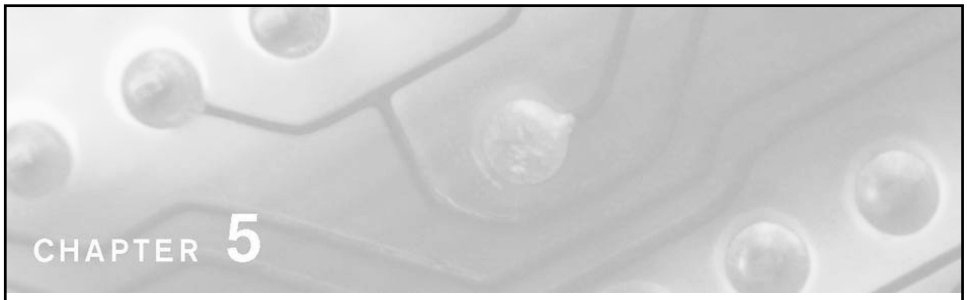
ECE321 Electronics I
Fall 2006

Professor James E. Morris

Lecture 12
2nd November, 2006



Bipolar Junction Transistors (BJTs)

5.3 Amplifiers & Switches (Basic circuits)
5.4 DC Circuits (Biasing)

2

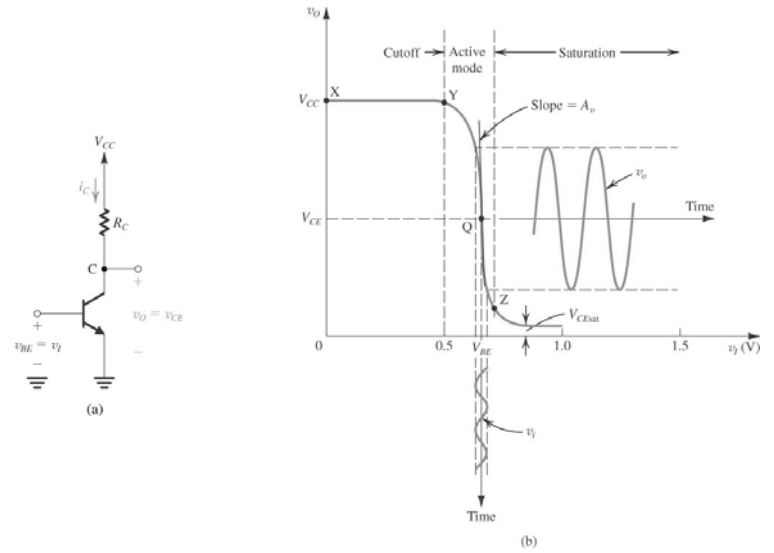


Figure 5.26 **(a)** Basic common-emitter amplifier circuit. **(b)** Transfer characteristic of the circuit in (a). The amplifier is biased at a point Q, and a small voltage signal v_i is superimposed on the dc bias voltage V_{BE}. The resulting output signal v_o appears superimposed on the dc collector voltage V_{CE}. The amplitude of v_o is larger than that of v_i by the voltage gain A_v.

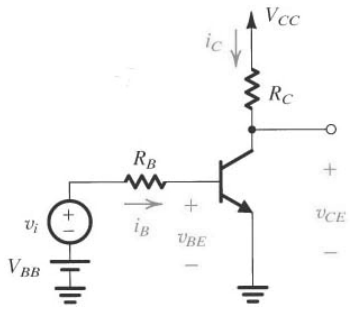


Figure 5.27 Circuit whose operation is to be analyzed graphically.

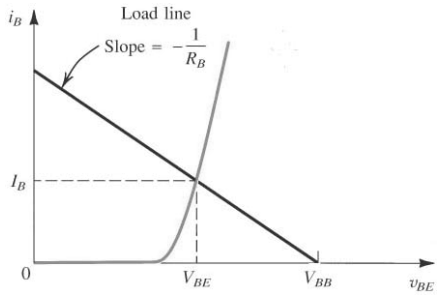


Figure 5.28 Graphical construction for the determination of the dc base current in the circuit of Fig. 5.27.

