ECE 523/421 – Analog Electronics

Lecture 5: Basic BJT Amplifiers II

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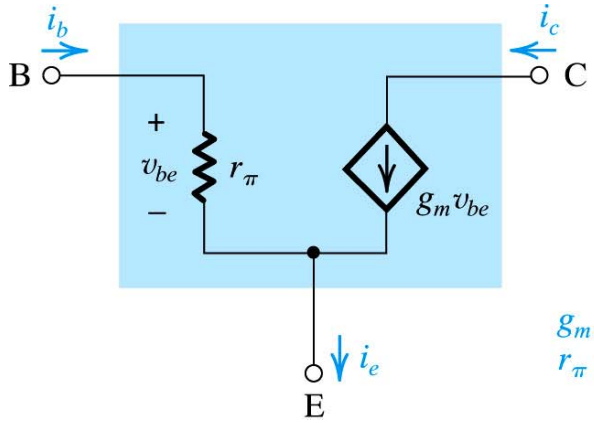
Review of Last Lecture

- **Basic BJT Characteristics**
- **DC analysis on BJT Circuits**

Today's Lecture

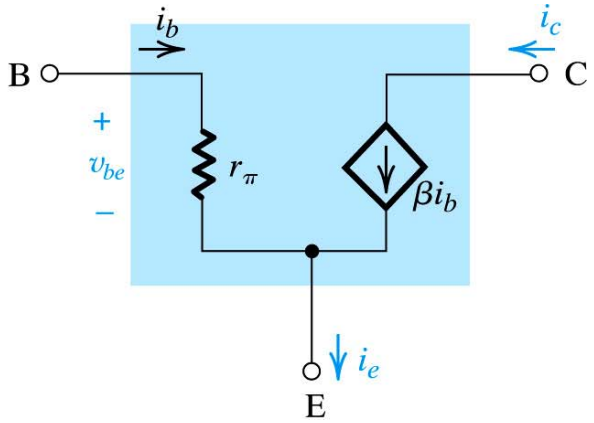
- **AC analysis on BJT Circuits**
- **Basic BJT Amplifier Configurations**
- **Some Examples**

