

# **ECE321 ELECTRONICS I**

## **FALL 2006**

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Lecture 13  
9<sup>th</sup> November, 2006

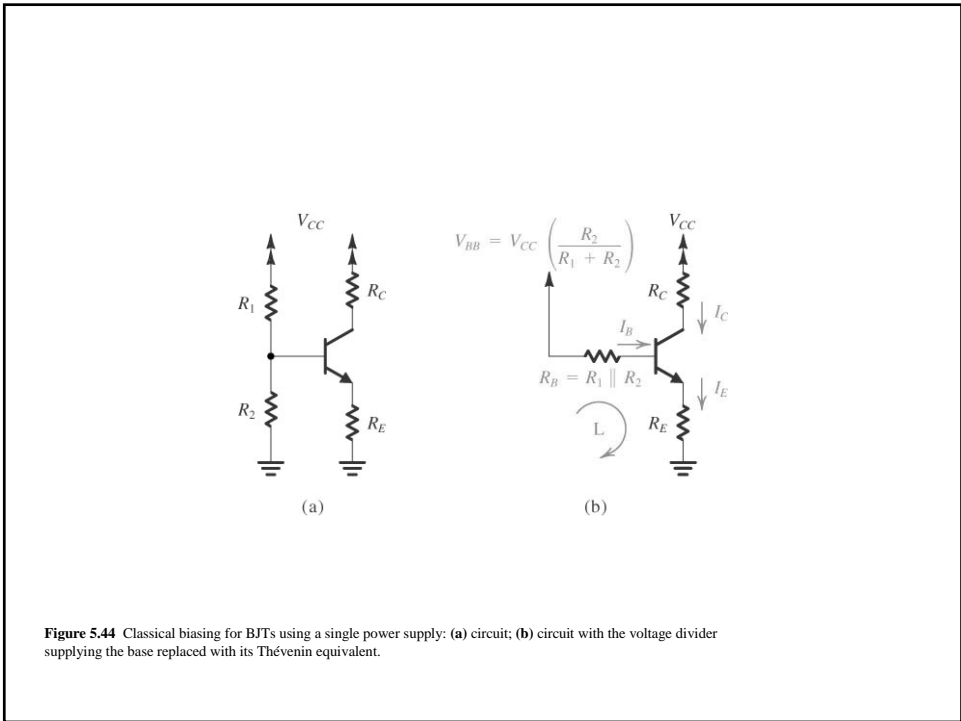
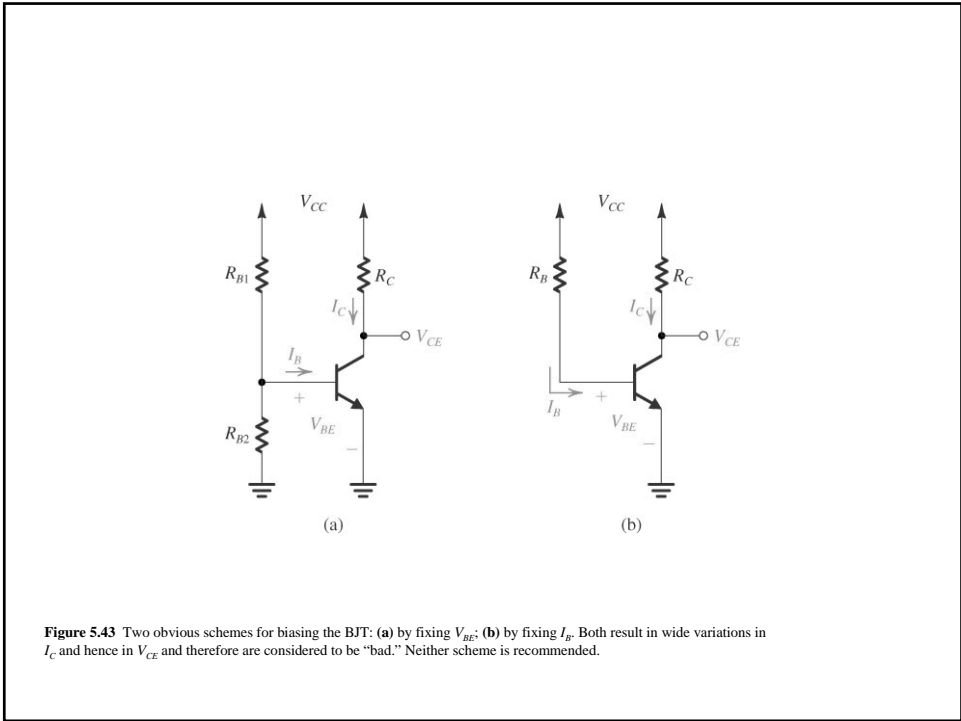