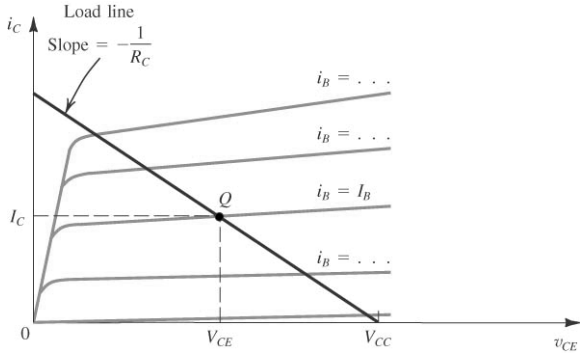


Figure 5.29 Graphical construction for determining the dc collector current I_C and the collector-to-emitter voltage V_{CE} in the circuit of Fig. 5.27.

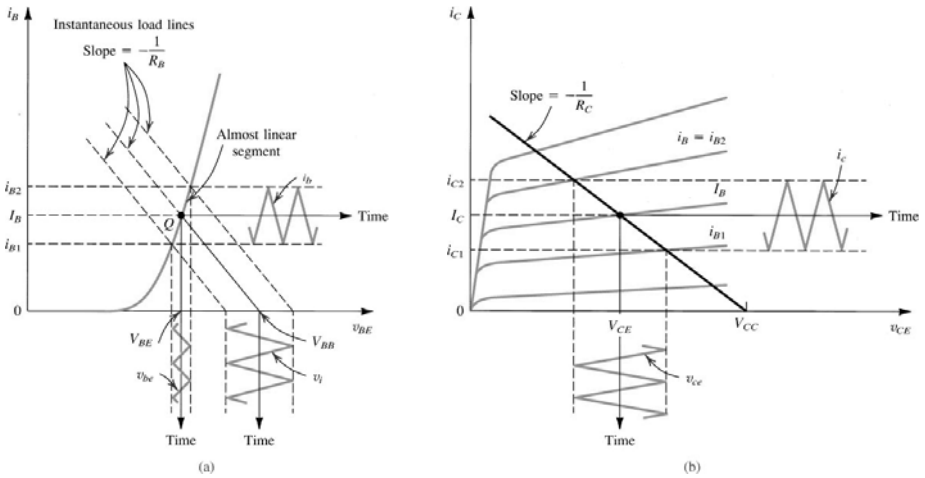


Figure 5.30 Graphical determination of the signal components v_{be}, i_b, i_c, and v_{ce} when a signal component v_i is superimposed on the dc voltage V_{BB} (see Fig. 5.27).

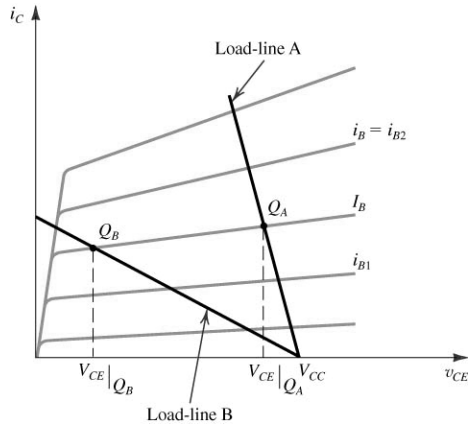


Figure 5.31 Effect of bias-point location on allowable signal swing: Load-line A results in bias point Q_A with a corresponding V_{CE} which is too close to V_{CC} and thus limits the positive swing of v_{CE}. At the other extreme, load-line B results in an operating point too close to the saturation region, thus limiting the negative swing of v_{CE}.

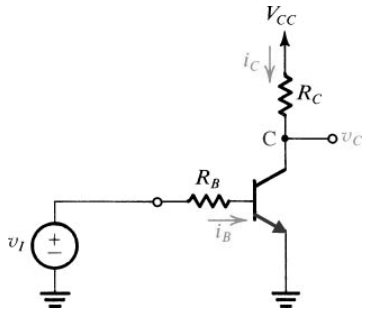


Figure 5.32 A simple circuit used to illustrate the different modes of operation of the BJT.

