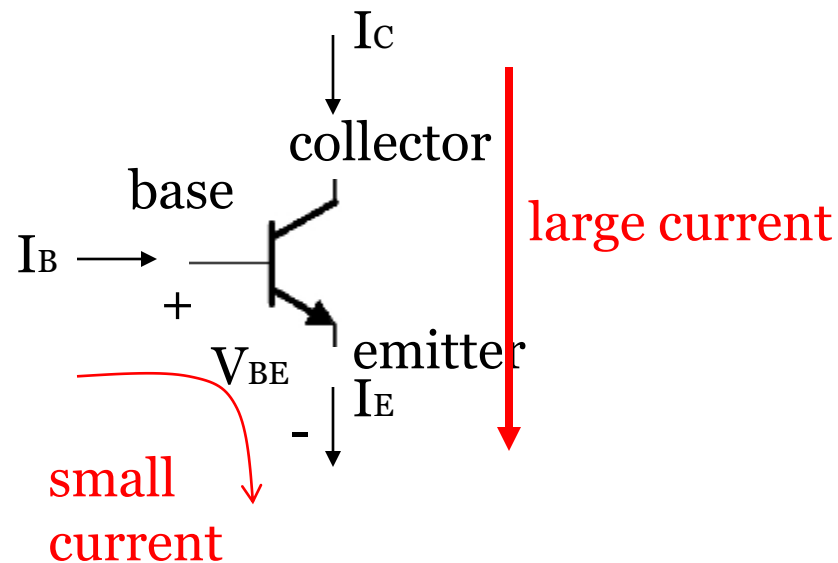# BJT transistors

Summary of DC problem

- Bias transistors so that they operate in the linear region B-E junction forward biased, C-E junction reversed biased

- Use $V_{BE} = 0.7$ (npn), $I_C \approx I_E$, $I_C = \beta I_B$

- Represent base portion of circuit by the Thevenin circuit

- Write B-E, and C-E voltage loops.

- For analysis, solve for I_C, and V_{CE}.

- For design, solve for resistor values (I_C and V_{CE} specified).

Summary of npn transistor behavior

npn

Transistor as an amplifier

•Transistor circuits are analyzed and designed in terms of DC and ac versions of the same circuit.

•An ac signal is usually superimposed on the DC circuit.

•The location of the operating point (values of I_C and V_{CE}) of the transistor affects the ac operation of the circuit.

•There are at least two ac parameters determined from DC quantities.

Small-signal equivalent circuit models

$$g_m = I_C/V_T$$
$$r_\pi = \beta/g_m$$
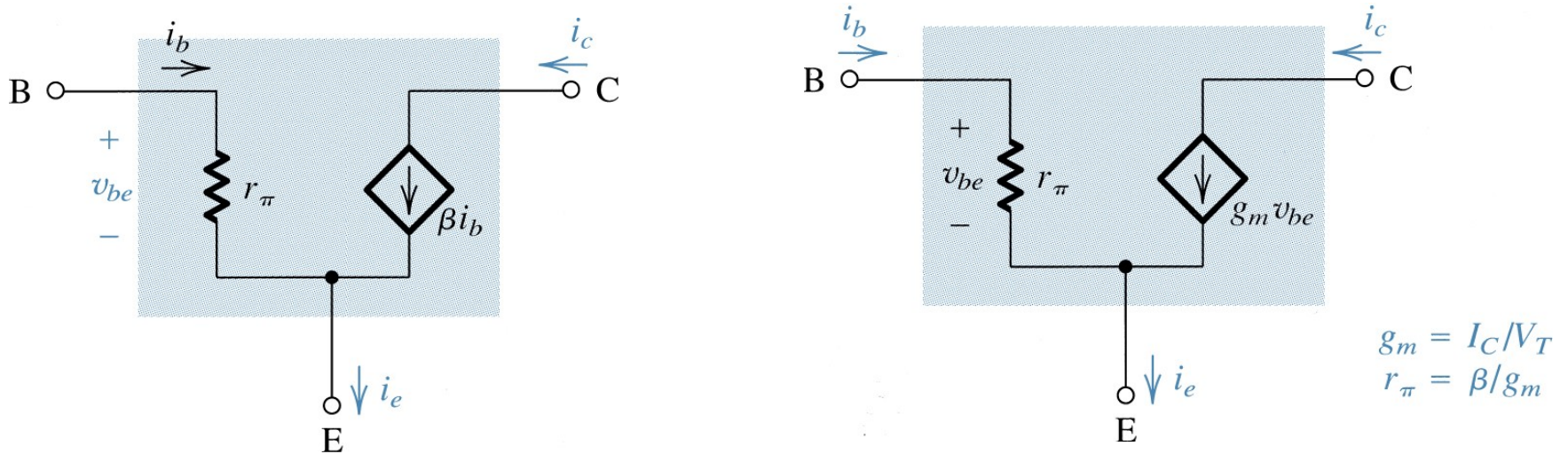
- ac model
- Hybrid-π model
- They are equivalent
- Works in linear region only

Steps to analyze a transistor circuit

1   DC problem
        Set ac sources to zero, solve for DC quantities, I_C and V_{CE}.

2   Determine ac quantities from DC parameters
        Find g_m, r_π, and r_e.

3   ac problem
        Set DC sources to zero, replace transistor by hybrid-π model, find ac quantites, Rin, Rout, Av, and Ai.