Assignment 1
Analog Electronics (EC-261)

Max. Marks: 10

Note: All questions are compulsory.

1. An input voltage of 2V rms (measured from base to ground) is applied to the circuit of Fig. 1. Assuming that the emitter voltage follows the base voltage exactly and that V_{be} (rms) = 0.1 V, calculate the circuit voltage amplification ($A_v = Vo/V_i$) and emitter current for R_E = 1 k.

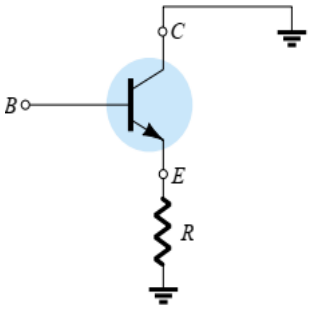

Fig. 1

2. For the pn junction for which $N_A = 10^{18}/cm^3$, $N_D = 10^{16}/cm^3$, $A = 10^{-4}cm^2$, and $n_i = 1.5 \times 10^{10}/cm^3$, let $L_p = 5$ μm, $L_n = 10$ μm, D_p (in the n region) = 10 $cm^2/V \cdot s$, and D_n (in the p region) = 18 $cm^2/V \cdot s$. The pn junction is forward biased and conducting a current I = 0.1 mA. Calculate: (a) I_S; (b) the forward-bias voltage V; and (c) the component of the current I due to hole injection and that due to electron injection across the junction.

3. For the common-emitter amplifier shown in Fig. 2, let V_{CC} = 15 V, R_1 = 27 kΩ, R_2 = 15 kΩ, R_E = 2.4 kΩ, and R_C = 3.9 kΩ. The transistor has β =100. Calculate the dc bias current I_C. If the amplifier operates between a source for which R_{sig} = 2 kΩ and a load of 2 kΩ, replace the transistor with its hybrid-π model, and find the values of R_{in}, and the overall voltage gain v_o/v_{sig}.

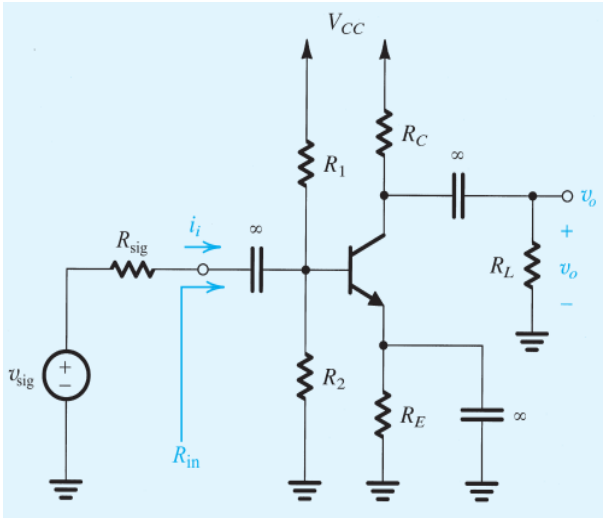

Fig. 2

4. Design the emitter follower (common collector amplifier) of Fig. 3 to operate at a dc emitter current I_E = 1 mA. Allow a dc voltage drop across R_B of 1 V. The available power supplies are ±5 V, β = 100, V_{BE} = 0.7 V, and V_A = 100 V. Specify the values required for R_B and R_E. Now if R_{sig} = 50 kΩ and R_L = 1 kΩ, find R_{in}, v_i/v_{sig}, v_o/v_i, G_v, and R_{out}. (Note: In performing the bias design, neglect the Early effect.)

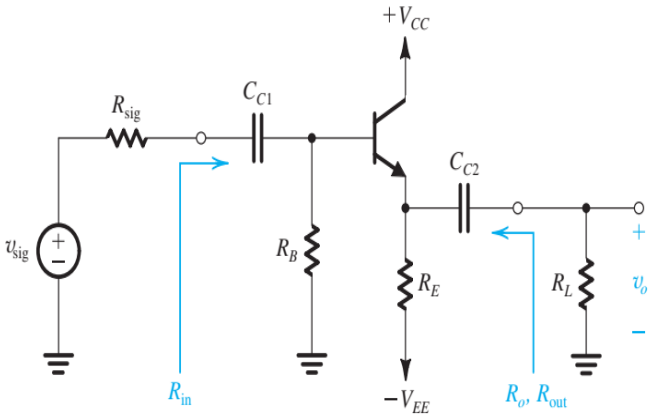

Fig. 3