Electrical Science: 2021-22

Lecture 26

BJT Amplifiers-Part2

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BJT Amplifier/Circuit Configurations

- Common-Emitter Configuration
- Common-Collector Configuration
- Common-Base Configuration

Common-Emitter Configuration

Design of Amplifier

24 V, 35 AH Battery

Microphone (10 mV)

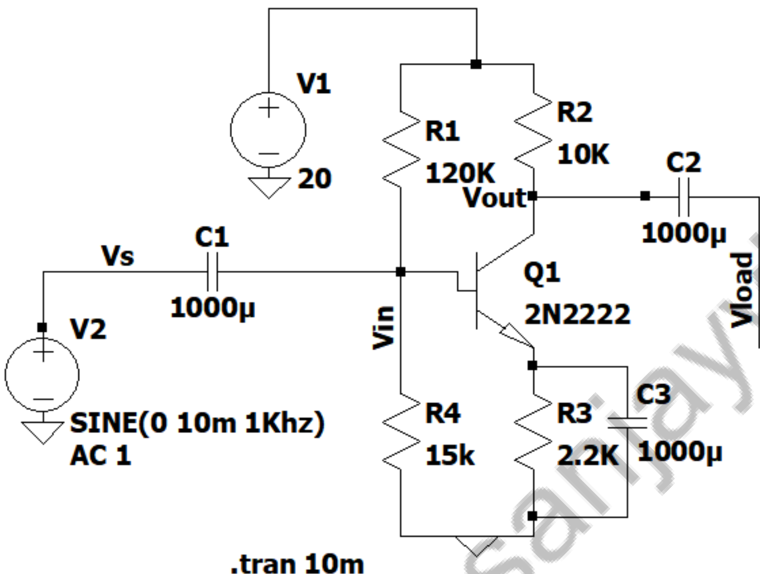
