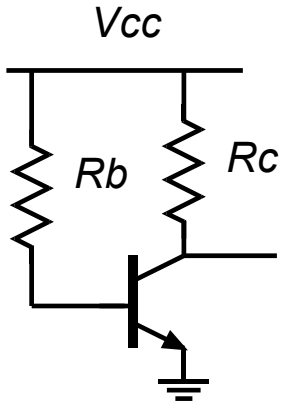
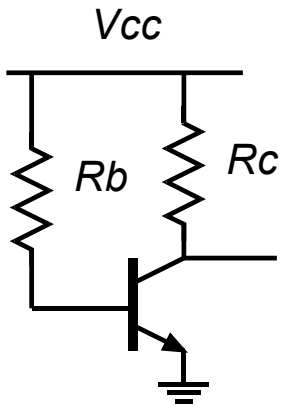
ECE137A Problem set #1

Problem 1. bipolar transistor biasing. Assume a Vbe(on) of 0.7 volts.



a)
beta=75
Vcc=15 volts
We want 0.5mA collector current,
and Vce=3 Volts
Find Rc and Rb

(this biasing circuit *not* recommended)

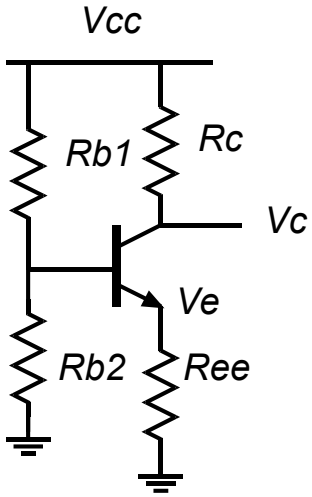


b) Bias stability of the circuit of problem 1(a).

First, keeping the same values for Rb and Rc you found above, compute the collector current and the collector voltage if beta is increased to 200.

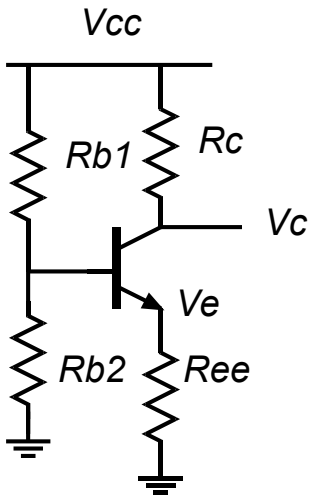
Second, keeping the same values for Rb and Rc you found above, compute collector current and the collector voltage if beta is returned back to its original value but Vcc is increased 10%.

Caution: You *must* consider the possibility of saturation.



c)
beta=75
Vcc=15 volts
collector current =0.5 mA
Collector voltage Vc=2 Volts
Emitter voltage Ve=0.5 volts
current in Rb2=100 microamps

Find Rb1, Rb2, Ree, Rc



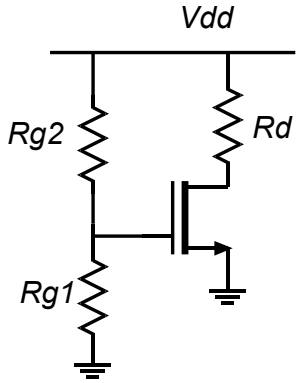
d) Bias stability of the circuit of problem 1(c).

First, keeping the same values for Rb1, Rb2, Ree and Rc you found above, compute the collector current and the collector voltage if beta is increased by a factor of two.

Second, keeping the same values for Rb1, Rb2, Ree and Rc you found above, compute the collector current and the collector voltage if beta is returned back to its original value but Vcc is increased 10%.

Caution: You *must* consider the possibility of saturation.

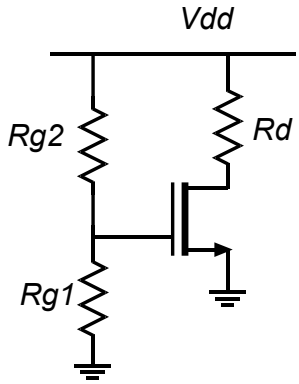
Problem 2 MOS Biasing:



a)

The MOSFET has a 0.3V threshold,
$K_\mu = \mu c_{gs} W_g / 2L_g = 10\text{mA/V}^2 \cdot (W_g / 1\mu\text{m})$,
$K_v = c_{gs} v_{inj} W_g = 2.0\text{mA/V} \cdot (W_g / 1\mu\text{m})$
$\Delta V = v_{inj} L_g / \mu = 100\text{mV}$, and
W_g =1 μm. Rg1 is 100 kOhms. Vdd is 1.0 Volts.
lambda=0. We would like to bias the MOSFET at 0.5 mA drain current and 0.5 volts between drain and source.

Please find the required values of Rg2 and Rd.



b) Bias stability of the circuit of problem 2(a).

First, keeping the same values for Rg1, Rg2, and Rd you found above, compute the drain current and the drain voltage if K_μ and K_v are both increased 10%.

Second, using the original value of K_μ and K_v, and keeping the same values for Rg1, Rg2, and Rd you found in 2(a), compute the drain current and the drain voltage if the power supply voltage is increased 10%.