IMPORTANT: Besides your calculator and the sheets you use for calculations you are only allowed to have an A4 sized "copy sheet" during this exam. Notes, problems and alike are not permitted. Please submit your "copy sheet" along with your solutions. You may get your "copy sheet" back after your solutions have been graded. **Do not forget to write down units!**

# ELE222E INTRODUCTION TO ELECTRONICS (21403)
## Midterm Exam #2 ✏ 30 April 2007 ⏰ 10.00-12.00
### İnci ÇİLESİZ, PhD, Mustafa ALTUN, BSE

1. The amplifier shown below consists of two identical common-emitter amplifiers connected in cascade. Recall, that the input resistance of the second stage, $r_{in2}$, constitutes the load resistance of the first stage.
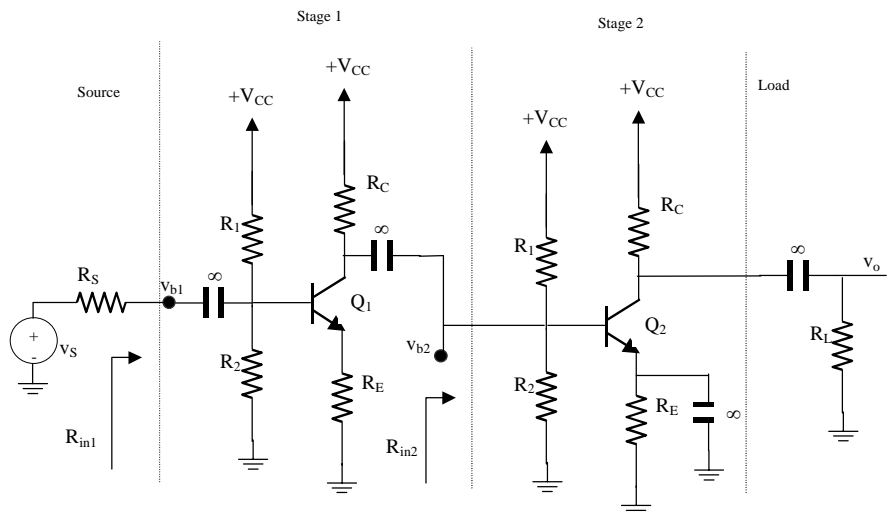
   a. For $V_{CC}$ = 15 V, $R_1$ = 100k, $R_2$ = 47k, $R_E$ = 3k9, $R_C$ = 6k8 and $h_{FE}$ = 100, find the DC collector currents and DC collector voltages of each transistor. (10 points)

   b. Find $r_{in1}$ and $v_{b1}/v_s$ for $R_s$ = 5k. (5 points)

   c. Find $r_{in2}$ and $v_{b2}/v_{b1}$. (10 points)

   d. Find $v_o/v_{b2}$ for $R_L$ = 2k. (10 points)

   e. Find the overall voltage gain $v_o/v_s$. (5 points)

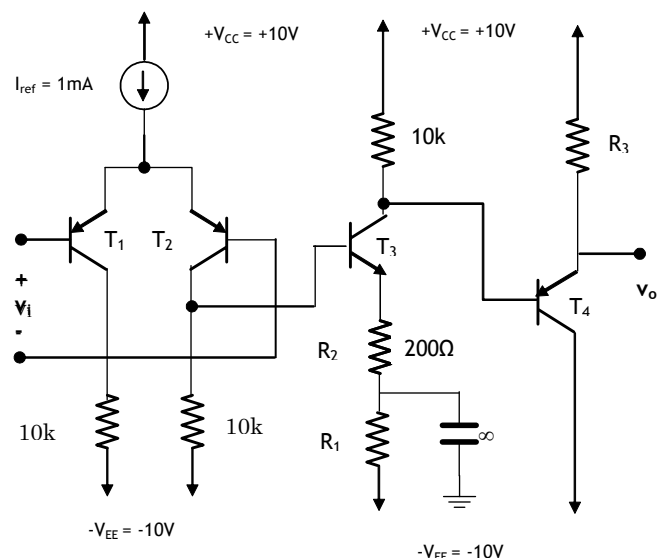2. Design a current mirror based constant current source for 1 mA DC current using pnp transistors. (10 points)

   a. Using the current mirror designed find $R_1$, $R_3$, $I_{C3}$ and $I_{C4}$ in the 3-stage amplifier circuit given below for $V_o$ = 0V and $r_o$ = 50Ω.

   Note, $h_{FE}$ = $h_{fe}$ = 250, $V_T$ = 25 mV, $|V_{BE}|$ = 0,6 V, $h_{oe}$ = $h_{re}$ = 0. (25 points)

   b. Do the AC analysis of the circuit below and find the total voltage gain, CMRR, and the differential input resistance. (25 points)

   If you could not find the collector currents correctly in (a), use the following values and do the AC analysis:
   $R_1$ = $R_3$ = 4k; $I_{C3}$ = $I_{C4}$ = 1 mA.

## GOOD LUCK!