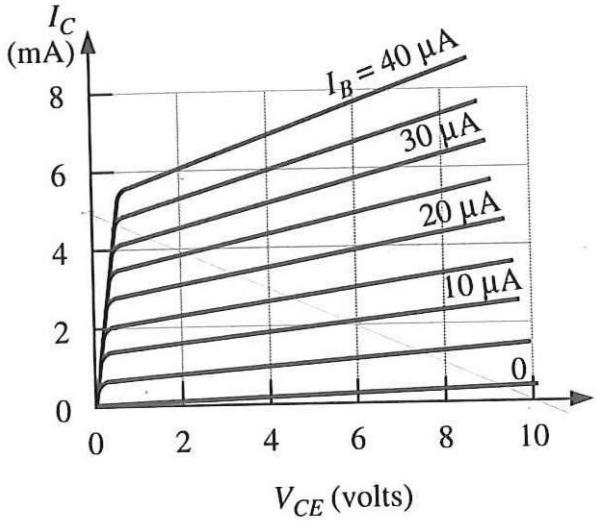
Physics 313 assignment 5 for Thursday, October 2, 2018:

Topics: transistors

Reading: my notes, supplementary info on transistors (see website)

General questions

1. For the transistor whose characteristic curves are shown at right,
a) Roughly what is the value of β (or $h_{FE}$) at $V_{CE}$ of 4 volts, say.
b) If the power rating of the transistor $P_{max}$ is 0.05 W, is there any region of the curves shown for which $P_{max}$ would be exceeded? (Power dissipated by a BJT ~ $V_{CE}I_C$.) Explain. Also, shade in roughly the region where $P_{max}$ is exceeded.




2. For the common-emitter amplifier,
i) Is there voltage gain (that is, is $v_{out}/v_{in}$ much different from 1)? If so, what does the gain depend on?
ii) If the voltage at the base rises by 0.1 V, what does the voltage at the emitter rise by?
iii) Is the output signal inverted with respect to the input signal?

3. For the emitter follower (a.k.a. common collector),
i) is there voltage gain (that is, is $v_{out}/v_{in}$ much different from 1)? If so, what does the gain depend on?
ii) If the voltage at the base rises by 0.1 V, what does the voltage at the emitter rise by?
iii) Is the output signal inverted with respect to the input signal?

Problems: (assume that all transistors are npn silicon, like the 2N3904)

4) This is an emitter follower with the base biased quiescently above ground so that a single supply can be used without clipping negative input signals.
a) Find the expected quiescent values of $V_B$, $V_E$, and $V_C$.
b) Find the expected quiescent values of $I_B$, $I_E$, and $I_C$ (hint: start with $I_E$ and assume β=100).
c) Check to make sure that the quiescent $I_B$ is small compared to the quiescent current through the 50k resistor. Why is it important to design the circuit so that this is the case?
d) For roughly what range of $V_{in}$ (+ and - ) is the output free from clipping?
e) Would you need the 45k and 50k resistors if you had a –15V power supply as well as a +15V supply available? Why?