Speakers (8 Ohms) 1 V p-p

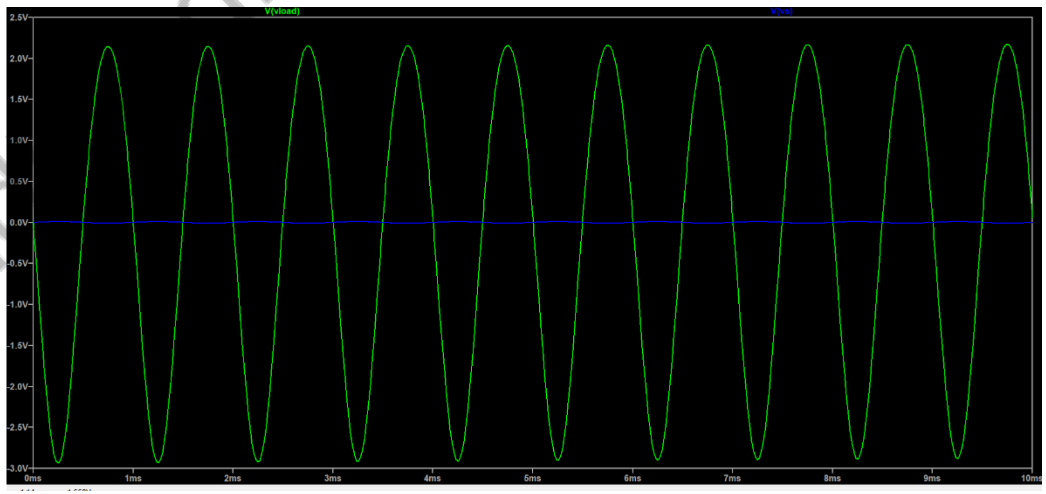
Gain 100

Audio Amplifier

Common-Emitter Configuration

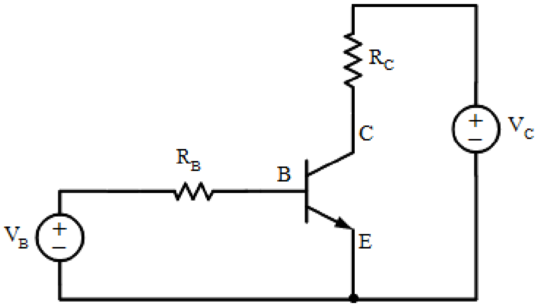
Design of Amplifier

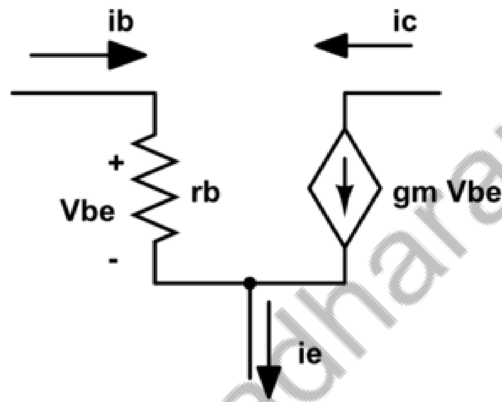




$$Gain = -\beta\, R_C / r_\pi$$

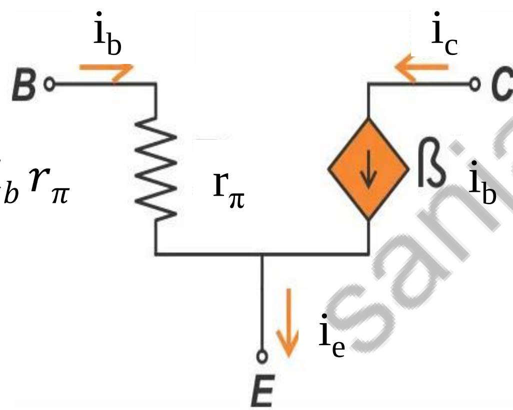
BJT DC and Small Signal Equivalent



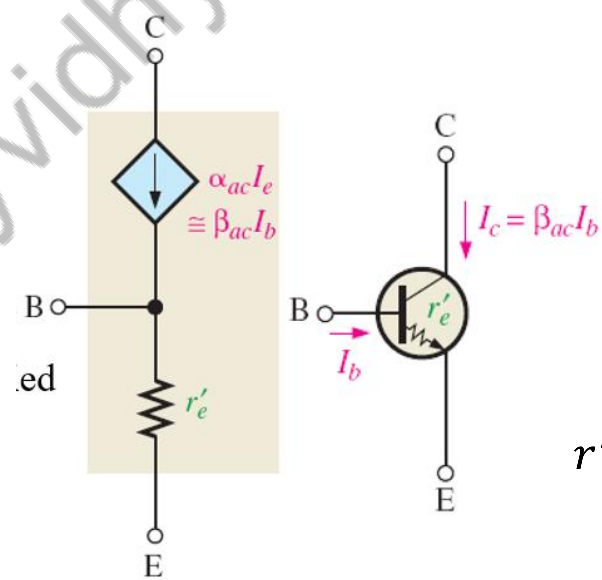


$$\beta i_b = g_m V_{be}$$