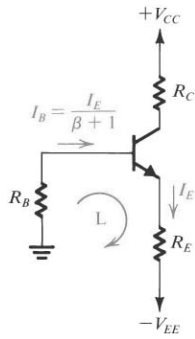
CHAPTER 5

## **Bipolar Junction Transistors (BJTs)**

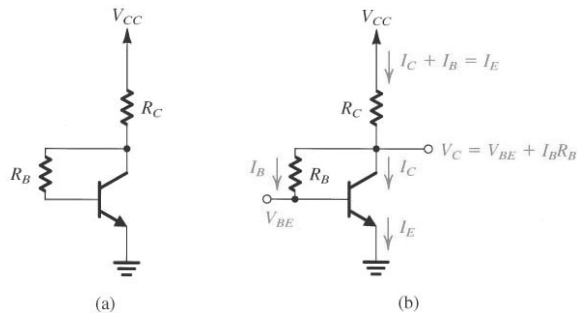
**5.5. Biasing** (DC analysis/design)

**5.6 Small Signal** (AC analysis/design)





**Figure 5.45** Biasing the BJT using two power supplies. Resistor  $R_B$  is needed only if the signal is to be capacitively coupled to the base. Otherwise, the base can be connected directly to ground, or to a grounded signal source, resulting in almost total  $\beta$ -independence of the bias current.



**Figure 5.46** (a) A common-emitter transistor amplifier biased by a feedback resistor  $R_B$ . (b) Analysis of the circuit in (a).

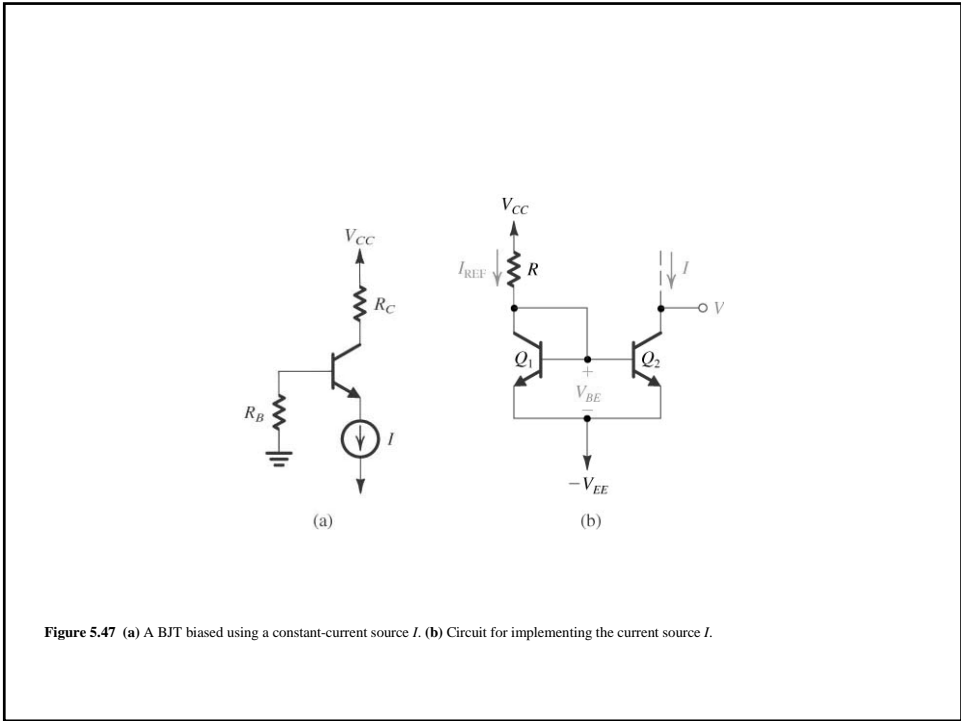


Figure 5.47 (a) A BJT biased using a constant-current source  $I$ . (b) Circuit for implementing the current source  $I$ .