Fig. for Ex. D5.22

Find max V_{BB} for BJT active mode

α = 1

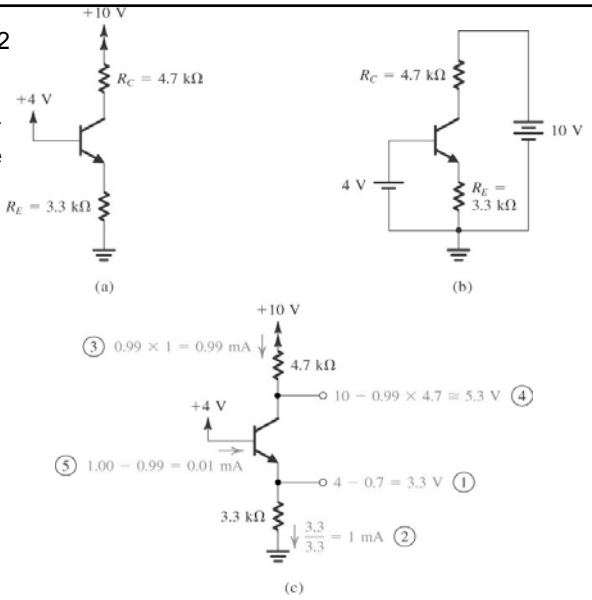


Figure 5.34 Analysis of the circuit for Example 5.4: **(a)** circuit; **(b)** circuit redrawn to remind the reader of the convention used in this book to show connections to the power supply; **(c)** analysis with the steps numbered.

Fig. for Ex. 5.24

Find V_B for saturation with $\beta_{forced} = 5$

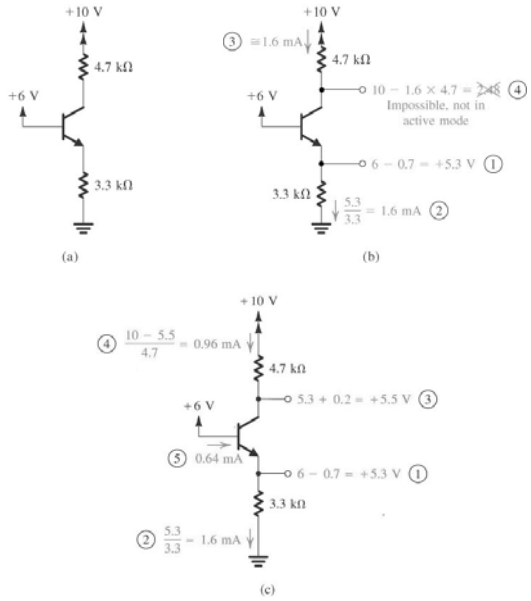


Figure 5.35 Analysis of the circuit for Example 5.5. Note that the circled numbers indicate the order of the analysis steps.

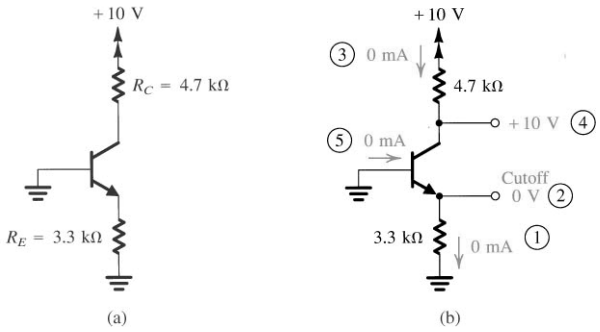


Figure 5.36 Example 5.6: **(a)** circuit; **(b)** analysis with the order of the analysis steps indicated by circled numbers.

