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EHB222E Introduction to Electronics
MIDTERM II

Duration: 120 Minutes

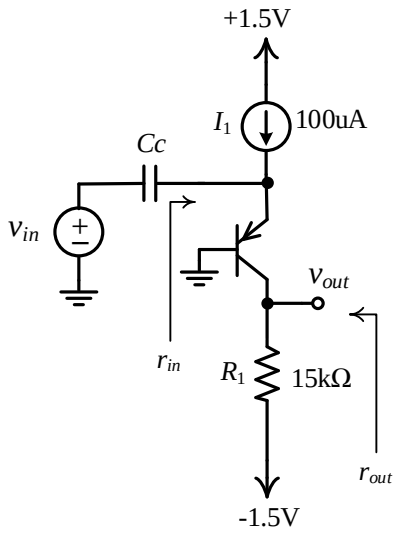
Grading: 1) 30%, 2) 30%, 3) 40%

Exam is in closed-notes and closed-books format; calculators are allowed

For your answers please use the space provided in the exam sheet

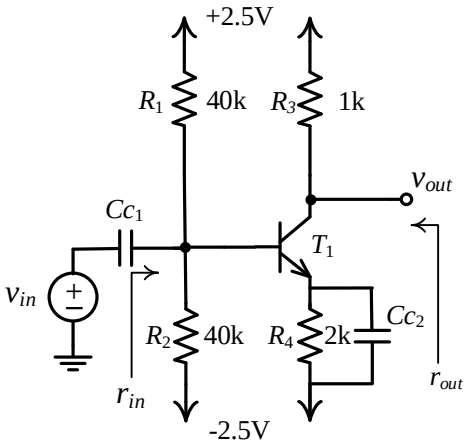
GOOD LUCK!

1) Consider an amplifier shown below. Suppose that the value of *Cc* is high enough, so it can be considered shorted in small signal analysis. Find the small signal values of r_{in}, r_{out}, and v_{out}/v_{in}. *PNP Transistor Parameters:* $|V_{BE}| = 0.7$, $\beta = 100$, $|V_A| = 10V$, $V_T = 25\ mV$.



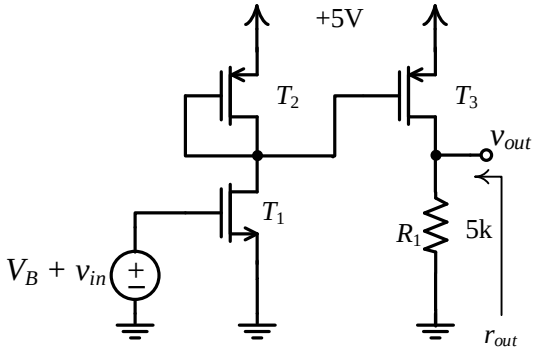
Common Base Amplifier.

2) Consider an amplifier shown below. Suppose that the value of the coupling capacitors Cc_1 and Cc_2 are high enough, so they can be considered shorted in small signal analysis. Find the small signal values of $\boldsymbol{r_{in}}$, $\boldsymbol{r_{out}}$, and $\boldsymbol{v_{out}/v_{in}}$.
NPN Transistor Parameters: $V_{BE} = 0.7$, $\beta = 40$, $V_A = \infty$, $V_T = 25\ mV$.



Common Emitter Amplifier

3) Consider a two-stage amplifier shown below. Suppose that $\boldsymbol{V_B = 2V}$. All PMOS transistors are identical. Determine the small signal output resistance $\boldsymbol{r_{out}}$ and the gain $\boldsymbol{v_{out}/v_{in}}$.



Two-Stage Amplifier

Transistor parameters: $k_p' = \mu_p c_{ox} = 50\text{uA/V}^2$, $k_n' = \mu_n c_{ox} = 100\text{uA/V}^2$, $V_{An} = |V_{Ap}| = 25\text{V}$, $V_{T,n} = 1\text{V}$, $V_{T,p} = -1\text{V}$, $W_{P2} = 32\text{u}$, $L_{P2} = 1\text{u}$, $W_{P3} = 80\text{u}$, $L_{P3} = 1\text{u}$, $W_{n1} = 4\text{u}$, $L_{n1} = 1\text{u}$.

- In DC analysis, neglect the Early effect and use the following equation:

$$I_D = \frac{1}{2} k'_{p,n} \frac{W}{L} (V_{GS} - V_{T\,p,n})^2 .$$

- In small analysis you should consider the Early effect.
- To find the gain ($\boldsymbol{v_{out}/v_{in}}$) of the amplifier, you need to find the gain of each stage.