Name: _____ (please print)

Signature: _____

ECE 3455
Quiz #6
Summer 2010

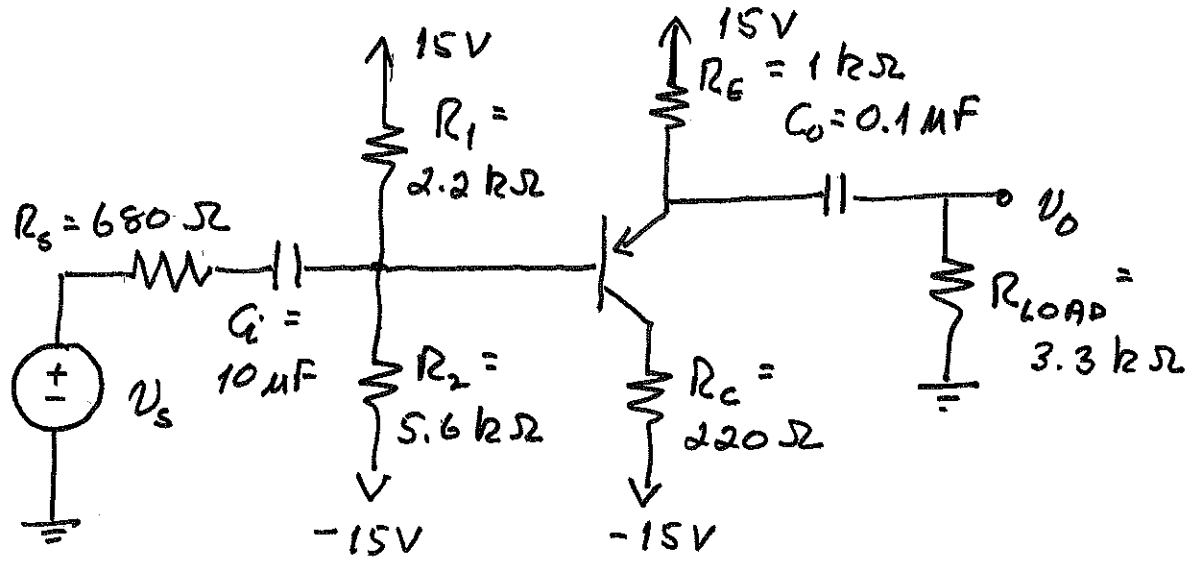
Quiz duration: 30 minutes

1. You may have one 8 ½ x 11 in. "crib" sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

SOLUTION

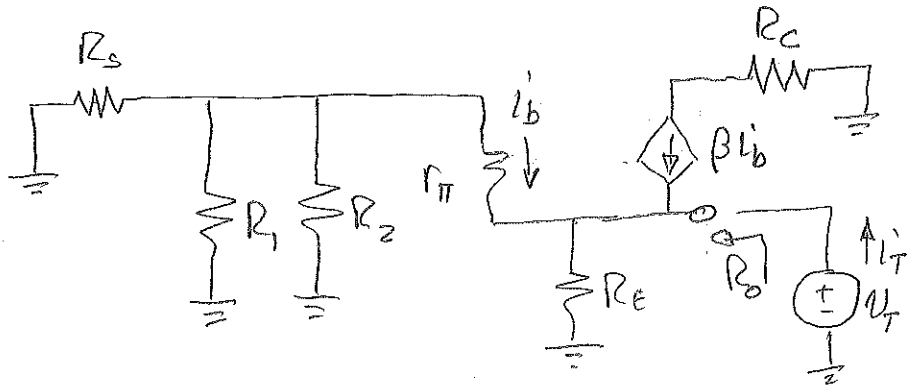
_____/20

The BJT below is biased in the linear region. There is no need to prove this assertion. The resistance r_π is 650 Ω and $\beta = 200$. Find the resistance seen by the load in the pass band. Note that in the pass band, amplifier parameters are not dependent on frequency, because reactive circuit elements have no effect.



In the passband, the capacitors will act as short-circuits. If we were to open-circuit either one, the output would be 0, which we will assume is not "passband".

So we need an ac circuit model, with capacitors shorted:



In this drawing we have removed the load and indicated the output resistance R_o, and de-activated the signal v_s.

Now R_s, R_1, R_2 are in parallel, and that result is in series with r_π, so if we put a test source v_T in, as shown, we have...

Room for Extra Work

$$i_b' = -\frac{v_T}{R_S \| R_1 \| R_2 + r_\pi}$$

Also $$i_T' = -(\beta+1) i_b' + \frac{v_T}{R_E} = \frac{(\beta+1) v_T}{R_S \| R_1 \| R_2 + r_\pi} + \frac{v_T}{R_E}$$

$$= v_T \left(\frac{\beta+1}{R_S \| R_1 \| R_2 + r_\pi} + \frac{1}{R_E} \right)$$

$$\Rightarrow \quad R_o = \frac{v_T}{i_T'} = \left(\frac{\beta+1}{R_S \| R_1 \| R_2 + r_\pi} + \frac{1}{R_E} \right)^{-1} = 5.56\ \Omega$$