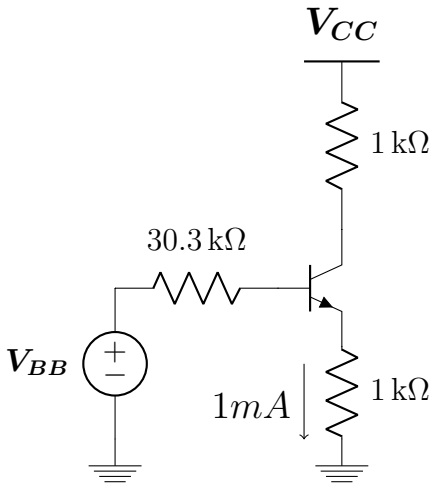
Assignment 8

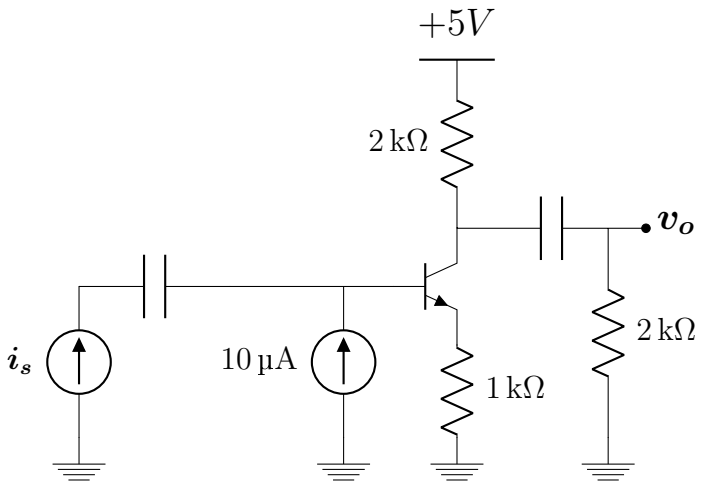
ESC 201

Basic

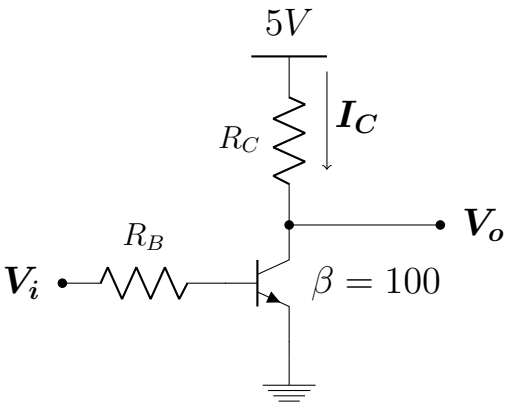
1. Determine the value of voltage V_{BB} so that dc emitter current is 1mA. Determine also the minimum supply voltage V_{CC} necessary so that transistor operates in forward active mode. Assume that current gain $\beta_F = 100$.



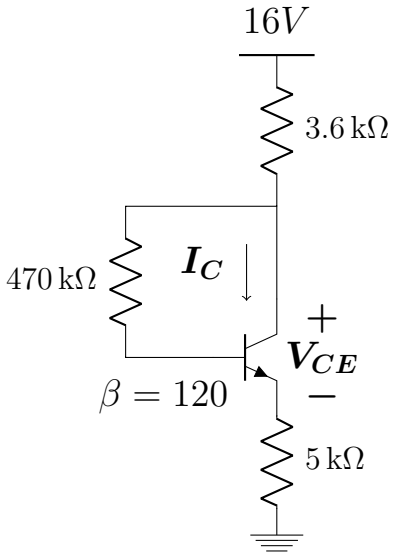
2. For the circuit shown below, carry out ac analysis to determine the ratio $\boldsymbol{v_o/i_s}$, where $\boldsymbol{v_o}$ is ac output voltage and $\boldsymbol{i_s}$ is ac sinusoidal current. Assume that transistor is biased in forward active mode and current gain $\beta_F = 100$.



3. Determine R_B and R_C such that the transistor is in saturation with $I_C = 2mA$ and $\beta_{\text{forced}} = 20$ when V_i=5V. Draw the voltage transfer characteristics (a plot of V_o vs V_i) with these resistances.

