_{CC}-I_{EQ}R_C$$

$$=7.9V$$

(b) 双端输出

$$r_{be}=r_{bb'}+(1+\beta)\frac{U_T}{I_{EQ}}=1.4k\Omega$$

差模信号作微变等效为

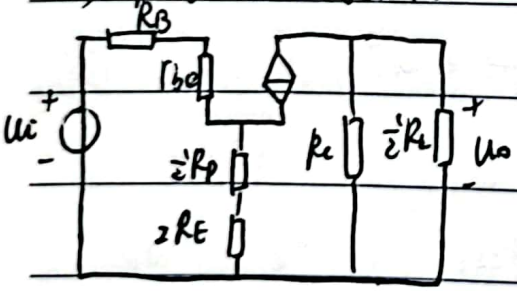


$$\dot{A}_{ud}=-\beta\frac{R_L'}{R_B+r_{bb'}+(1+\beta)\frac{1}{2}R_P}=-\beta\cdot\frac{R_C/\!/\frac{1}{2}R_L}{R_B+r_{be}+(1+\beta)\frac{1}{2}R_P}$$

$$=-50.9$$

输入电阻 $R_{id}=2\left(R_B+r_{be}+(1+\beta)\frac{1}{2}R_P\right)=10.9k\Omega$

共模信号作微变等效为



由于 R_L 两端电压在共模下时刻相同

$\therefore u_o=0$ $\quad \dot{A}_{uc}=0$

$$\therefore K_{CMR}=\left|\frac{\dot{A}_{ud}}{\dot{A}_{uc}}\right|=\infty$$

输入电阻 $R_B+r_{be}+(\frac{1}{2}R_P+2R_E)(1+\beta)=627.7k\Omega$

输出电阻 $R_O=2R_C=10.2k\Omega$

(c) 当 R_L 在射极和地之间变为单端输出

静态工作点不改变 $I_{EQ}=1.4mA$ $\quad U_{CQ}=7.9V$

相对动态部分负载变为 R_L $\quad \dot{A}_{ud}=-\frac{\beta}{2}\cdot\frac{R_C/\!/R_L}{R_B+r_{be}+(1+\beta)\frac{1}{2}R_P}=-26.7$

$$\dot{A}_{uc}=-\beta\cdot\frac{R_C/\!/R_L}{R_B+r_{be}+(1+\beta)(\frac{1}{2}R_P+2R_E)}=-0.47$$

$K_{CMR} = \left|\frac{A_{ud}}{A_{uc}}\right| = 56.6$

输入电阻：差模 $R_{id} = 2(R_B + r_{bc} + (1+\beta)\frac{1}{2}R_p) = 14.9k\Omega$

共模 $R_{ic} = 627.7k\Omega$

输出电阻：$R_O = R_C = 5.1k\Omega$

4.20

解：微压降处于反偏且进入恒流状态，故电压为6V.

$$I_{E3} = \frac{U_Z - U_{BEQ}}{R_3} = 2.3mA$$

(a) $I_{C3} \approx I_{E3} = 2.3mA$ $\therefore I_{C1} = I_{C2} = \frac{1}{2}I_{C3} = 1.15mA$

$\therefore U_{CQ} = V_{CC} - I_{C1}R_C = 4.8V.$

(b) $r_{be} = r_{bb'} + (1+\beta)\frac{U_T}{I_{EQ}} = 1.45k\Omega$

差模信号 $A_{ud} = -\beta \cdot \frac{R_C}{R_B + r_{be}} = -126.5$

$R_{id} = 2(R_B + r_{be}) = 4.9k\Omega$

$R_{od} = 2R_C = 12.4k\Omega$