Experiment-3

BJT Common Emitter Amplifier Characteristics

Simulation Exercise

1. Design a common-emitter amplifier as shown in Figure 1 (obtain the values of R_1, R_E and R_C) for I_C = 1 mA, V_{CE} = 5 V, V_E = 2 V, V_{CC}= 12 V (let R_2 = 10 k) using BJT model. (You need not connect the capacitors and load resistor at this stage).

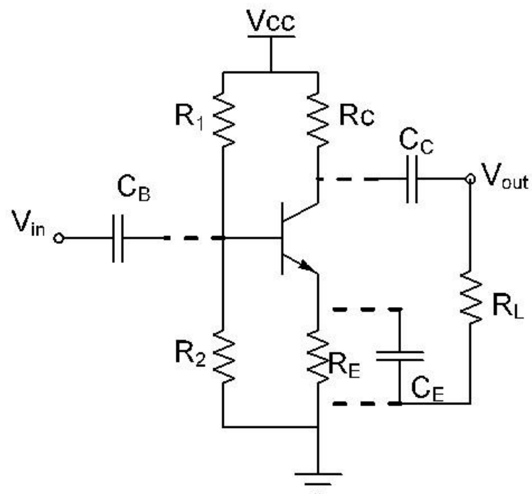

Figure 1

2. Write the netlist for the circuit you designed. Use the model for BJT 2N2222A

   .MODEL Q2N2222A NPN(IS=8.11E-14 BF=205 VAF=113 IKF=0.5 ISE=1.06E-11

   + NE=2 BR=4 VAR=24 IKR=0.225 RB=1.37 RE=0.343 RC=0.137 CJE=2.95E-11

   + TF=3.97E-10 CJC=1.52E-11 TR=8.5E-8 XTB=1.5)

3. Run the simulation. Note down the values of V_{CE}, I_C, I_E, I_B, V_E and verify them with their calculated values.

4. Choose the appropriate values of C_B, C_C, C_E for the signal frequency of 2 kHz to be in the mid-band region. Use R_L=1k.

5. Observe the output voltage waveform and input voltage waveform for V_{in} = 100 mVp−p at 2 kHz.

6. Measure the frequency response of the amplifier by varying the frequency from 10 Hz to 1.5 MHz.

Hardware Exercise Objectives:

1. To study the effect of proper biasing on the performance of BJT amplifier
2. To study the frequency response of the CE amplifier

Equipment/Components Required:

1. BJT- 2N2222
2. Resistors of suitable values
3. Capacitors of suitable values
4. Regulated power supply – 12V
5. Arbitrary Function Generator
6. Digital Storage Oscilloscope

Steps:

1. Wire up the circuit as shown in Figure 1 with suitable values of the resistors. Make sure that the BJT is operating in active region and also the values of C_B, C_C, C_E are sufficiently large for the signal frequency of 2 kHz to be in the mid-band region.
2. Bias the circuit using regulated power supply and take the input, V_{in} from AFG. Check your calculations against measurements made with a sinusoidal signal having frequency of 2 kHz (use oscilloscope, not multi-meter). Keep the input voltage sufficiently small so as to give an undistorted output.
3. Fix the amplitude of the sinusoidal input to 200 mV_{p-p} and vary the frequency from 100 Hz to 1.5 MHz.
4. Observe the input and output waveforms on DSO. Observe and calculate the voltage gains.
5. Increase the input amplitude to 500 mV_{p-p} and 1V_{p-p} and study the frequency characteristics of the amplifier circuit. Is the output signal distorted?
6. Plot the frequency responses of the amplifier (log-log plot) and comment on the salient features you observe.