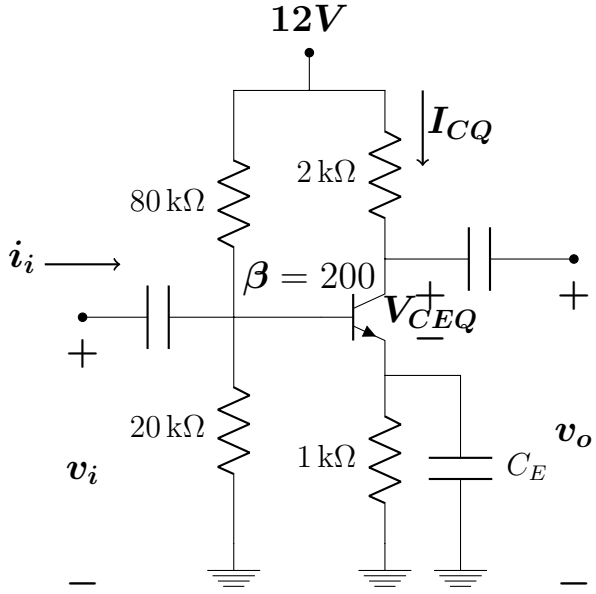


4. Determine I_C and V_{CE}.



Advanced

5. For the following common emitter amplifier circuit:

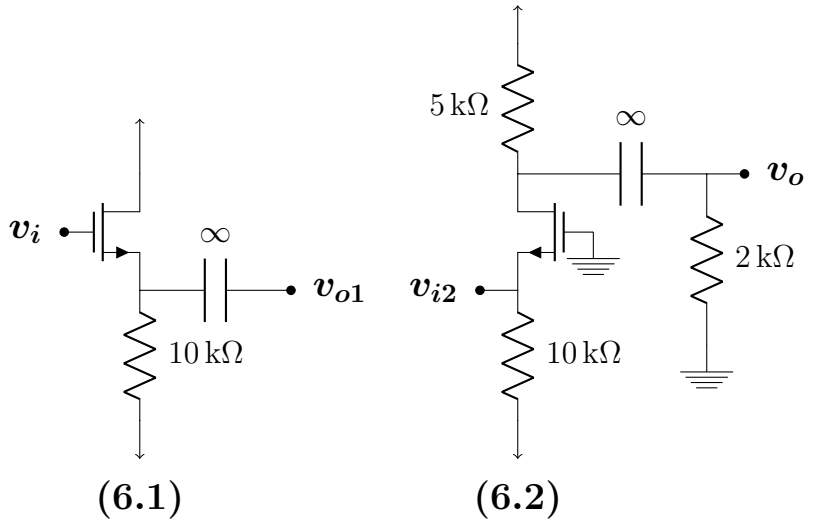


(a) Calculate V_{CEQ} and I_{CQ}.

(b) Calculate the small signal voltage gain $A_v = \frac{v_o}{v_i}$ and the input impedance $Z_i = \frac{v_i}{i_i}$.

(c) What will the small signal voltage gain and the input impedance be if C_E is removed from the circuit?

6. Consider the following circuits



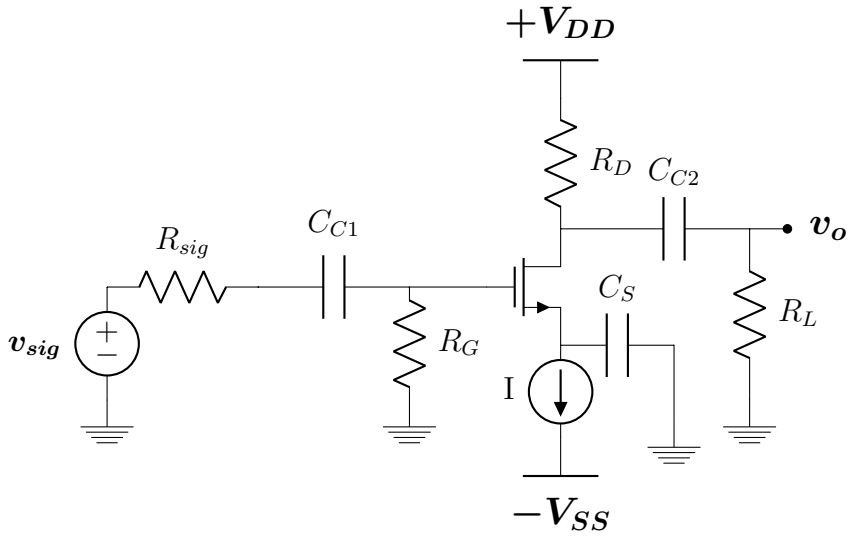
(6.1) **(6.2)**

(a) The NMOS transistor in the source follower circuit shown in Fig.(6.1) has $g_m = 5mA/V$ and a large r_o. Find the open-circuit voltage gain and the output resistance.