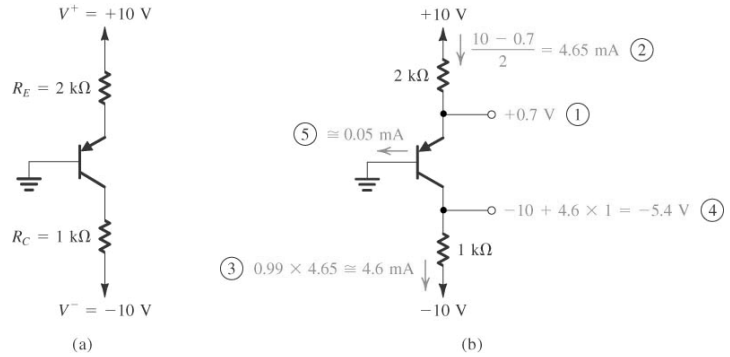


Figure 5.37 Example 5.7: **(a)** circuit; **(b)** analysis with the steps indicated by circled numbers.

Figure for Exercise D5.27: β = 50 to 150

Find R_C for all circuits in active mode.
Find V_C range for β = 50 to 150.

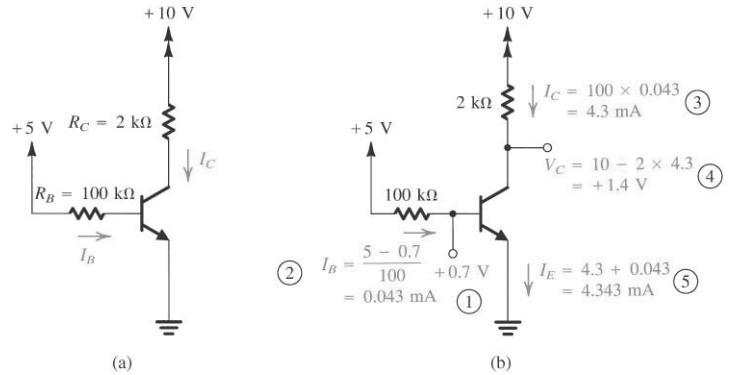


Figure 5.38 Example 5.8: **(a)** circuit; **(b)** analysis with the steps indicated by the circled numbers.

Fig. for Ex. 5.28

Example 5.10 calculates I_C=1.28mA for β=100

Recalculate for β=50

What is % change?

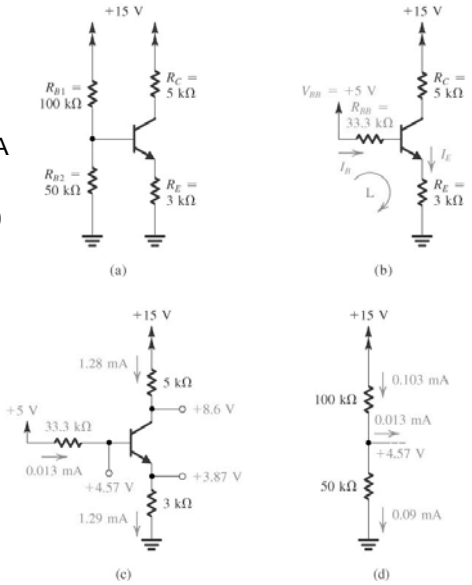


Figure 5.40 Circuits for Example 5.10.

Figure for Exercise 5.29: Find total current from power supply and power dissipation in the circuit. (See Example 5.11)

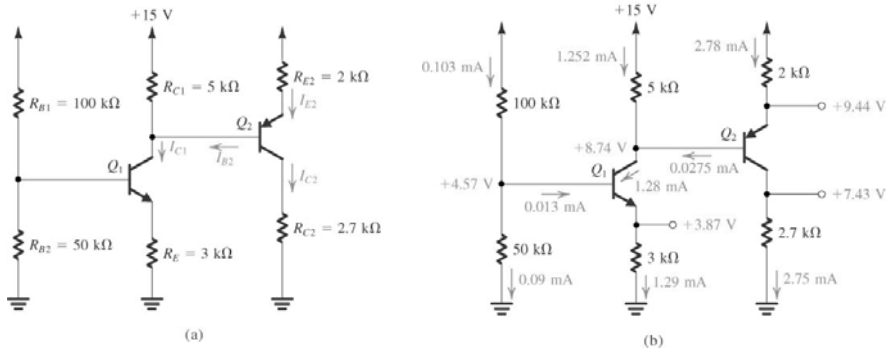


Figure 5.41 Circuits for Example 5.11.