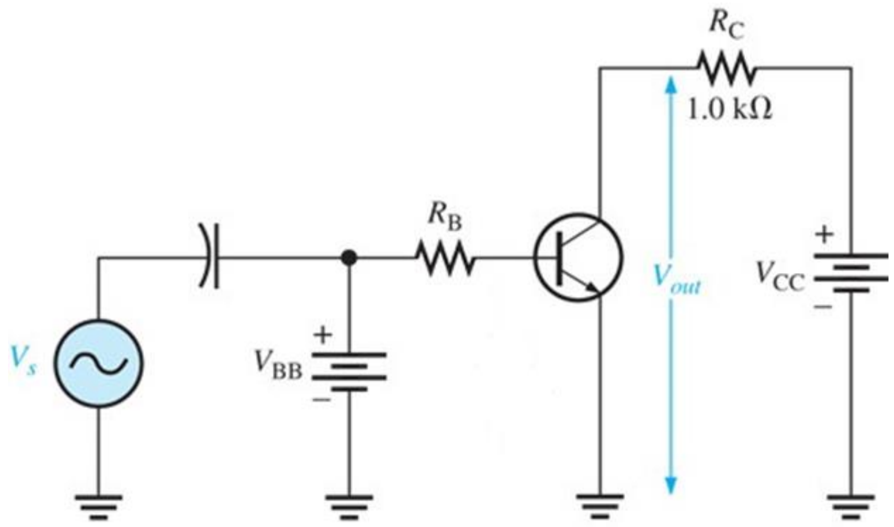
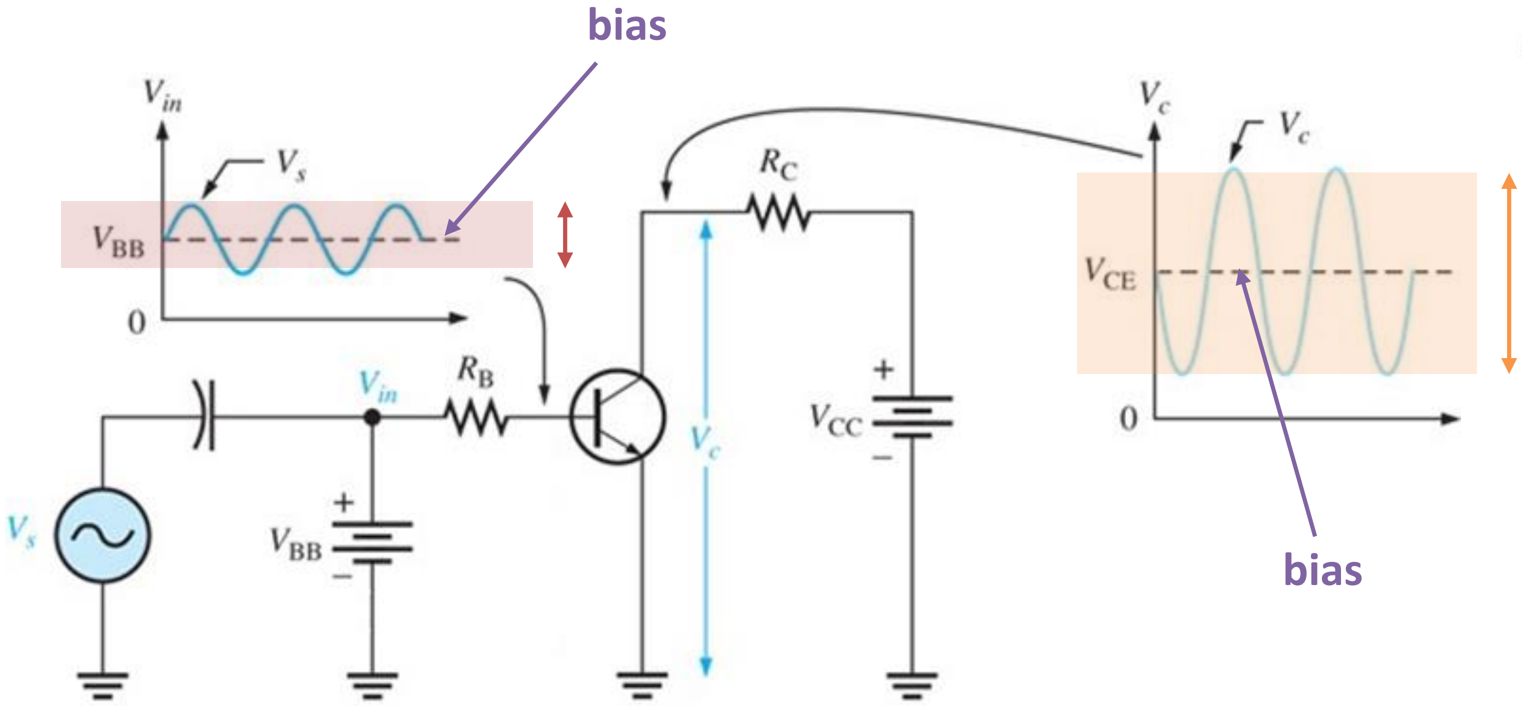
Large-Signal vs Small Signal Behavior

