EE333 FALL 2017 ASSIGNMENT#2

1. Answer the following with 40 ***words*** or less for each (you get +1 bonus if the answer is shorter than 21 ***words*** and is still sensible – full sentences are not a necessity, but be clear.). (6pts each)

a) For the forward active operation of an pnp transistor what is the dominant carrier and transport mechanism at each region?

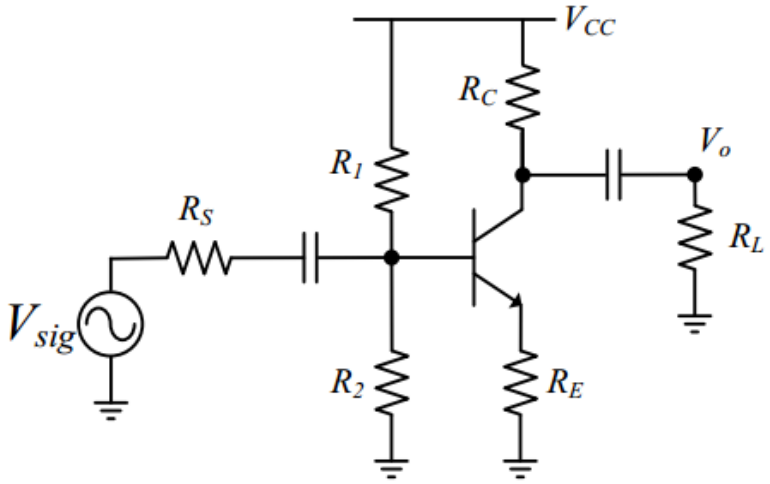
b) What are the two main undesired effects interfering with the forward active operation? How do they affect current components of the transistor?

c) How are these effects alleviated (in perspective of device design and physics, NO external circuit design techniques are asked.)?

d) What is base width modulation effect (Early effect)? Choosing a lighter doing concentration for the collector compared to base reduces base width modulation. Explain why.

e) Why is a narrow base good for transistor β? What is the limiting factor for a very, very narrow base?

2. For the amplifier configuration below, β = 100, V_{CC} = 10V, R_S = 500Ω, R_1 = 7kΩ, R_2 = 3kΩ, R_C = 5kΩ, R_L = 25kΩ, and all capacitor values are 330μF. The signal source has 10mV amplitude and 1kHz frequency.



a) What is the maximum value of R_C that keeps the transistor in the active operation region for this R_E? Neglecting the base width modulation, calculate R_E for A_{vo} = 2.5. What are the theoretical R_{in}, R_o, A_v, and G_v for this R_E? How would these change when a bypass capacitor of 500μF is added in parallel with R_E? You may assume infinite β in DC calculations. (30% pts)

b) Run a SPICE simulation using the model given below and plot V_{sig}, V_B, V_C and V_O with and without the bypass capacitor. Find values of R_{in}, A_v from the waveforms. Explain very shortly how you derive them and propose a way to determine R_o. Compare these with your hand calculations. (30% pts)

.model qn NPN(Bf=100)

c) Repeat the simulations in b) with R_L = 2.5kΩ and observe the change in A_v. Explain why this happens and propose a way to increase small signal voltage across the load resistance. (10% pts)

You can write your hand calculations on a paper and add it to the rest of the homework. Provide the relevant plots as well as the circuit schematics. Make sure the numbers are visible and the figures can easily be referred to.

Do not waste ink, paper and material. (bonus: 5% pts)