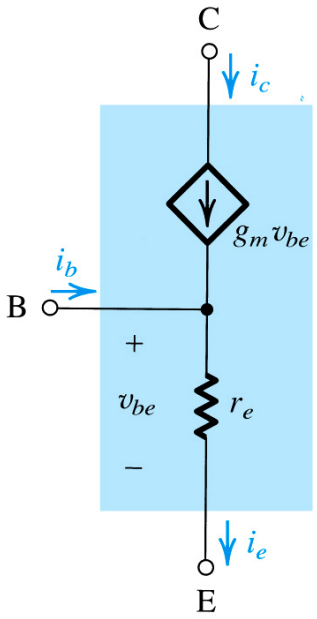
Small Signal Bipolar Transistor Models



$g_m = I_C / V_T$

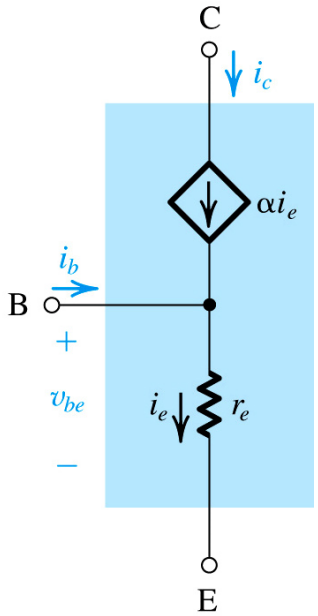
$r_\pi = \beta / g_m$





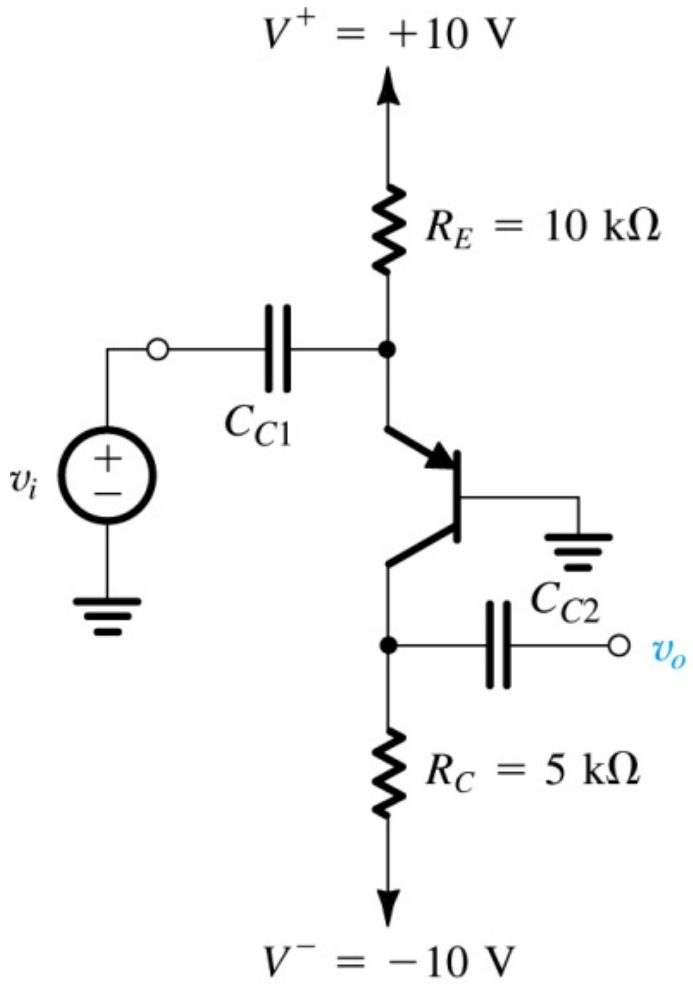
$g_m = I_C / V_T$

$r_e = \dfrac{V_T}{I_E} = \dfrac{\alpha}{g_m}$

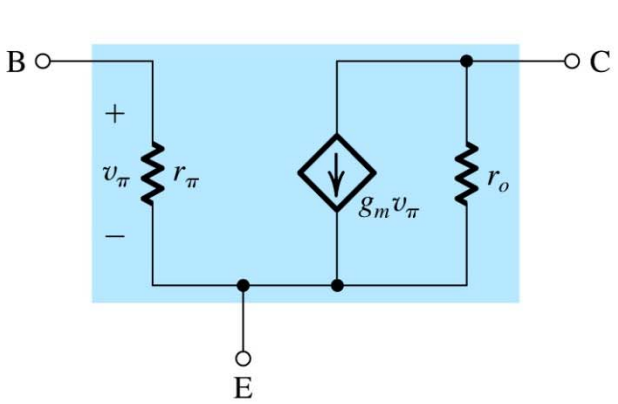


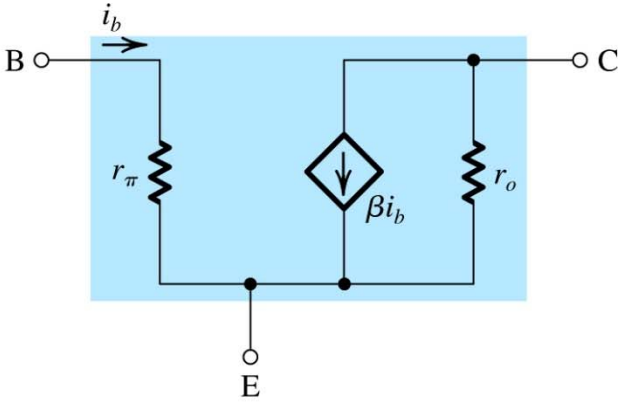
Example: Common Base Design I

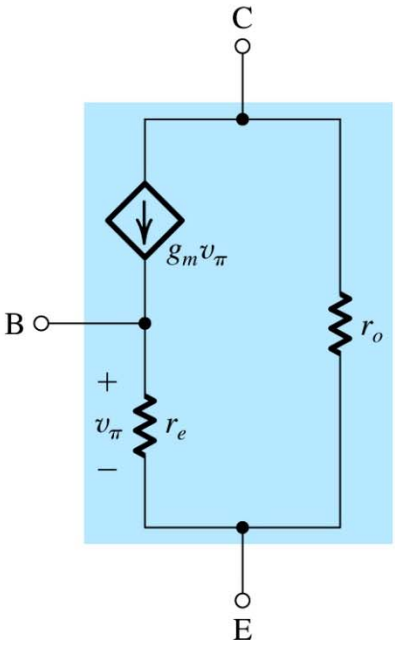
1) Analyze the following circuit assuming that β=100.

