EEO 352 Fall 2023 - Assignment 8 – Bipolar Junction Transistors (BJTs)

Please document each step with snapshots of the built circuit, plots, pictures and your observations. Please include this page.
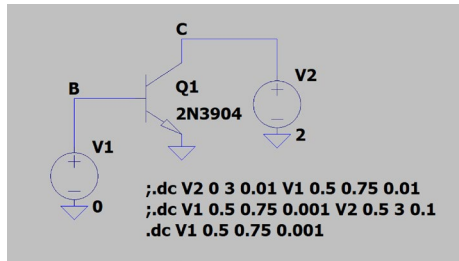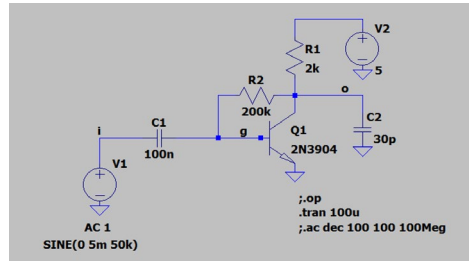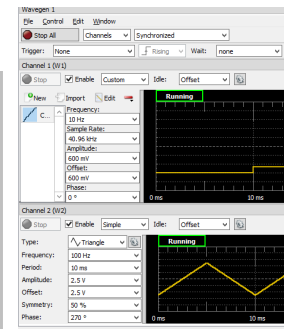

| Fig.1 | Fig.2 | Fig.3 |

1) Using the npn BJT 2N3904 (pick from npn) as in Fig1 simulate and plot the following (**25pts**):

   a) Collector current Ic vs Vce (range 0V to 3V) with parametric Vbe (0.5V to 0.75V, 10mV steps)

   b) Collector current Ic vs Vbe (range 0.5V to 0.75V) with parametric Vce (0.5V to 3V in 100mV steps)

   c) Collector current Ic vs Vbe (range 0.5V to 0.75V) at Vce=2V, and extrapolate the Vbe at Ic=1mA

   d) Derivative (d(.)) of the collector current Ic vs Vbe (range 0.5V to 0.75V) at Vce=2V, and extrapolate the transconductance at Ic=1mA

   e) Current gain Ic/Ib vs Vbe (range 0.5V to 0.75V) at Vce=2V, and extrapolate the gain at Ic=1mA

2) Using the npn BJT 2N3904, one 2kΩ resistor at the collector, and one 200kΩ to bias the base, build the amplifier in Fig.2 and simulate and plot the following (**25pts**):

   a) Response to 50kHz 5mV sinusoidal signal (plot in separate panes) and extrapolate the gain

   b) Frequency response, extrapolating the gain and -3dB bandwidth without and with a 30pF load

3) Using the npn BJT 2N3904, one 100Ω resistor at the collector and one 10kΩ resistor at the base (between the base and the applied voltage), build and plot (**75pts**):

   a) Collector current Ic vs Vce (range 0V to 3V) with parametric Vbe (see example in Fig.3)

   b) Collector current Ic vs Vbe (range 0.5 to 0.75V) for Vce>2V, and extract the Vbe and the gm at Ic=1mA

   c) Gain Ic/Ib vs Collector current Ic (setting as in (b)) and extract the gain at Ic=1mA

   Hint1: for (b) use W1 Triangle Amp=0.3V, Off=0.9V at the 10kΩ

   Hint2: for (c) use connect C2 across the 10kΩ and add Math Ic/Ib

4) Build and measure the amplifier in Fig.2 and plot the following (**75pts**):

   a) Response to 50kHz 5mV sinusoidal signal and extract the gain

   b) Frequency response, extracting the gain and the -3dB bandwidth

   Hint1: for (b) use the minimum signal amplitude