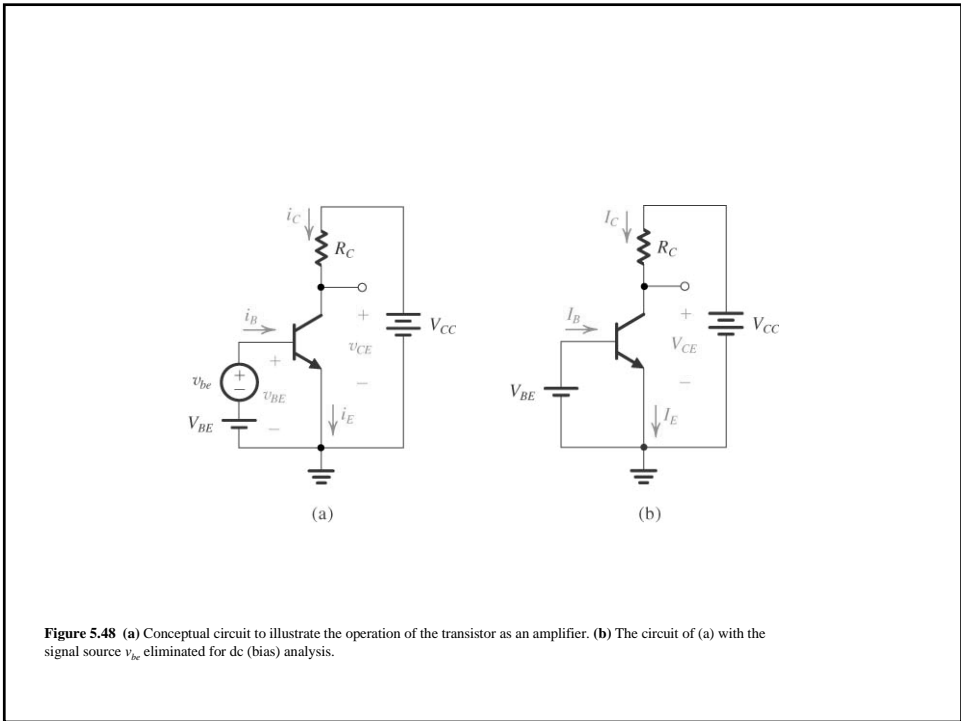
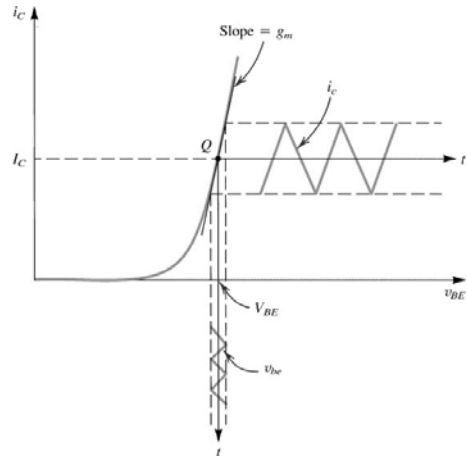
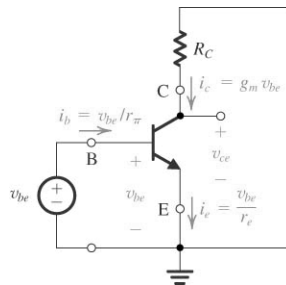


