

Assignment 5

Due: 10:00pm, Thursday, April 2

Problem 6.3

6.3 In a particular technology, a small BJT operating at $v_{BE} = 30V_T$ conducts a collector current of $100 \mu\text{A}$. What is the corresponding saturation current? For a transistor in the same technology but with an emitter junction that is 32 times larger, what is the saturation current? What current will this transistor conduct at $v_{BE} = 30V_T$? What is the base-emitter voltage of the latter transistor at $i_C = 1 \text{ mA}$? Assume active-mode operation in all cases.

Problem 6.6

6.6 In this problem, we contrast two BJT integrated-circuit fabrication technologies: For the “old” technology, a typical *npn* transistor has $I_S = 2 \times 10^{-15} \text{ A}$, and for the “new” technology, a typical *npn* transistor has $I_S = 2 \times 10^{-18} \text{ A}$. These typical devices have vastly different junction areas and base widths. For our purpose here we wish to determine the v_{BE} required to establish a collector current of 0.5 mA in each of the two typical devices. Assume active-mode operation.

Problem 6.17

6.17 Using the *npn* transistor model of Fig. 6.5(b), consider the case of a transistor for which the base is connected to ground, the collector is connected to a 3-V dc source through a 2- $\text{k}\Omega$ resistor, and a 1-mA current source is connected to the emitter with the polarity so that current is drawn out of the emitter terminal. If $\beta = 100$ and $I_S = 5 \times 10^{-15} \text{ A}$, find the voltages at the emitter and the collector and calculate the base current.

Problem 6.30

6.30 A very simple circuit for measuring β of an *npn* transistor is shown in Fig. P6.30. In a particular design, V_{CC} is provided by a 3-V battery; M is a current meter with a 50- μ A full scale and relatively low resistance that you can neglect for our purposes here. Assuming that the transistor has $V_{BE} = 0.7$ V at $I_E = 1$ mA, what value of R_C would establish a resistor current of 1 mA? Now, to what value of β does a meter reading of full scale correspond? What is β if the meter reading is 1/5 of full scale? 1/10 of full scale?

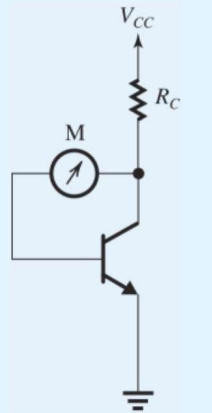


Figure P6.30

Problem 6.52

6.52 The transistor in the circuit of Fig. P6.51 has a very high β . Find the highest value of V_B for which the transistor still operates in the active mode. Also, find the value of V_B for which the transistor operates in saturation with a forced β of 3.

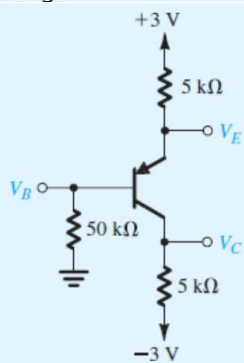


Figure P6.51

Problem 16.5

16.5 Find the PUN that corresponds to the PDN shown in Fig. P16.5, and hence the complete CMOS logic circuit. What is the Boolean function realized?

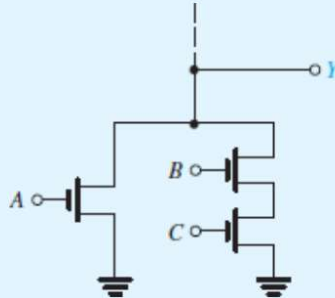


Figure P16.5

Problem 16.8

16.8 Give the CMOS realization for the Boolean function

$$Y = \overline{AB + CDE}$$