$$Transconductance\ g_m = \frac{\beta}{r_\pi}$$



$$V_{be} = i_b r_\pi$$



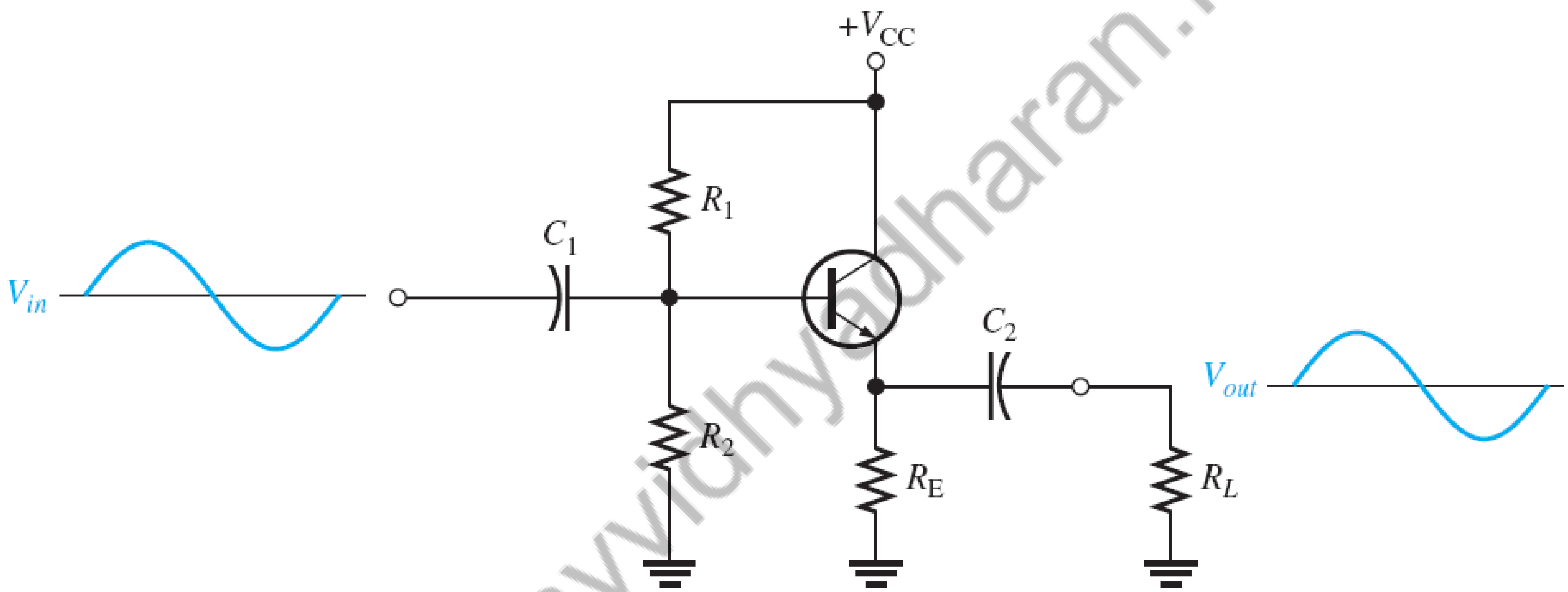
$$V_{be} = i_e r'_e$$

$$V_{be} = (1+\beta) i_b r'_e$$

$$r_\pi = (1+\beta)\ r'_e$$

$$r'_e = \frac{25\ mV}{I_C}$$

Common Collector Amplifier



Common Collector Amplifier

$$V_{out} = I_e R_e$$

$$V_{in} = I_e(r'_e + R_e)$$

$$A_v = V_{out}/V_{in}$$