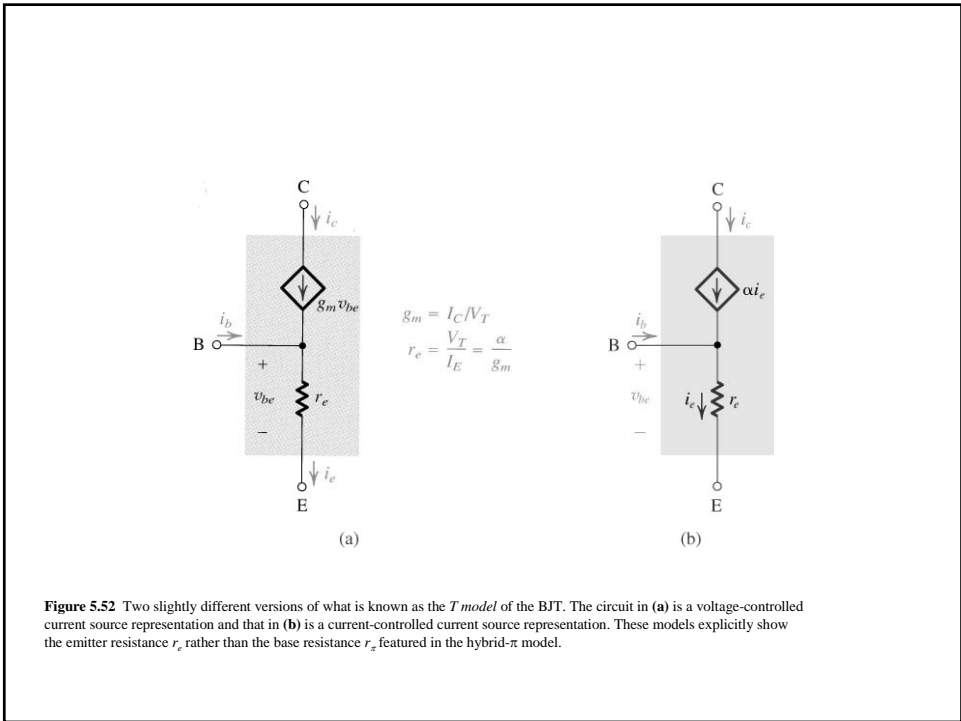
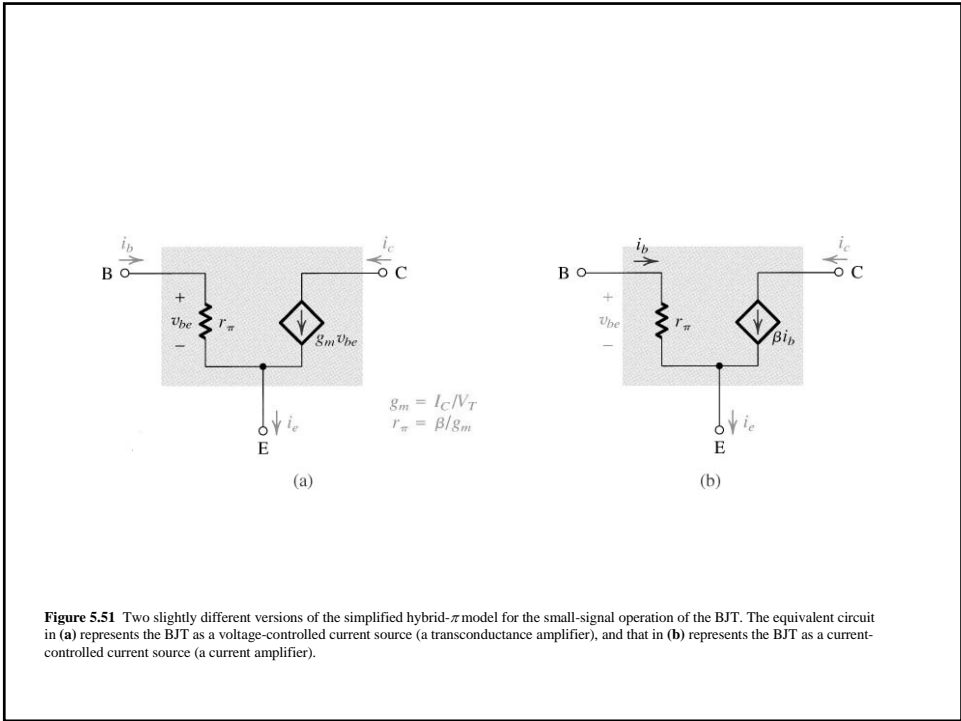
Figure 5.48 (a) Conceptual circuit to illustrate the operation of the transistor as an amplifier. (b) The circuit of (a) with the signal source  $v_{be}$  eliminated for dc (bias) analysis.