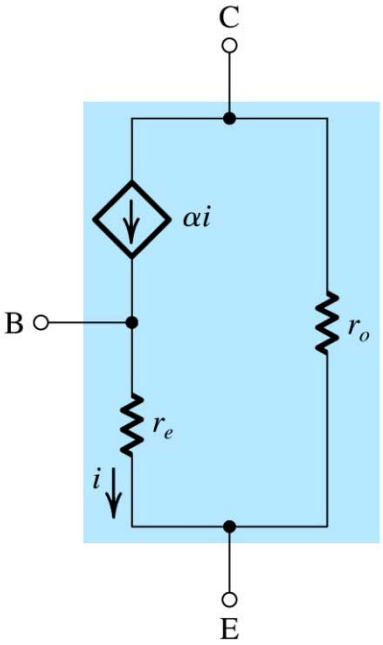


Impact of Transistor Output Resistance



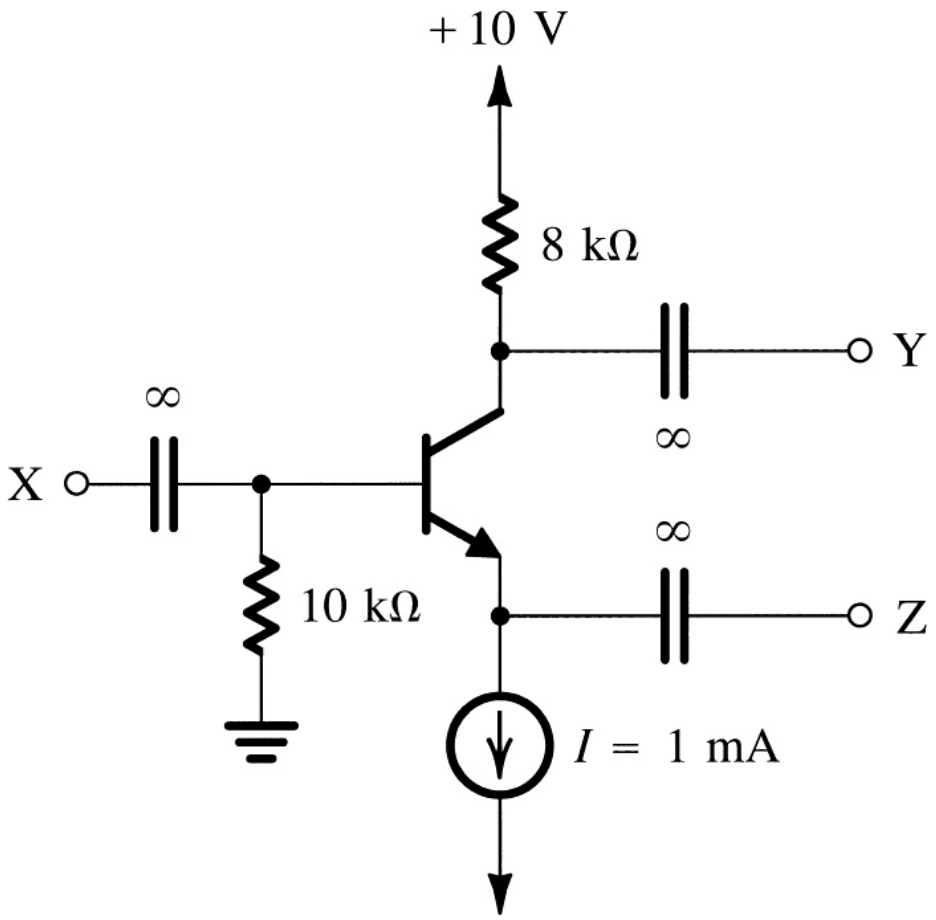




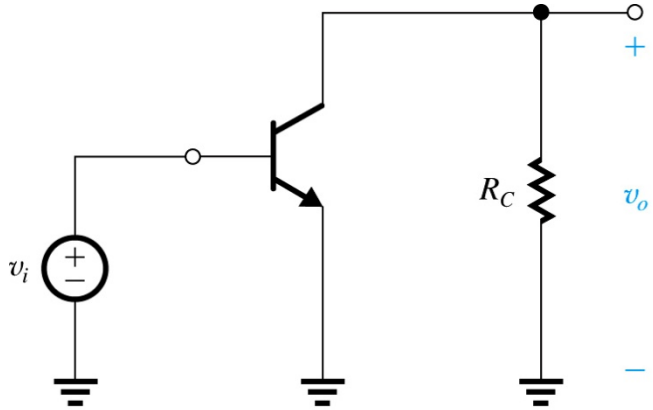


Example: Common Emitter Design I