$$A_v = \frac{I_e R_e}{I_e(r'_e + R_e)}$$

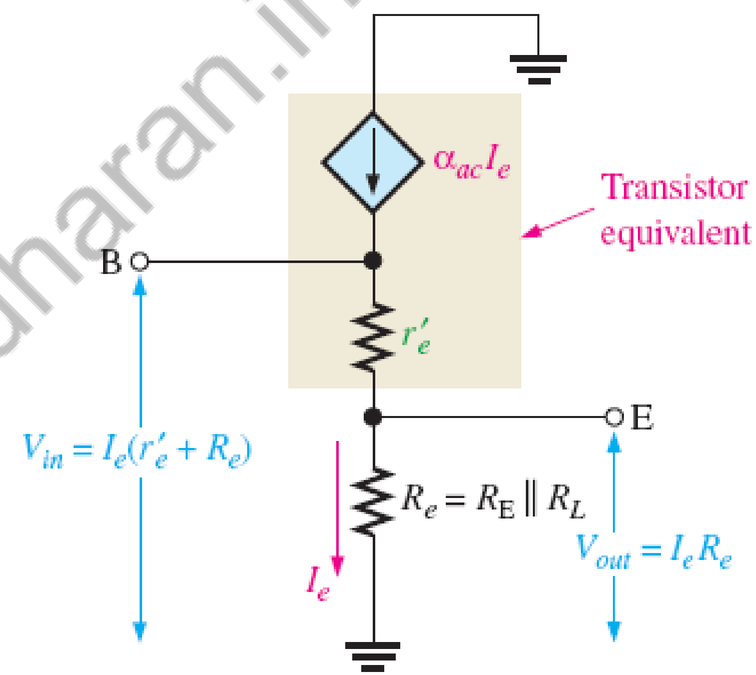
$$r_\pi = (1 + \beta)\, r'_e$$

$$A_v = \frac{R_e}{r'_e + R_e}$$

$$r'_e = \frac{25\, mV}{I_C}$$

If $R_e >> r'_e$, which is the Usual case

$$A_v \cong 1$$



Current Gain

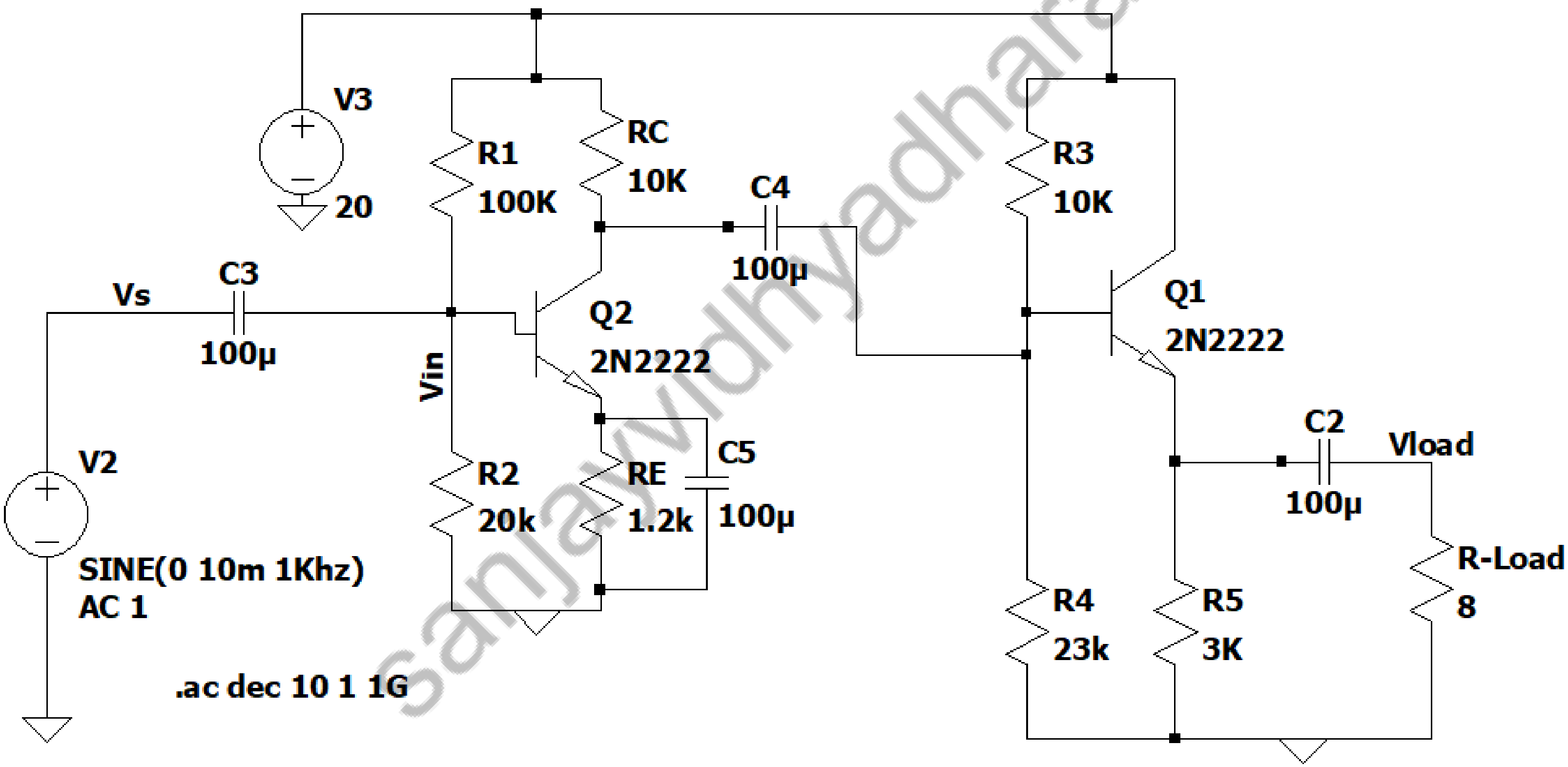
Power Gain

$$Input\ Resistance\ h_{ie} = (r'_e + R_e)(1 + \beta)$$
$$= r_\pi + R_e(1 + \beta)$$