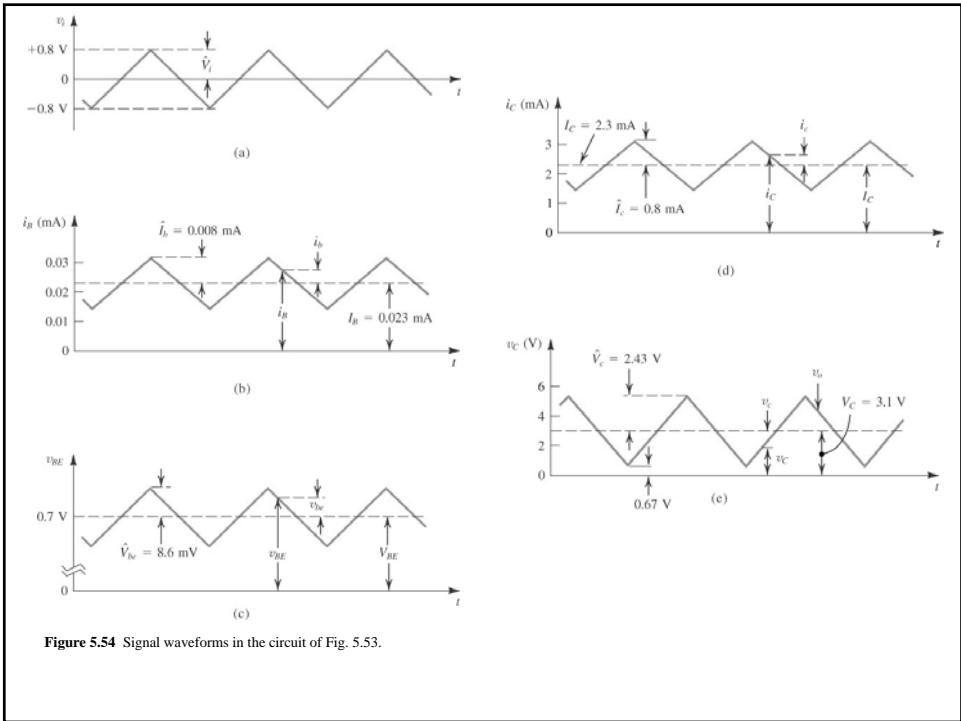
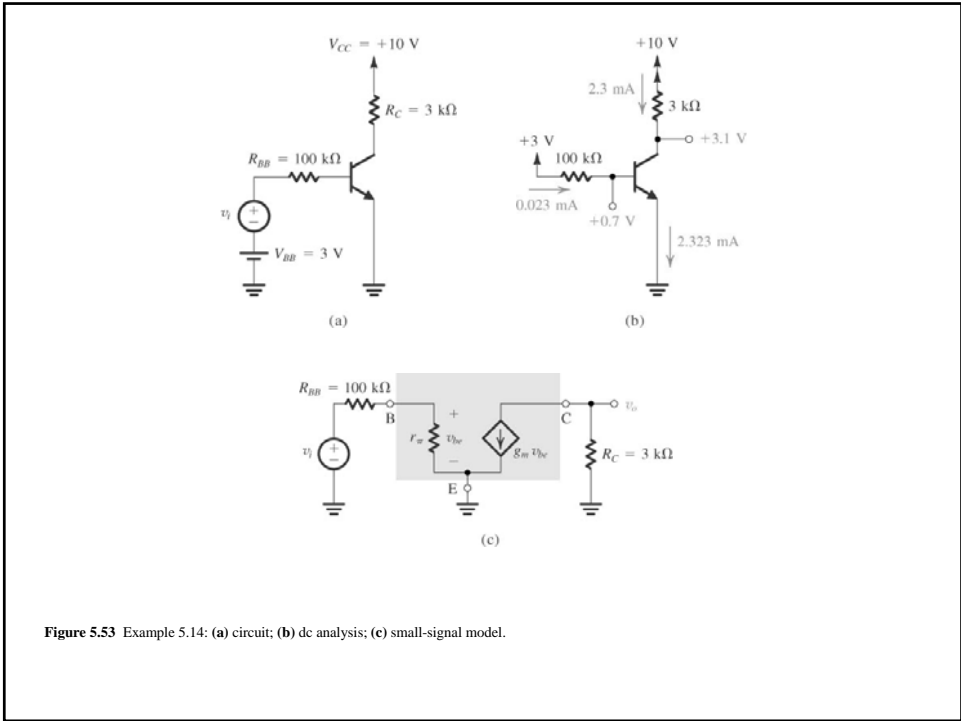


