You will follow the same basic procedure that the revision of Exp. 6 for the JFET requested, i.e., you will measure the output characteristics using the oscilloscope for the display, estimate parameters for the model for the transistor, then use PSpice with the model parameters to produce the same output characteristics, and finally compare the simulated and measured results.

Follow the instructions in the EE 248 manual for Exp. 7 as modified below; the revision addresses the procedures for finding both the common base characteristics (1-4) and the common emitter characteristics (4-8); you will not perform the temperature bath procedure 9.

Common-base characteristics:
1,2 - No change. Note that you are essentially measuring the reverse bias saturation current for a diode, the base-collector junction with the base-emitter junction a open circuit (iE = 0). Note that vEB is not necessarily zero; measure it.
3,4 - Modify the circuit in Figure 1 as follows. The voltage VCC will be varied and the current iE will be used as a parameter to obtain a set of curves of iC as a function of vCB with iE as a parameter. Therefore, use the function generator as the source for VCC and the DC power supply as the source for vEE. Monitor the value of iE with the DMM using Ohm's law and the voltage of R1. Set the value of the function generator to 10 Vpp with a 5 V DC offset using the triangular wave at a frequency of about 30 Hz; observe the waveform on the scope to verify its value. The DC power supply should initially be set to 0 V for vEE. Using the collector terminal as the ground reference, connect the x channel of the scope to measure vCB and the y channel of the scope to measure the voltage across the 100 ohm resistor. Ohm's law will be used to determine iC, and you will annotate the printed scope y axis display to present the values of vC. Be sure to measure the 100 and 1000 ohms resistors and use that value for the calculations. Note that the polarity of the x channel must be inverted to display vCB. Adjust the position and the scale settings of the scope to maximize the size of the display - the origin should be near the lower left hand corner, the curve should be near the top of the display at the maximum value of the resistor voltage, and near the right side of the display for the maximum value of vCB. Print the display for iE = 0, 1, 2, 3, 4, and 5 mA, and then annotate them; you can use PAINT to present all the curves on one display.

Common-emitter characteristics:
5,6 - No change.
7,8 - Modify the circuit in Figure 2 as follows. The voltage VCC will be varied and the current iB will be used as a parameter to obtain a set of curves of iC as a function of vCE with iB as a parameter; use a value of R1 of 100 Kohms (rather than the 68 Kohms shown). Use the DC power supply for VBB and the function generator with the same output as above for VCC. Follow the same basic procedure as before, but measure current iB using the voltage across R1 and Ohm's law. Capture the output displays of iC versus vCE for iB = 0, 10, 20, 30, 40, and 50 uA, and use PAINT to present all the curves on one display as before.

9. Notes on the PSpice model for a BJT (see Tinenga second edition Section 14.5): The basic BJT PSpice model will be used (refer to the JFET as a template):

Qname collector_node base_node emitter_node model_name
.MODEL model_name NPN ( IS = value BF = value VA = value)

The DC model for the JFET to be used in this project will use the default parameters except for the following measured values of IS, BF, and VA. Note that IS is the transport saturation current, and should be on the order of 10 nA; use ICEO as a rough estimate. Use the common emitter measurements to estimate BF as iC / iB, and the slope to estimate the Early voltage VA. Instead of investigating the temperature effects, you will compare the common emitter characteristics of the PSpice model results with your measurements. This may require “fine tuning” of the input parameters IS, BF and VA; start with the default values for IS and VA. Since you will be using the input current iB as a parameter, replace the voltage source VBB with an independent current source IBB:

IBB positive_node negative_node ; positive current flow from positive node through ; the branch to the negative node

Then use the nested sweep DC instruction approach previously used:

.DC VCC 0 10 0.05 IBB 0 50u 10u ; nested sweep - start stop step

Obtain printed output of the PROBE display; do not forget to change the x axis variable to vCE. Discuss any discrepancies between the PSpice results and the measured value of the output characteristics for the common emitter circuit.