University of Michigan
EECS 311: Electronic Circuits
Fall 2009

PROBLEM SET 6

Issued 10/21/2009
Due in Lecture 10/28/2009

J&B refers to the course text: "Microelectronic Circuit Design (3rd Edition)," by Richard Jaeger and Travis Blalock.

P6.1 For the circuit shown in Figure 1, derive expressions for, and find the values of V_{BE}, I_C and I_E, given $I_B = 10\mu A$, $\beta_F = 200$, and $I_S = 10^{-17}$. Ignore base-width modulation.

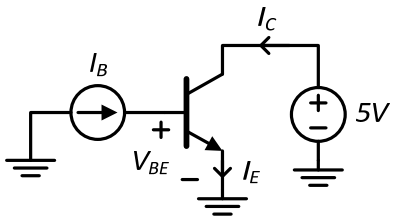

Figure 1.

P6.2 The current gain of a BJT from the emitter to the collector is given by $I_C/I_E \equiv \alpha_F$ when in the forward-active region, where $\alpha_F = \beta_F/(1+\beta_F)$. Use this to answer the following parts. Ignore base-width modulation.

a) Derive an expression for I_B/I_E in terms of only α_F.

b) We often approximate that $I_E \approx I_C$. Given that up to a 5% error is acceptable, we can use the approximation of $I_E \approx I_C$ by placing the following condition on α_F: $\alpha_F > 0.95$. What is the minimum value of β_F allowed that satisfies this condition? What is the minimum value of β_F if only a 1% error is acceptable?

P6.3 J&B Problem 5.2. Ignore base-width modulation.

P6.4 Find the values of base and collector currents I_B and I_C for the circuit shown in Figure 2, given that $\alpha_F = 0.995$. Ignore base-width modulation.

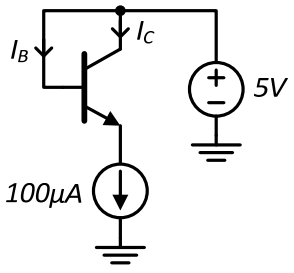

Figure 2.

P6.5 J&B Problem 5.72.

P6.6 J&B Problem 5.82. In J&B, "Q-point" refers to the quiescent, or DC bias point. Ignore base-width modulation.

P6.7 J&B Problem 5.85. In J&B, "Q-point" refers to the quiescent, or DC bias point. Assume $V_{BE,on} = 0.7V$. Ignore base-width modulation.

P6.8 J&B Problem 5.87, part (a) only. Assume $V_{BE,on} = 0.7V$. Ignore base-width modulation.