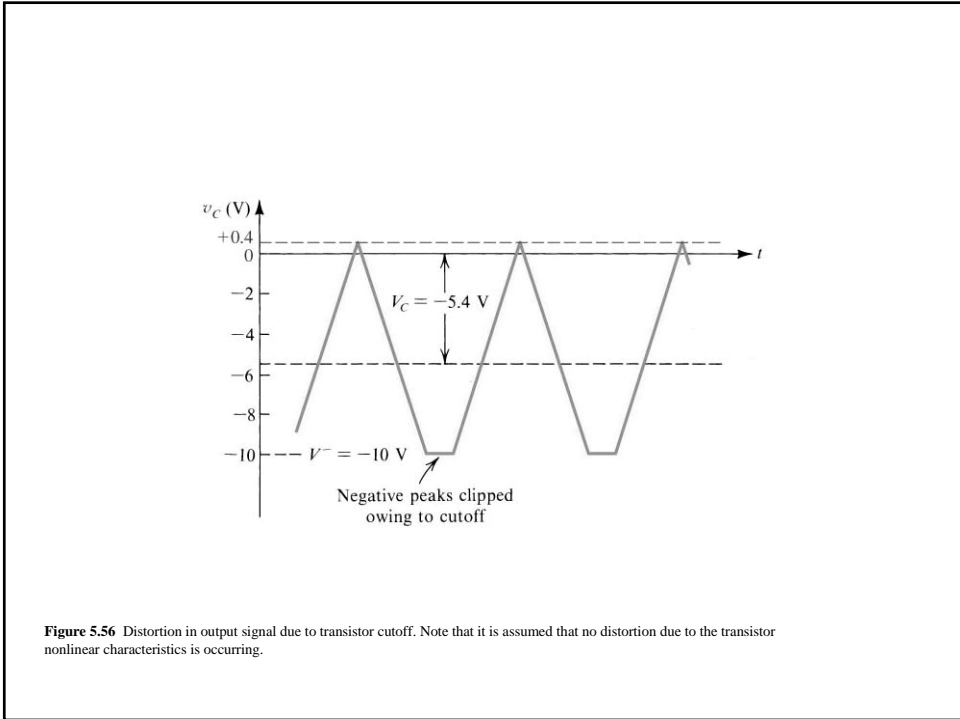
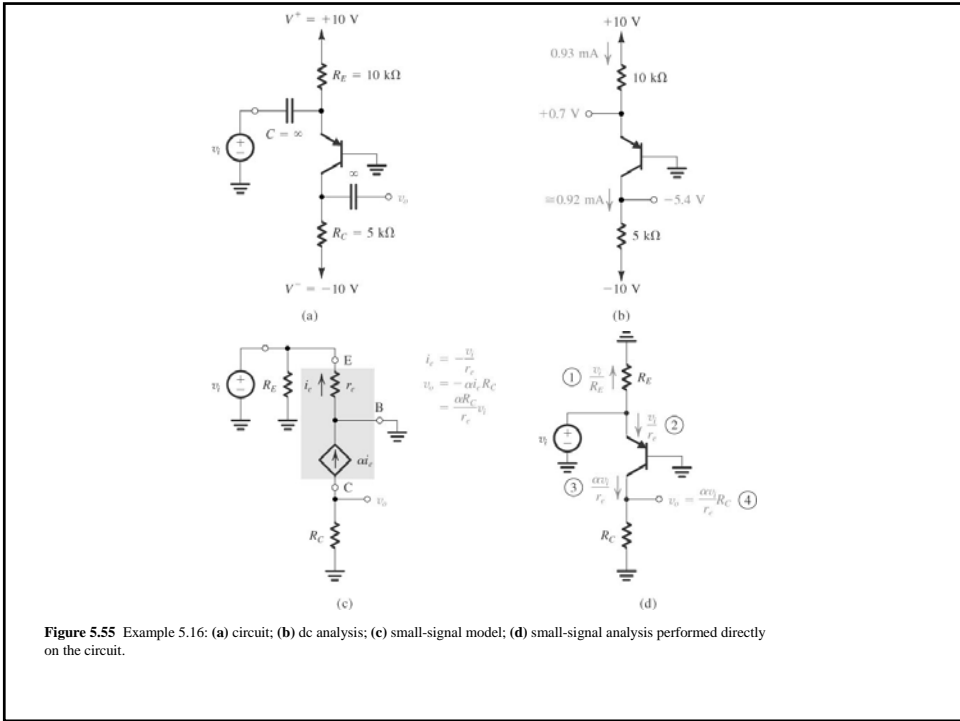
**Figure 5.49** Linear operation of the transistor under the small-signal condition: A small signal  $v_{be}$  with a triangular waveform is superimposed on the dc voltage  $V_{BE}$ . It gives rise to a collector signal current  $i_c$ , also of triangular waveform, superimposed on the dc current  $I_C$ . Here,  $i_c = g_m v_{be}$ , where  $g_m$  is the slope of the  $i_c$ - $v_{BE}$  curve at the bias point  $Q$ .



