

Principles of Electronics Design 521431A
 Exam 02/01/2008

1. Find the input and output impedance of the MOSFET amplifier shown in figure 1? Find the gain u_L/u_{src} . Which load resistance would cause 1 V/V gain? Transistor parameters: $\mu_n C_{ox} = 25 \text{ uA/V}^2$, $\lambda = 0$, $W/L = 50$ and $U_t = 2 \text{ V}$. Capacitors C_1 , C_2 and C_3 are large coupling capacitors. (6p)

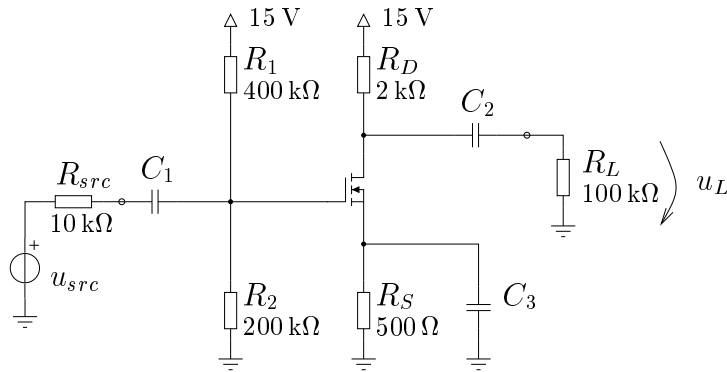


Figure 1: Figure for question 1.

$$i_D = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (u_{GS} - U_t)^2 (1 + \lambda \cdot u_{DS})$$

$$g_m = \left. \frac{\partial i_D}{\partial u_{GS}} \right|_{u_{GS}=U_{GS}} = \mu_n C_{ox} \frac{W}{L} (U_{GS} - U_t)$$

2. Assuming ideal operational amplifiers and $R_1 = 2 \text{ k}\Omega$, $R_2 = 10 \text{ k}\Omega$, $R_3 = 2 \text{ k}\Omega$, $R_4 = 6 \text{ k}\Omega$. Find
- the input resistance and gain u_o/u_i of circuit in Fig. 2 (a). (2p)
 - the input resistance and gain u_o/u_i of circuit in Fig. 2 (b). (2p)
 - the output voltage u_o as a function of input voltages u_{i1} and u_{i2} in circuit Fig. 2 (c). (2p)

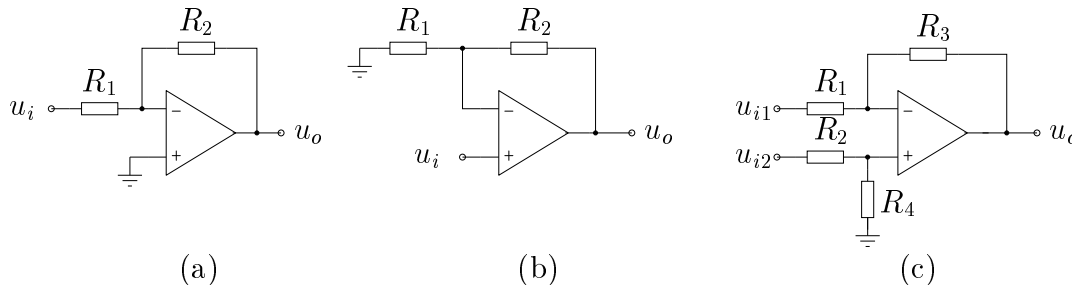


Figure 2: Figure for question 2.

3. (a) Calculate I_C and U_{CE} in the circuit in Fig. 3. Recalculate, if $\beta = 300$. (2p)
- (b) Show the two small signal models for bipolar transistor and use either of them to calculate the input impedance and gain of the circuit presented in Fig. 3 ($\beta = 100$). (2p)
- (c) How would you change the circuit in Fig. 3 in order to improve the stability of the circuit (so that the circuit is still a one bjt amplifier)? (2p)

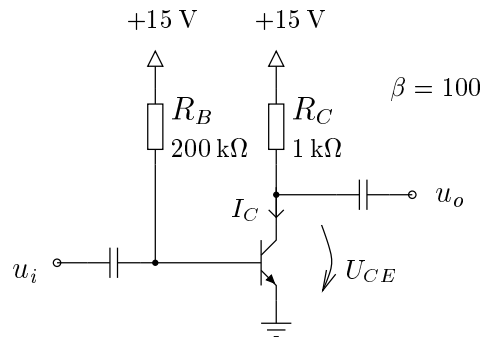


Figure 3: Figure for question 3.

4. (a) Describe the operation of the circuit presented in Fig. 4 and the purpose of the circuit. (2p)
- (b) What does mean the dynamic power consumption of the CMOS inverter (in other words, where is the power used, when the CMOS inverter changes its state)? (2p)
- (c) Draw the schematic of a flash-A/D- converter and describe it's good and bad properties. (2 p.)

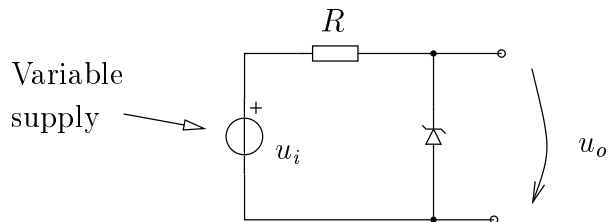


Figure 4: Figure for question 4.