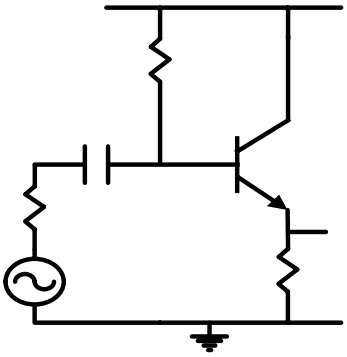
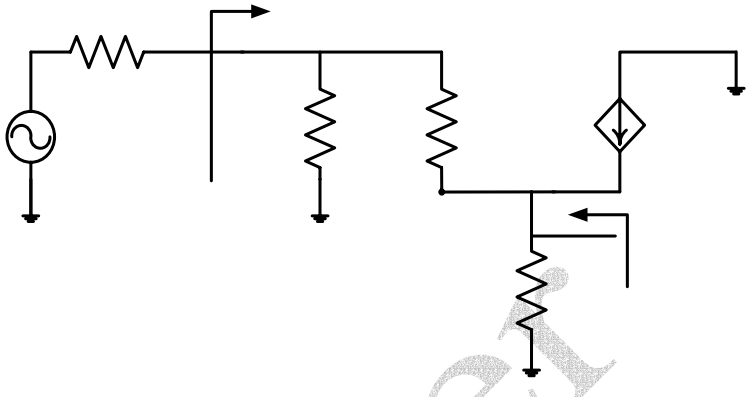
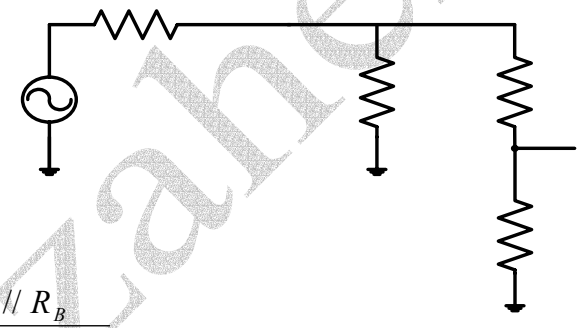
Analysis of common collector amplifier







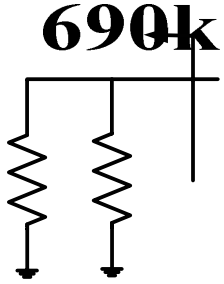
1) To find the gain: apply the RRR:

By voltage division:

$$v_b = \frac{[r_\pi + (1+\beta)R_E] // R_B}{R_s + [r_\pi + (1+\beta)R_E] // R_B} v_s$$

$$v_o = \frac{(1+\beta)R_E}{r_\pi + (1+\beta)R_E} v_b$$

$$\Rightarrow \frac{v_o}{v_s} = \frac{(1+\beta)R_E}{r_\pi + (1+\beta)R_E} \frac{[r_\pi + (1+\beta)R_E] // R_B}{R_s + [r_\pi + (1+\beta)R_E] // R_B}$$



2) The input resistance: $R_{in} = R_B // [r_\pi + (1+\beta)R_E]$

3) The output resistance. Applying IRRR:

$$R = \frac{R_s // R_B + r_\pi}{(1+\beta)}$$

$$R_o = [\frac{R_s // R_B + r_\pi}{(1+\beta)}] // R_E$$

Comparison between the different amplifiers.

Assuming that all circuit are biased with equal DC collector current and the BJT has $\beta = 25$ and $r_\pi = 3.5k\Omega$, the following table is obtained.

Amplifier	Voltage Gain (V/V)	Input resistance (Ω)	Output resistance (Ω)	Phase shift (Degree)
Common Emitter	31 (High)	3.50k (Low)	6.8k (High)	180
Common Base	45.6 (High)	0.106k (V. Low)	10k (High)	0
Common Collector	0.68 (V. Low)	55.8k (V. High)	0.66k (V. Low)	0
Ideal	V. High	V. High	V. Low	

Conclusions: Each type of amplifier has its own advantages and disadvantage. Thus, practical amplifiers consist of multi-stages. Depending on the required gain, the source and load resistances, these basic amplifiers are cascaded to achieve the desired specifications.