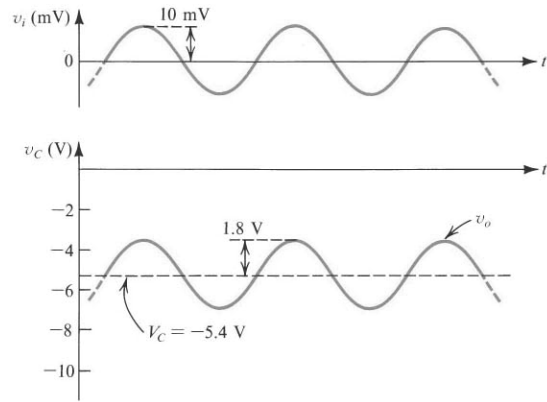
**Figure 5.50** The amplifier circuit of Fig. 5.48(a) with the dc sources ( $V_{BE}$  and  $V_{CE}$ ) eliminated (short circuited). Thus only the signal components are present. Note that this is a representation of the signal operation of the BJT and not an actual amplifier circuit.



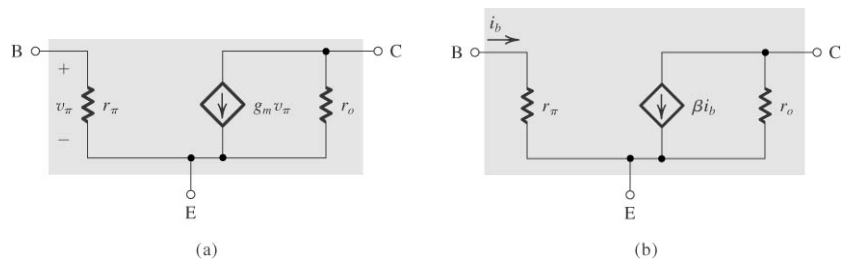








**Figure 5.57** Input and output waveforms for the circuit of Fig. 5.55. Observe that this amplifier is noninverting, a property of the common-base configuration.



