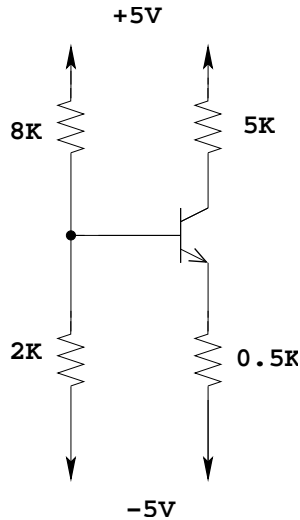


EE 321 - Exam 3

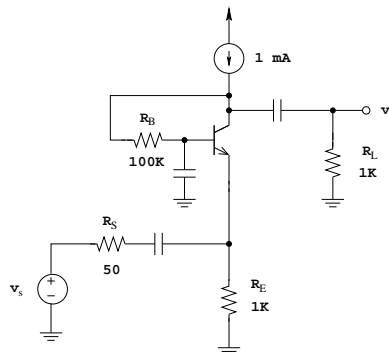
November 16, 1993

Closed book. One page of notes and a calculator are allowed. Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

- The following circuit shows an NPN transistor biased in the active mode. For the transistor, assume $\beta = 100$ and $V_A = 100$ V.

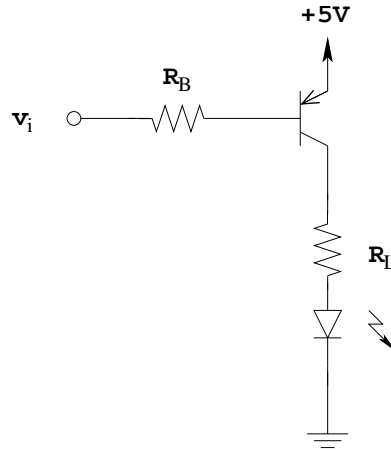


- Find the bias voltages at the base (V_B), the collector (V_C), and the emitter (V_E).
 - Find the base current (I_B) and the collector current (I_C).
 - Find the small-signal parameters g_m , r_π , r_e and r_o .
- The circuit below is used as an amplifier. Assume $\beta = 100$.



- Draw the small-signal model for the amplifier. You may ignore r_o . (Hint: One of the small-signal models is easier than the other.)
- Find the input impedance of the amplifier R_{in} .
- Find the output impedance of the amplifier R_{out} .
- Find the voltage gain of the amplifier $A_v = v_o/v_s$.

3. The following circuit is used to drive a light-emitting diode. The input voltage v_i will be either 0 V or 5 V, The minimum β for the transistor is 50. The LED needs 20 mA of current to operate properly, With 20 mA of current the forward voltage drop across the diode is 2 V.



- Find R_L to give a current of 20 mA when the transistor is on.
- Find R_B to provide an overdrive factor of 10.
- Is the LED on or off when $v_i = 5 V$?