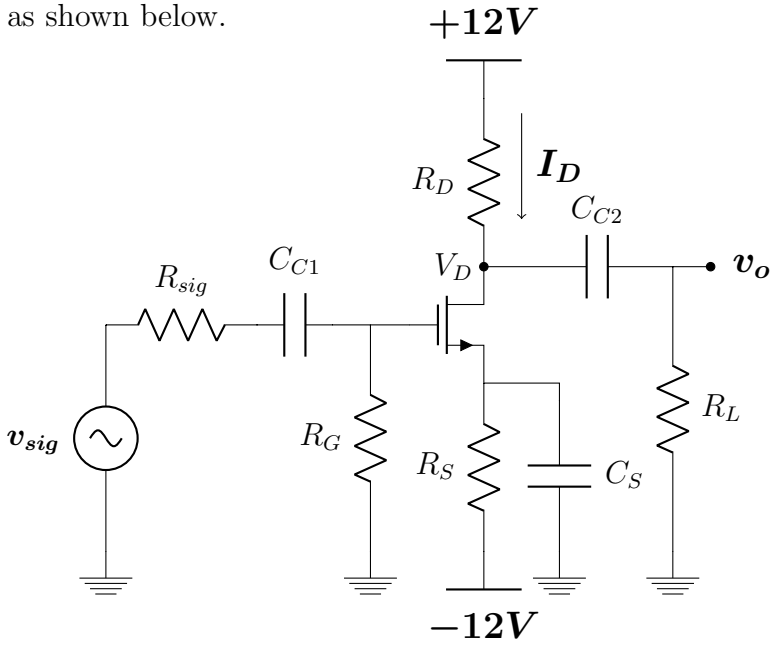
(b) The NMOS transistor in the common-gate amplifier shown in Fig.(6.2) has $g_m = 5mA/V$ and a large r_o. Find the input resistance and the voltage gain.

(c) If the output of the source follower in Fig.(6.1) is connected to the input of the common-gate amplifier in Fig.(6.2), use the results of (a) and (b) to obtain the overall voltage gain $\frac{v_o}{v_i}$.

7. Calculate the overall volatge gain $G_v = \boldsymbol{v_o/v_{sig}}$ of a common source amplifier, shown in below, which has $g_m = 2mA/V$, $r_o = 50k\Omega$, $R_D = 10k\Omega$, $R_G = 10M\Omega$. The amplifier is fed from a signal source with a resistance, R_{sig} of $0.5k\Omega$ and amplifier output is coupled to a load resistance, R_L of $20k\Omega$.



8. The common source amplifier is designed using MOSFET [$V_t = 1V$, $k_n'W/L = 0.8\ mA/V^2$ and $V_A = 50V$] as shown below.



(a) For the MOSFET to operate in saturation region, it is biased such that drain current $I_D = 0.1\ mA$ and drain voltage $V_D = 0.5V$. Determine the values of R_D and R_S.

(b) Determine the values of g_m and r_o at the bias point [$g_m = \frac{2I_D}{V_{GS}-V_t}$, $r_o = \frac{V_A}{I_D}$].

(c) Given $R_{sig} = 1\ M\Omega$, $R_G = 9\ M\Omega$ and $R_L = 85\ k\Omega$, determine the voltage gain from signal source to load ($G_v = \boldsymbol{v_o/v_{sig}}$).

(d) What should be the maximum amplitude of input signal $\boldsymbol{v_{sig}}$ so that the MOSFET always operates in saturation region ?

(e) What happens to the output voltage $\boldsymbol{v_o}$ of the amplifier if amplitude of the input signal $\boldsymbol{v_{sig}}$ is larger than the value calculated in part (d).