UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE 105 Prof. Pister
Spring 2011

LAB 3 Bipolar Junction Transistor – Prelab

Start with the prelab instructions for Lab3, sp10, with the following modifications:
SKIP part 4.
ADD part 5: Add a 5k resistor to the base (input) and between V_{DD} and the collector (output) of your SPICE circuit from part 3. With a 5V supply, estimate the input bias voltage necessary to put the output at 2.5V. Estimate the voltage gain at that bias voltage. Use .dc in SPICE to plot V_{OUT} vs. V_{IN} and use awaves to calculate the gain vs. bias point (awaves can take derivatives).

LAB 3 Bipolar Junction Transistor

Start with the instructions for Lab3, sp10, with the following modifications
ADD part 1.7B:
Use two different values for VCC and estimate the value of r_o and V_A.

SKIP parts 3.2, 3.3, and 3.4.

ADD Part 5:
The common emitter can be used as an analog amplifier and a digital inverter.
5A) Using V_{CC}=5V, modify the circuit in Figure 1 to achieve the maximum voltage gain that you can. You might want to use your SPICE deck from the prelab to help design this amplifier. **5% extra credit** for the group in each lab section that demonstrates the highest gain to the TA during the lab. Drive the input of your circuit with a small, low frequency sine wave to show the gain. Make sure that you record the bias conditions, and capture an image that shows the input and output waveforms to prove your claim.
5B) Using the amplifier that you built for part 4A, measure the DC transfer function from V_{IN} to V_{OUT}.
i) Estimate the maximum slope of the transfer function. How well does it correspond to your gain from part 4A?
ii) Hook your inverter up with some of the other lab groups' to form a ring oscillator. Measure the frequency of oscillation, and record the details of the waveform.
5C) Extra, for fun (and maybe a little credit): make a TTL NAND gate and demonstrate it to the TA. Use your ring oscillator to drive a voltage doubler, or a a diode ladder. How high can you go?

LAB 3 Bipolar Junction Transistor - Report

Start with the instructions for Lab3, sp10, with the following modifications:
ADD 3.1.7B:
Show your calculations for r_o and V_A.
SKIP sections 3.2, 3.3, and 3.4
ADD 3.5:
5A) Draw your final circuit, showing clearly all component values, bias currents, and bias voltages, and the input/output waveforms proving your gain.
5Bi) Turn in the plot of the DC transfer function,
5Bii) turn in a schematic of your ring oscillator, and a plot of the waveform. Make sure that you clearly indicate the frequency and amplitude of oscillation.