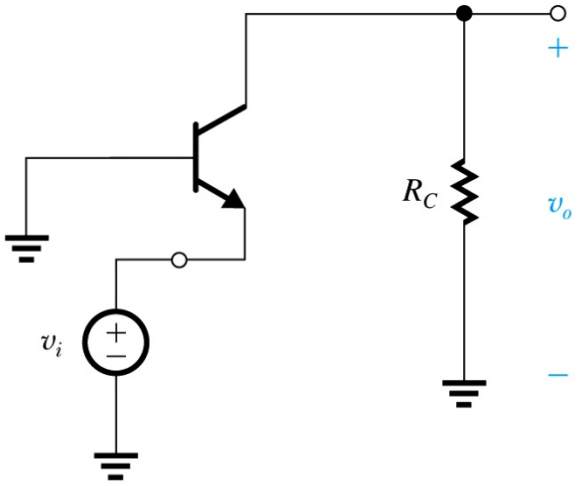
1) Analyze the following circuit assuming that V_A=100 V and β=100.



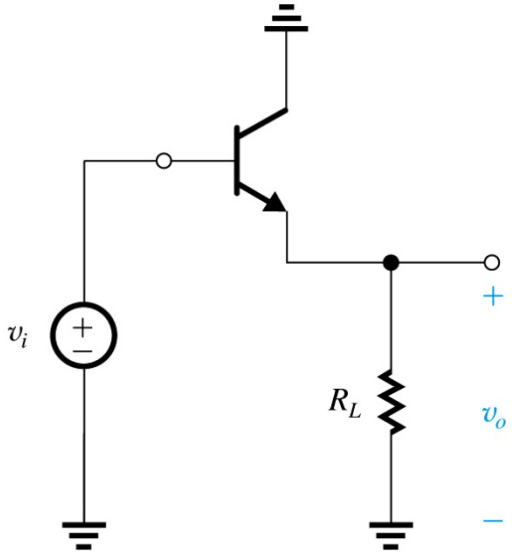
Summary of BJT Amplifier Configurations



(a) Common-Emitter (CE)

