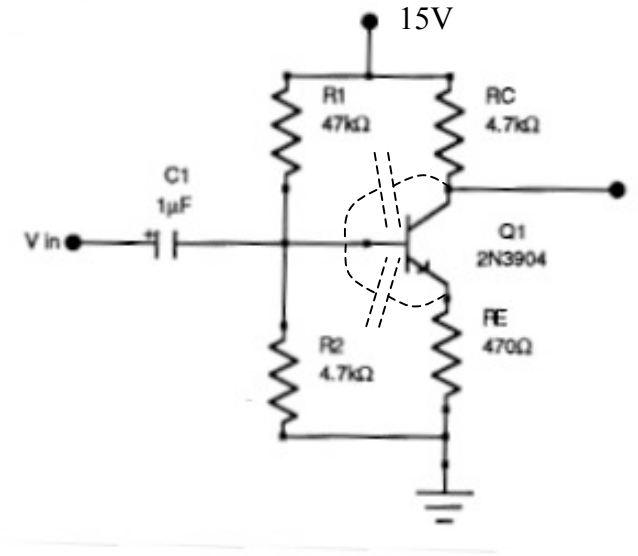
Designing a the Common Emitter Amplifier -Handout

The transistor can be used as a voltage amplifier. R_1, R_2, R_c, R_E, must be selected based on design criteria: Input impedance, Output Impedance, Gain.



stray capacitance
$X_c=1/\omega C$

Voltage gain = Vout/Vin = **$- R_C / R_E$**
Zin = βR_E **(β~100)**
Zout = R_C

ΔVb=0.6V transistor activation voltage

1. The input signal is AC coupled to the amplifier. The input capacitor blocks the DC. There is stray capacitance in the circuit which we ignore at low frequency.

2. First select the output impedance. **R_C = 4700Ω .**

3. Then choose the voltage drop across V_C to be half the supply voltage V_C = 15V/2 = **7.5V**. This allows the AC input signal to swing full range of +-7.5V

4. Calculate the nominal current thru $I_C = 15V - V_C / R_C = 7.5/ 4.7K =$ **1.6mA**

5. Choose **R_E** = R_C /10 = **470Ω** for a gain of 10! **Zin = βR_E**

6. To set the base voltage divider note that $V_E = I_E R_E \sim I_C R_E = (1.6mA)(470\Omega) =$ 0.75V

7. We have that $V_B = V_E + \Delta Vb = 0.75V + 0.6V = 1.35$ V

8. To limit the power supply current through the base choose $R_2 <$ **Zin** ~ (1/10) βR_E
   Let R_2 = (β /10) R_E =10 R_E = **4700 Ω** *(rule of thumb!)*

9. Then R_1 can be calculated by considering the current and voltage drop on R_1.
   $I_2 = V_B / R_2 = 1.35V/4700\ \Omega = 0.29mA$ and $I_B = I_C/\beta = 0.016A$
   $I_1 = I_2 + I_B = 0.31mA$
   R_1 = (15V- V_B) / I_1 = (15.0-1.35)V/.30e-3A = ~**46 kΩ** (Use 47 kΩ)

Chapter-8 Homework

#1- Design a common-emitter amplifier with output impedance 10KΩ and a gain of 100 using a transistor of β=200 and a 24V power supply.