6.301 Solid State Circuits

Problem 1: Saturation

Determine the DC Operating voltage V_1 at which Q_1 saturates and V_2 at which M_1 enters the triode regime.
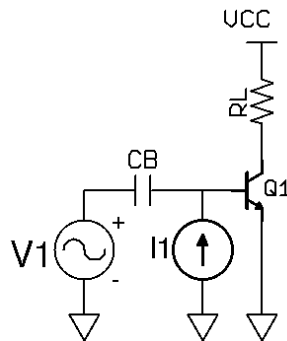
Your answer should be in terms of transistor parameters (I_S, $V_{CE,sat}$, β_0, etc).
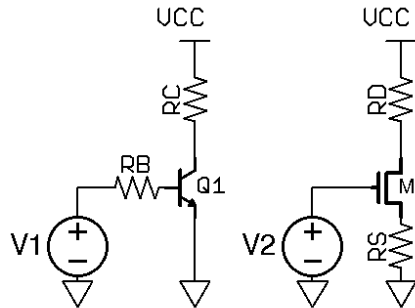
Problem 2: Small-signal Parameters

Calculate the small-signal transistor parameters g_m, r_π, and r_o in the following circuit.

Assume $V_A = 60v$ and $\beta_0 = 200$.

(a) $I_1 = .5\mu A$

(b) $I_1 = 50\mu A$

(c) Draw the small signal model

(d) How does the bias current $I1$ affect output impedance?

(e) How does the bias current $I1$ affect input impedance?

Problem 3: Extracting Parameters from Datasheets

Extract r_π, β_0, r_μ, r_o, c_μ, and c_π from the 2N2222 datasheet posted on stellar.

Problem 4: Finding τ_F

In many cases, datasheets will not provide enough information to extract every transistor parameter. Using the 2N3866 datasheet posted on stellar, determine an upper bound on τ_F. Briefly explain all assumptions that you make and define τ_F and f_T.