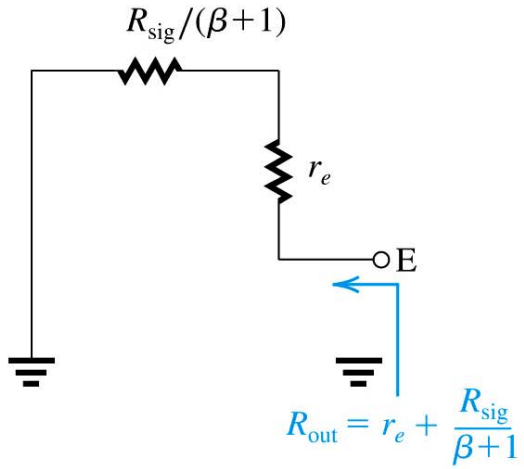


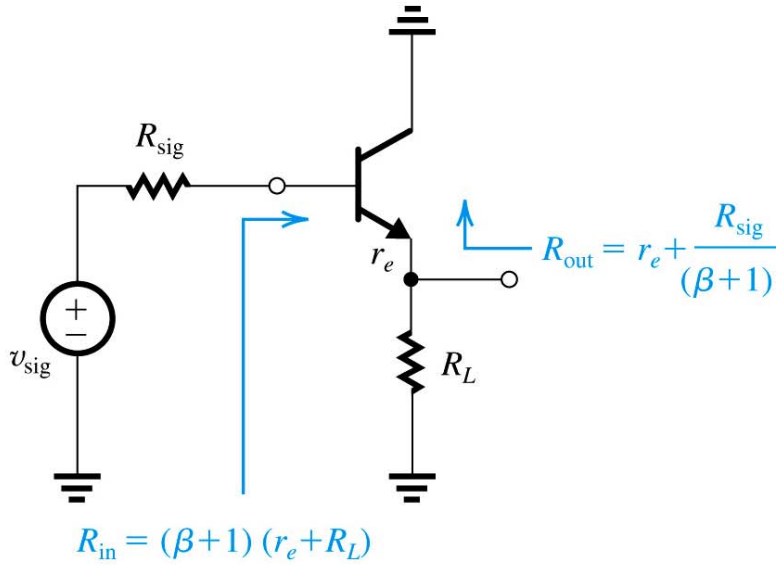
(b) Common-Base (CB)



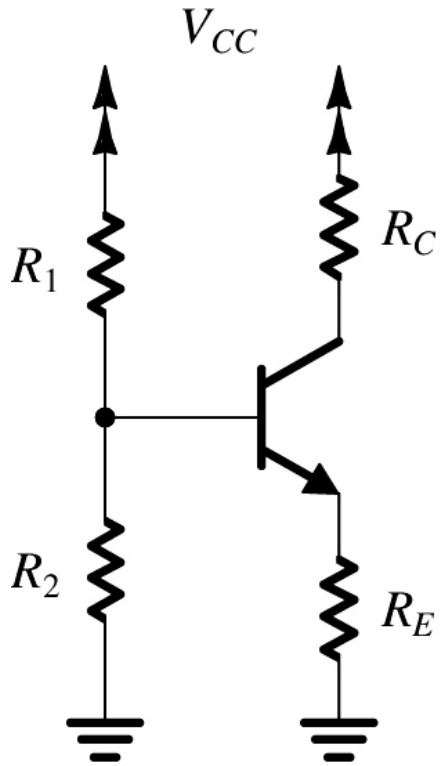
(c) Common-Collector (CC)
or Emitter Follower

Helpful Point 1: Resistance Transformation



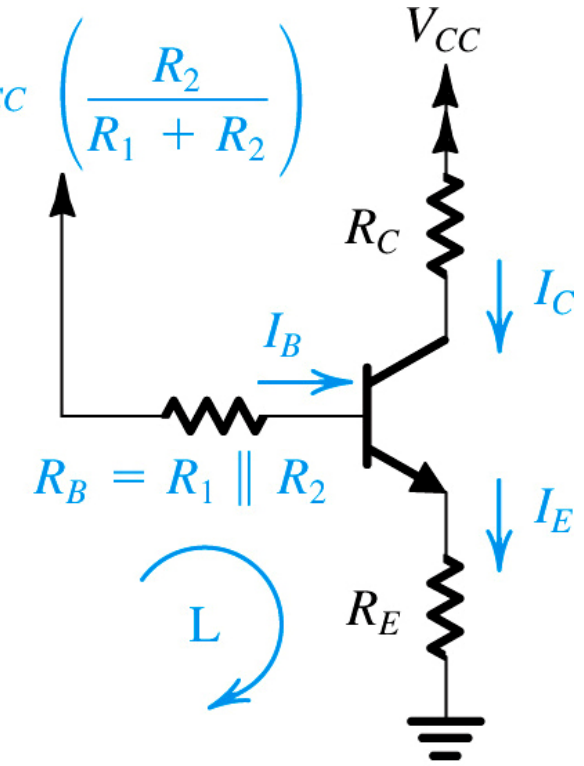


Helpful Point 2: Thevenin of Bias Resistors



(a)