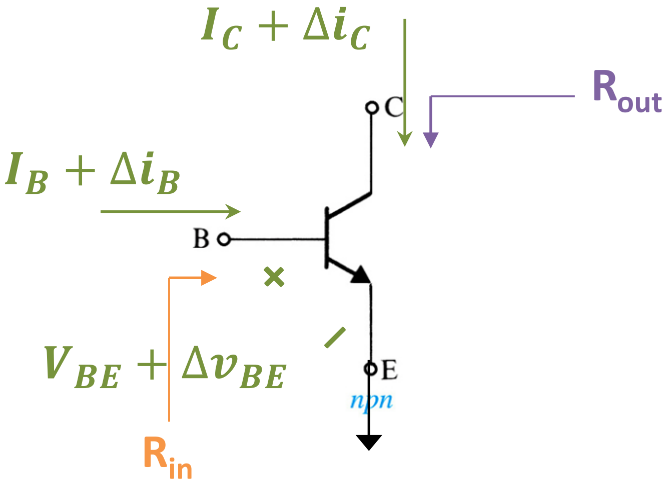


1) Bias current is stablished through V_{BB} and supplied by V_{cc}
2) AC signal is coupled through the capacitor and superimposed to the DC signal
3) AC behavior will be determine by the circuit configuration and the DC bias



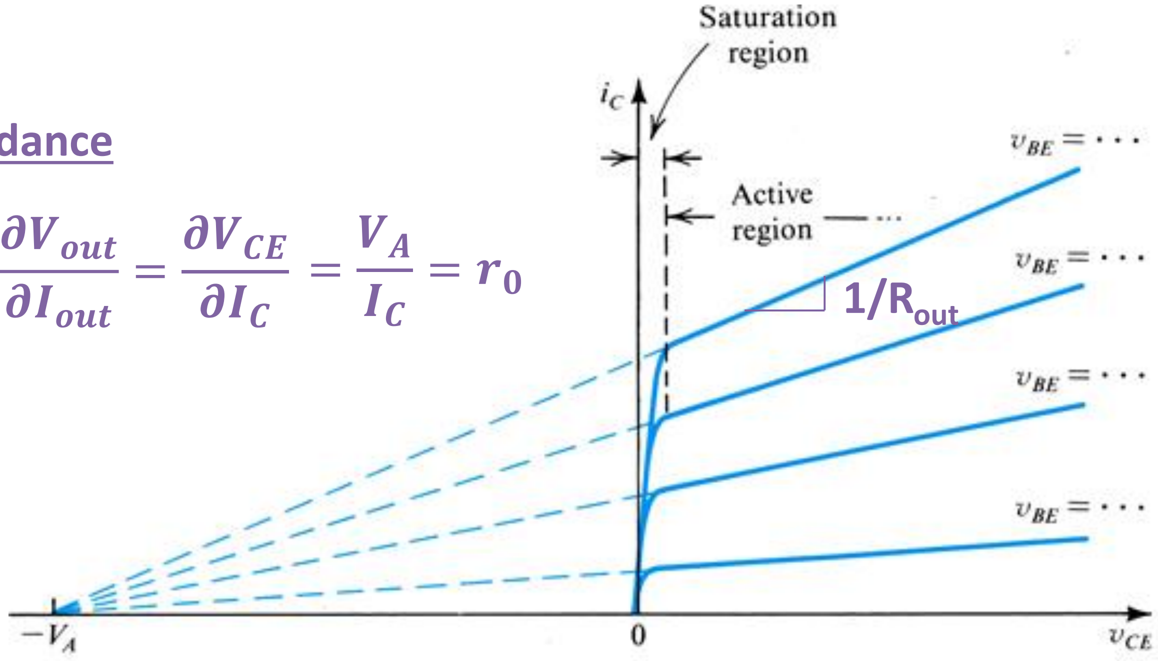
- Large-Signal – stablishes the DC operating point of the circuit
- Small-Signal – determines de circuit behavior around the DC operating point

