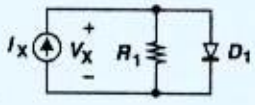
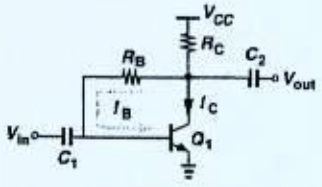
●不可使用電子計算機

1. (15%) Sketch V_x as a function of I_x for the following circuit. Assume a constant-voltage model. ($D_{on} = 0.8\ V$) ($I_S = 8 \times 10^{-16}$ A, $V_T = 26$ mV, $R_1 = 1\ K\Omega$). 15%



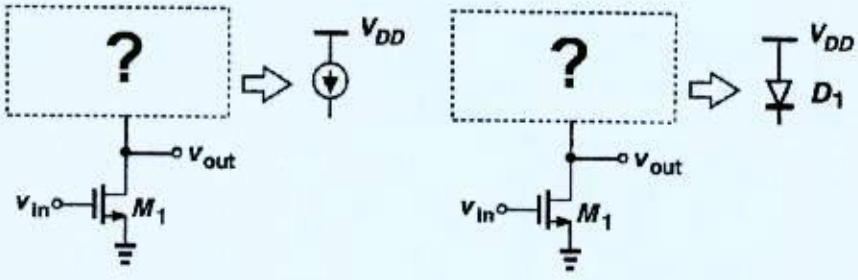
2. (20%) Design a self-biased common-emitter amplifier for votage gain $A_v = 36.5$. Assume $V_{CC} = 1.8\ V$, $I_C = 2\ mA$, $I_S = 5 \times 10^{-16}\ A$, $\beta = 100$, $V_A = \infty$ and blocking capacitors are large. (a) Determine the required value of R_C and R_b. (b) Calculate the V_{CE}, V_{BE} and I_B. (c) Plot the small signal equivalent circuit that neglects R_B. (Hint. $V_{BE} = V_T \ln(I_C / I_S)$ and $V_T = 26\ mV$) 20%



註 1：ln(2)=0.693

註 2：三小題配分，分別為 (a)7%；(b)7%；(c)6%

3. (15%) Plot the schematic circuit of a NMOS common-source amplifier with (a) current-source load that usesPMOS device and (b) diode-connected load that uses NMOS device. These are CMOS CS amplifiers and explain the advantages of these circuits. 15% 註：(a)8%；(b)7%。



4. (20%) The CMOS operational amplifier shown in Fig. 1 has the following device geometries (in μm).

Transistor	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8
W/L	20/0.8	20/0.8	5/0.8	5/0.8	40/0.8	10/0.8	40/0.8	40/0.8

Assume $I_{REF} = 90\mu A$, $V_{tn} = 0.7V$, $V_{tp} = -0.8V$, $\mu_n C_{ox} = 160\mu A/V^2$, $\mu_p C_{ox} = 40\mu A/V^2$, $V_{DD} = V_{SS} = 2.5V$, $|V_A| = 10V$ for all devices. Find I_D, $|V_{OV}|$, g_m and r_o for all devices (12%). Also find the open-loop voltage gain in dB scale (8%).

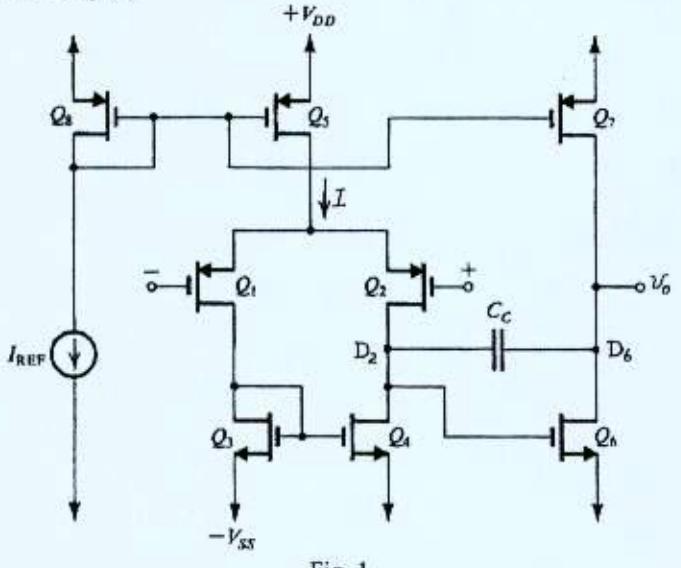


Fig. 1

5. (10%) Sketch Bode plots for the magnitude and phase of the transfer function

$$T(s) = \frac{10^2(1+s/10^5)}{(1+s/10^3)(1+s/10^4)}$$

Determine the approximated values for magnitude and phase at $\omega = 10^6$ rad/s. (10%)

6. (30%) A shunt-shunt feedback amplifier is shown in Fig. 2, where the parameters are given as follows: R_s = 1K, R_{id} = 10K, R_{os} = 10Ω, A_v = −10000, R_f = 10K, and R_L = 10K. (a) Find the basic amplifier gain A and the feedback factor β. (10%) (b) Find the feedback gain A_f and the voltage gain V_o/V_s. (10%)

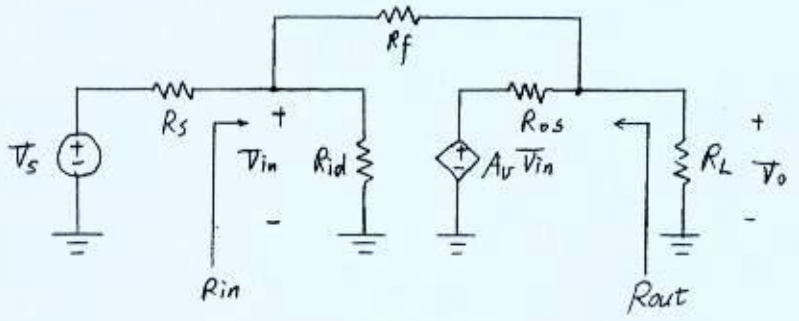


Fig. 2