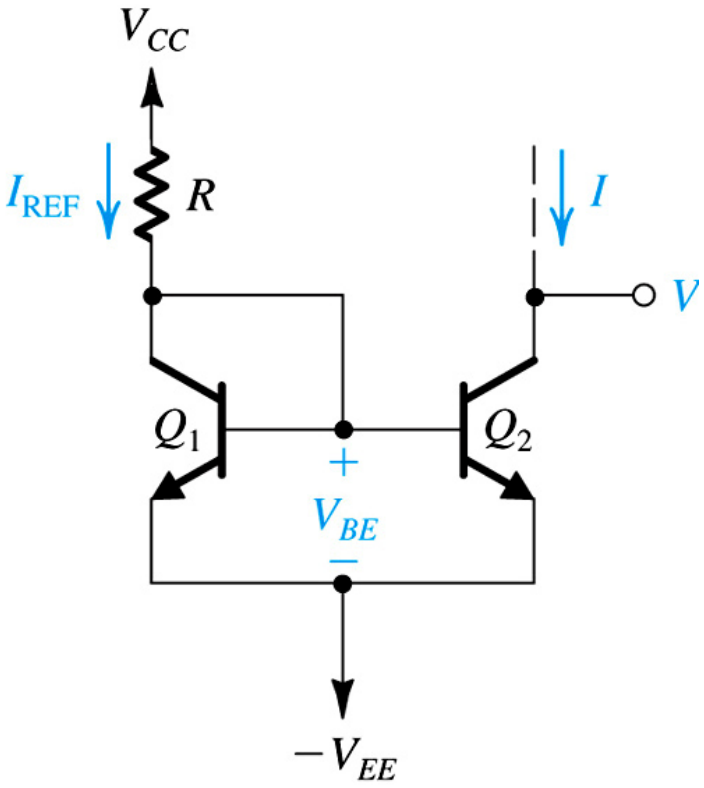
$$V_{BB} = V_{CC}\left(\frac{R_2}{R_1 + R_2}\right)$$



(b)

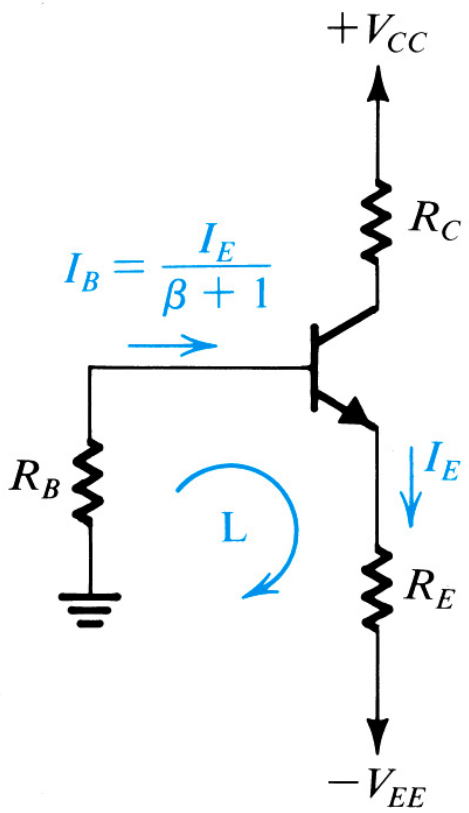
Example: BJT Current Mirror

1) Find R such that the output current become I_{REF}.