Small Signal Parameters



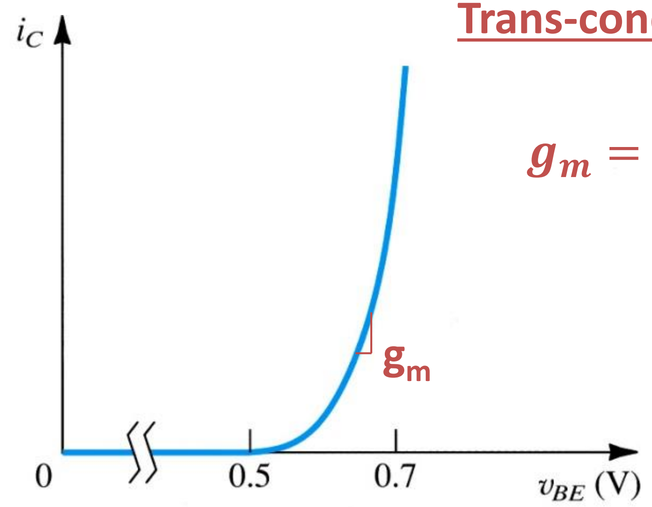
Output Impedance

$$R_{out} = \frac{\partial V_{out}}{\partial I_{out}} = \frac{\partial V_{CE}}{\partial I_C} = \frac{V_A}{I_C} = r_0$$



Trans-conductance

$$g_m = \frac{\partial I_{out}}{\partial V_{in}} = \frac{\partial I_C}{\partial V_{BE}} = \frac{I_C}{V_T}$$

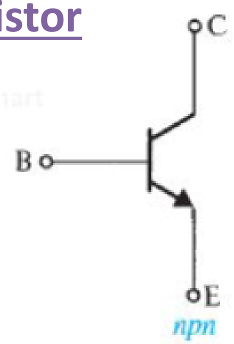


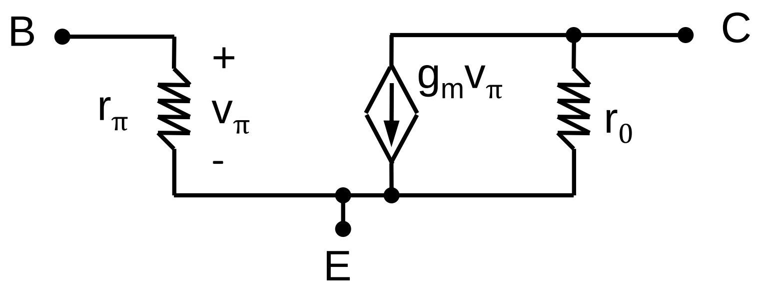
Input Impedance

$$R_{in} = \frac{\partial V_{in}}{\partial I_{in}} = \frac{\partial V_{BE}}{\partial I_B} = \frac{\beta}{g_m} = r_\pi$$

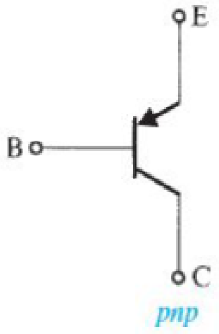
Small Signal Equivalent Circuit

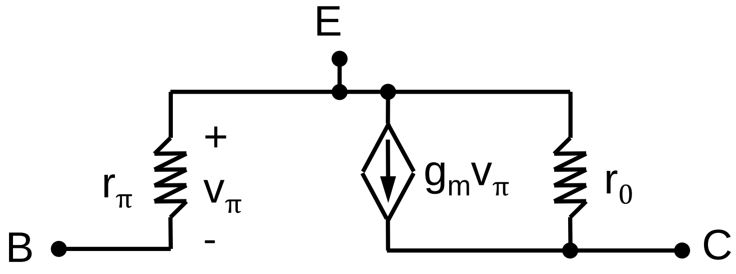
- **npn transistor**





- **pnp transistor**

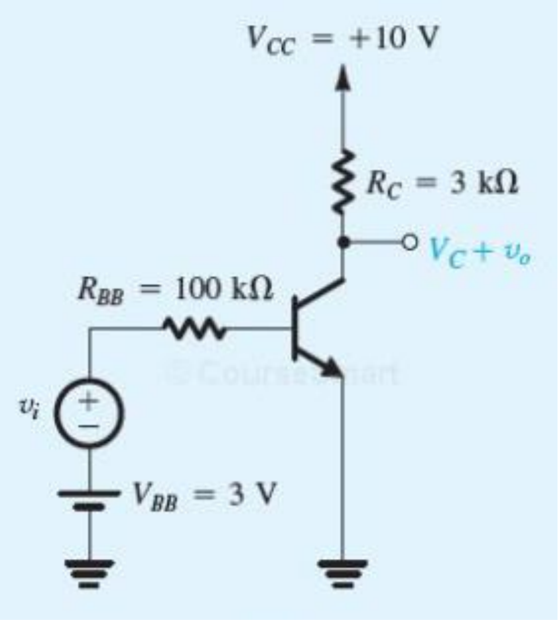




Small Signal Analysis

⟶ with the small-signal model

Assuming β=200 and V_{BE}=0.7V find the input resistance R_{in} (seen by v_s) and the overall voltage gain v_o/v_s.



Procedure

1) Determine the transistor bias current (DC Analysis)
2) Determine the small-signal parameters
3) Draw the small-signal equivalent circuit
   - All DC sources off!
   - Low freq. cap shorted!
4) Replace transistor with small-signal circuit
5) Calculate the desired specifications