Chapter-8 Homework

#1- Design a common-emitter amplifier with output impedance 10KΩ and having a gain of 100 using a transistor of β=200 and a 24V power supply.
Sketch the amplifier and give R1, R2, RC, RE.

Vcc=+24V

Output impedance = **RC = 10KΩ**
Choose VC = Vcc/2 so the amplifier has +-12V swing
iC = (24-VC)/Rc = 12/10K = 1.2 mA
For a gain = -100 choose Rc/RE = 100 or **RE = 100Ω**

Determine the base voltage for biasing R1 and R2-
VE = IE RE ~ IC RE = (1.2mA)(100 Ω) = 0.12V
VB = VE + 0.6V = 0.72V

Choose R2 = 10 RE satisfying $\beta RE >> (1/R1 + 1/R2)^{-1}$.
This limits the bias current through the base. We want the input signal current to dominate the base bias current!
R2 ~ (1/10) βRE = **2KΩ**

I2 = VB/R2 = 0.72V/2000Ω = 0.36mA
iB = iC/ β= 1.2mA/200 ~ 0.006mA
i1 = iB + I2 = 0.37mA

R1 = (Vcc-VB) / i1 = (24-0.72)/0.37 = **63KΩ**

Also VB =0.6V + 0.12V = **0.72V**
where 0.6V is transistor turn-on and 0.12V is 1/100 of (Vcc/2) the null output voltage

VB = [R2/(R1+R2)] x 24V voltage divider theorem
0.72V = [2000/(R1+2000)] 24V
R2=65KΩ ~ 63κΩ

#2- Design an emitter-follower with input impedance of 1 MΩ using a β=500 transistor. If a 300 Ω signal generator is driving the circuit, what is the output impedance?

Vcc = 12 V
RE = Rin / β = 1e6 / 500 = **2KΩ**

Rout = Rsource/β=300/500=**0.6 Ω**

#3- An amplifier has an input impedance Z_{IN} = 10KΩ and output impedance Z_{OUT}=100Ω. The input signal is sent through a C = 470 µF input capacitor. The stray capacitance in the leads is C_S =10pF. Determine the high and low cutoff frequency of the open amplifier circuit.

f_{LO} = 1/2πRinCin = 1/(6.28)(10K)(470e-6) = 0.034 Hz

f_{HI} = 1/2πRoutCout = 1/(6.28)(100)(10pf) = 160 MHz