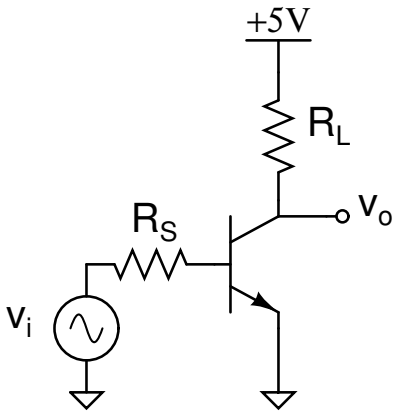
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.301 Solid State Circuits

Fall Term 2010 — Issued : Sept. 9, 2010, 2010
Problem Set 2 — Due : Friday, Sept. 17, 2010

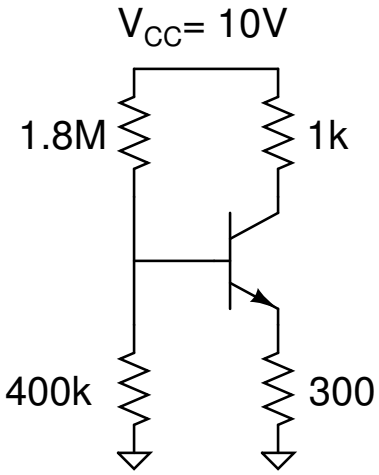
Problem 1: For the common-emitter amplifier shown below:



(a) Find the small signal voltage gain v_o/v_i as a function of R_S, R_L, β, V_A, and collector current I_C. Do not ignore r_o in this problem.

(b) Determine the value of DC collector bias current I_C that maximizes the small signal voltage gain. What is the voltage gain at the optimum I_C? Explain qualitatively why the gain falls at very high and very low collector currents.

Problem 2: Consider the following transistor circuit.



(a) With $V_{BE} = 0.7$ V and $\beta = 400$, calculate the transistor operating point (find I_C and V_{CE}).

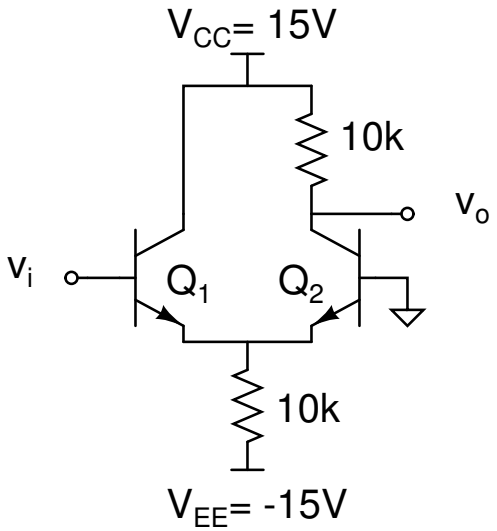
(b) Due to a manufacturing mix-up, some of your transistors have $\beta = 100$. Find I_C for the new transistors.

(c) Find new values for the base-biasing resistors so that I_C only changes by 10% when β falls from 400 to 100.

(d) Refer again to the circuit in part (a). Due to temperature fluctuations in your operating enviroment, V_{BE} sometimes drops as low as 0.5V. Find I_C under this condition.

(e) How should the transistor be biased so that I_C only changes by 10% if V_{BE} falls from 0.7V to 0.5V?

Problem 3: A EFCB (emitter-follower common-base) connection is illustrated below. Determine the overall small signal voltage gain v_o/v_i, input resistance, and output resistance. You may neglect r_o for this problem.



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