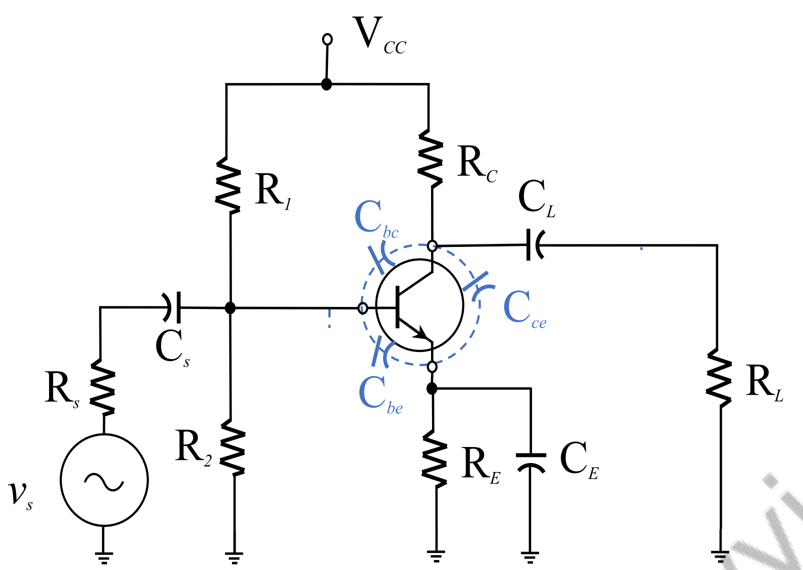
$$Output\ Resistance\ h_{oe} = R_e || r'_e = R_e || (\frac{r_\pi}{1 + \beta}) = R_e || (\frac{1}{g_m})$$