**Figure 5.58** The hybrid- $\pi$  small-signal model, in its two versions, with the resistance  $r_e$  included.

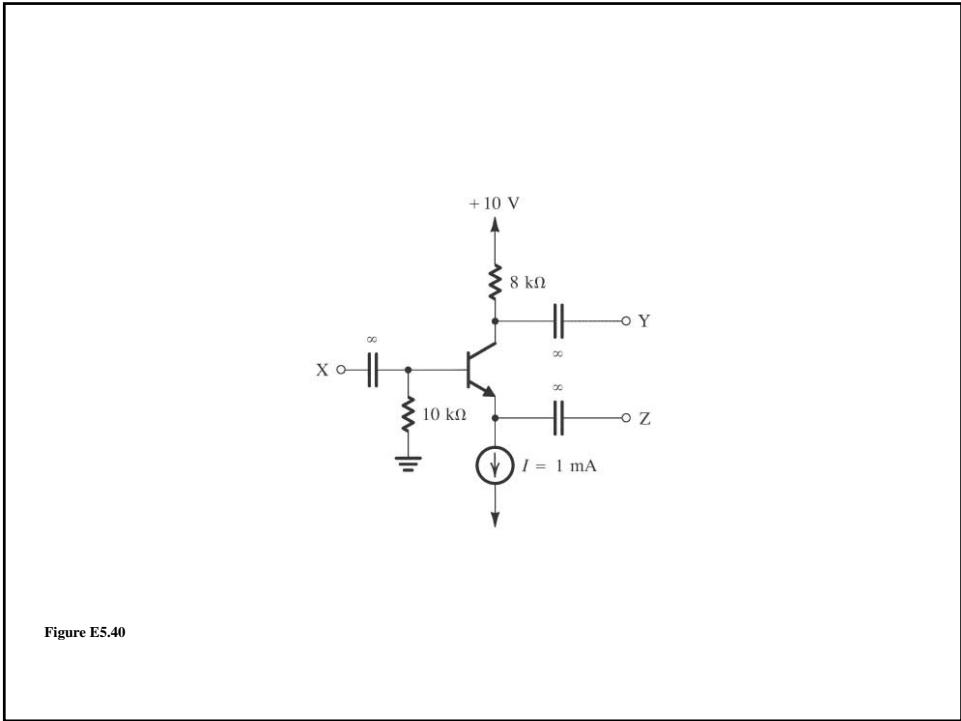


Figure E5.40

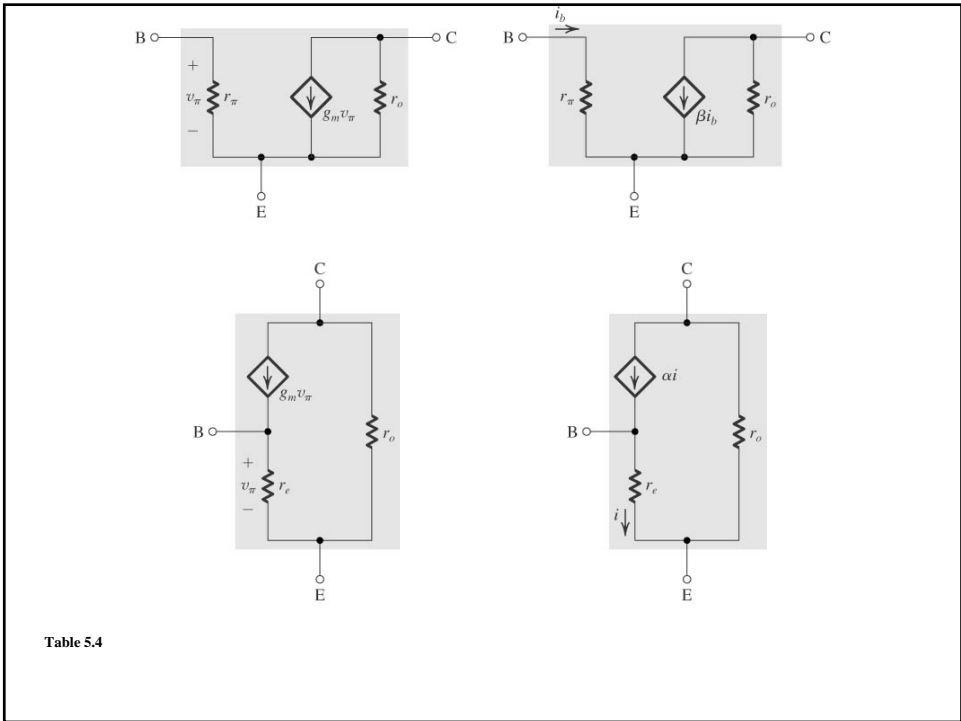


Table 5.4