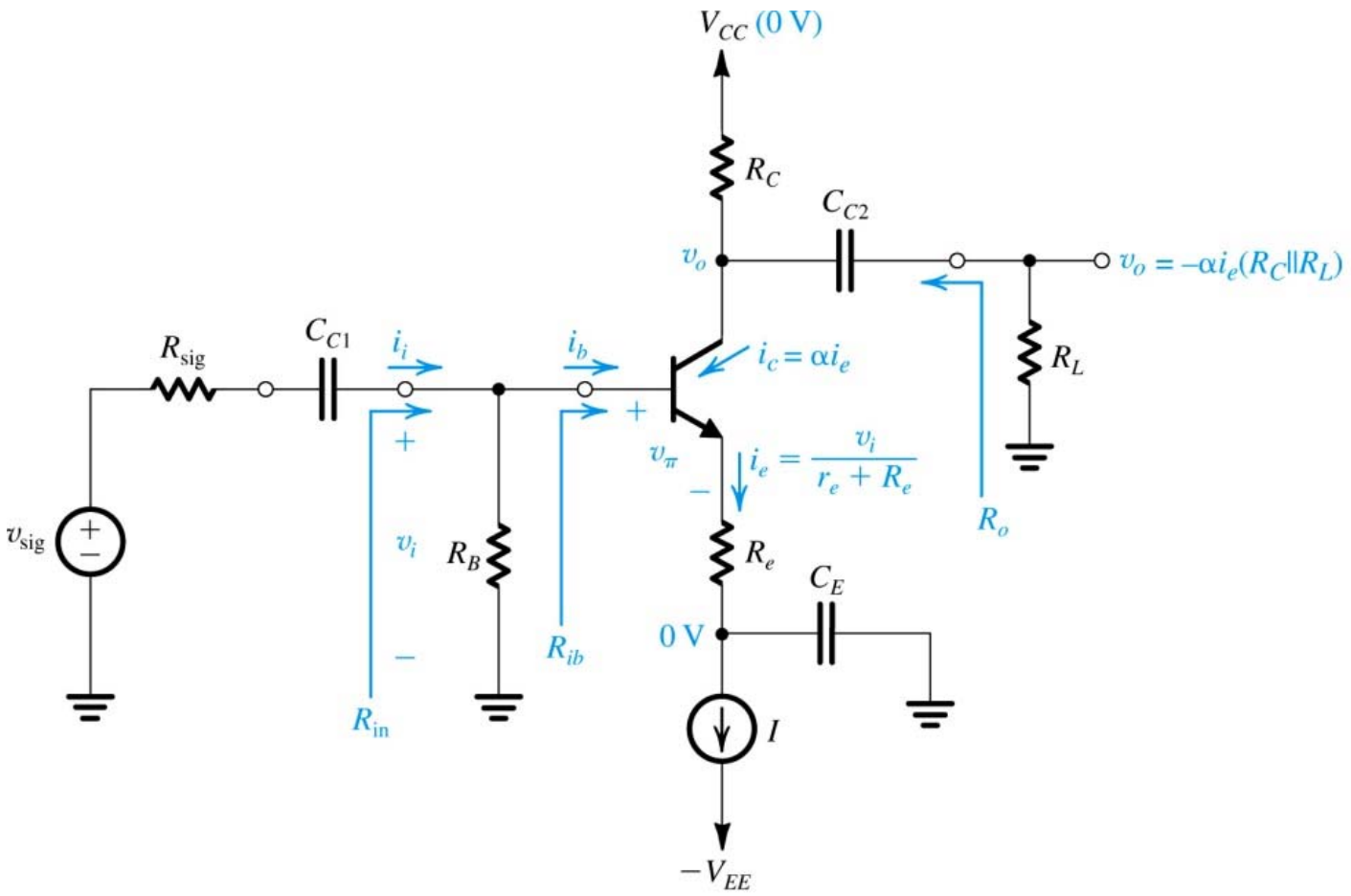
Example: Common Base Amplifier Design

The bias arrangement below is to be used for a common-base amplifier. Design the circuit to establish a dc emitter current of I mA and provide the highest possible voltage gain while allowing for a maximum signal swing at the collector of ±2 V. Use +10 V and -5 V power supplies.



Example: Common Source Amplifier

What is the overall gain, G_V, in the following circuit.



Example: Emitter Follower Design

The emitter follower below is used to connect a source with R_{sig} = 10 kΩ to a load R_L = 1 kΩ. The transistor is biased at I=5 mA, utilizes a resistance R_B = 40 kΩ and has β=100. Find R_{ib}, R_{in}, G_v, G_{vo}, and R_{out}. If in order to limit nonlinear distortion, the base-emiter signal voltage is limited to 10 mV peak, what is the corresponding amplitude at the output? What Will the overall voltage gain become If R_L is changed to 2 kΩ? To 500 Ω?