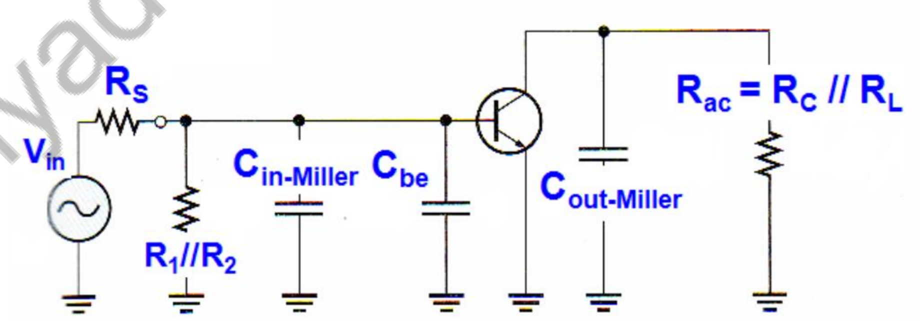
CE-CC Amplifier

Design of Amplifier



Miller Effect Amplifier in CE Amplifier

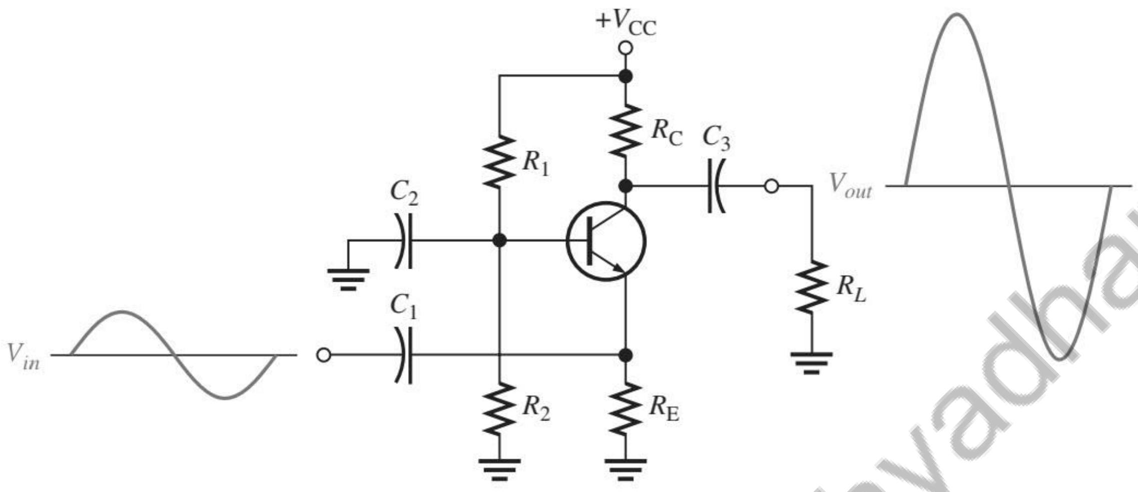


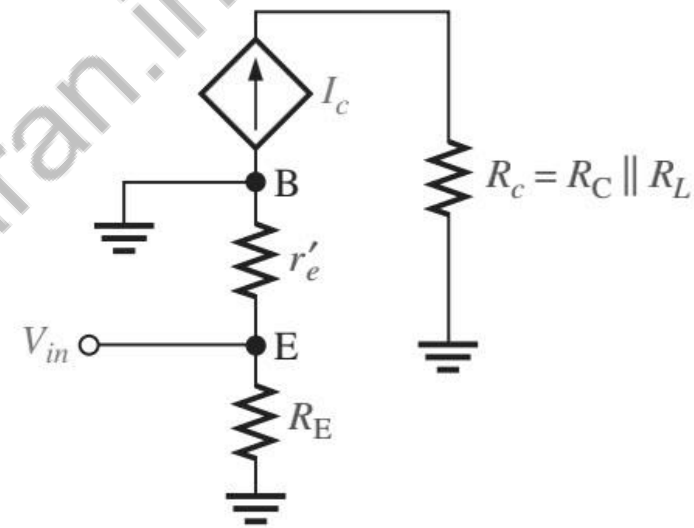


$$C_{in}(Miller) = C(A_v + 1)$$

$$C_{out}(Miller) = C(A_v + 1)/A_v$$

CB Amplifier





$$A_V = \frac{V_{out}}{V_{in}} = \frac{I_c R_c}{I_c(R_E||r'_e)} \approx \frac{R_c}{r'_e}$$

$Since\ I_E \approx I_C,$ $the\ current\ gain\ A_i \approx 1.$

$R_{out} \approx R_c$

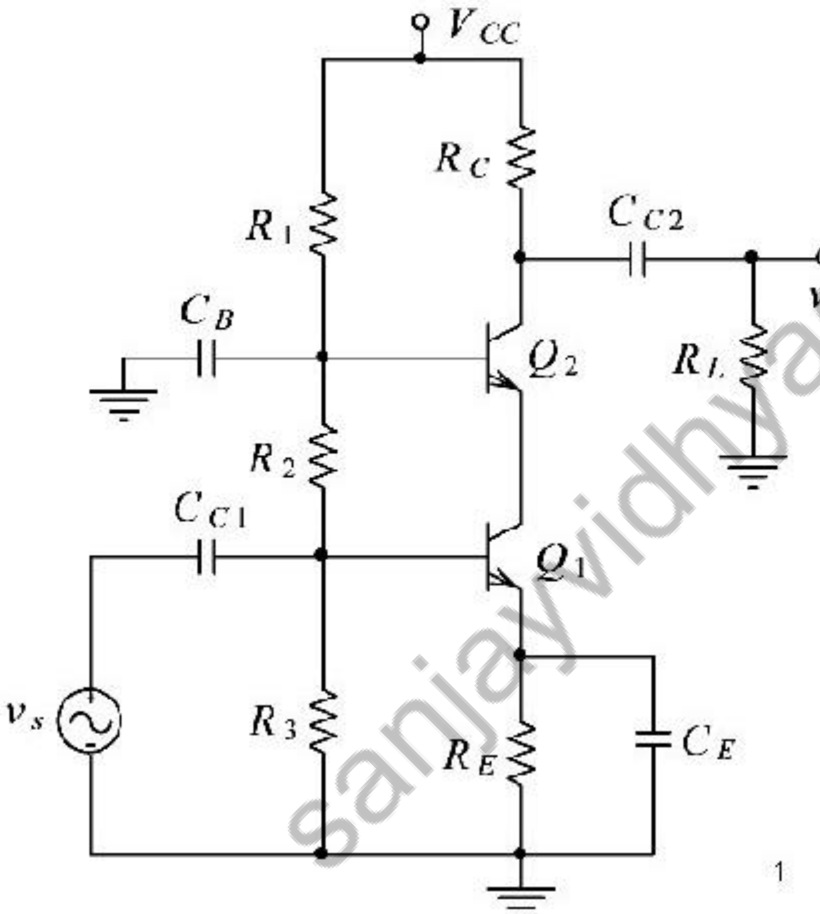
$$R_{in} = \frac{V_{in}}{I_{in}} = r'_e||R_E$$

$Usually, R_E\ is\ much\ greater\ than\ r'_e.$

$R_{in} \approx r'_e$ (Low Input Impedance)

Lesser Miller effect

Cascode Amplifier



$$Gain = -\beta\, R_C / r_\pi$$

Thank you