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Student ID:

Date: 29/11/2012

EHB262E Electronics II, Fall 2012
MIDTERM

Duration: 75 Minutes
Grading: 1) 20% (4% each), 2) 40%, 3) 40% (20%+20%)
Exam is in closed-notes and closed-books format
For your answers please use the space provided in the exam sheet
GOOD LUCK!

1) Please circle TRUE if you think that the statement is true; FALSE otherwise.

a. While obtaining the small signal gain of an amplifier, all dependent voltage sources should be shorted.
TRUE / FALSE

b. If a voltage amplifier has a 1 Volt DC input and a 3 Volt DC output values then the small signal gain of the amplifier is 3 (3V/1V).
TRUE / FALSE

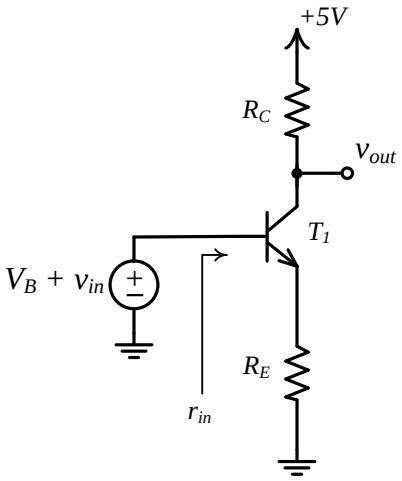
c. In analog circuits, MOS transistors are preferably operating in triode (linear) region.
TRUE / FALSE

d. Consider two voltage amplifiers with small signal gains of A and B and infinite small signal input resistances. Cascading them results in an amplifier with a small signal gain of A×B.
TRUE / FALSE

e. Consider a current amplifier with a small signal gain of 100 and a small signal output resistance of 3kΩ. If this amplifier drives a load resistance of 1kΩ then the gain of the amplifier reduces to 75.
TRUE / FALSE

2) You are asked to design an amplifier satisfying the following specifications: $\mathbf{r_{in} \geq 200\ k\Omega}$ and $\mathbf{|v_{out}/v_{in}| \geq 10}$. Use the amplifier shown below and determine the minimum values of $\boldsymbol{R_E}$ and $\boldsymbol{R_C}$ to meet the specifications where $\boldsymbol{V_B = 0.95V}$.

Transistor parameters: $V_{BE} = 0.7$, $\beta = 100$, $V_A = 100V$, $V_T = 25\ mV$.



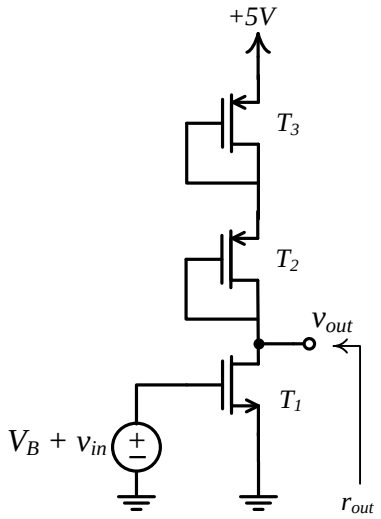
Common Emitter Amplifier with an Emitter Resistance

3) Suppose that $\boldsymbol{V_B = 1.5V}$ and all NMOS/PMOS transistors are identical. In DC analysis, use the following equation:

$$I_D = \frac{1}{2} k'_{p,n} \frac{W}{L} (V_{GS} - V_{T0\,p,n})^2 .$$

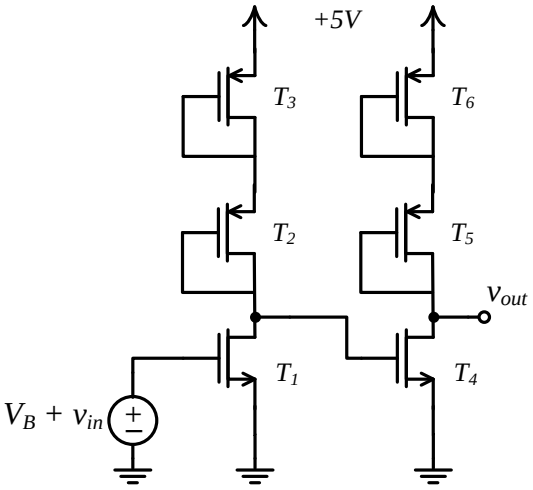
Transistor parameters: $k_p' = \mu_p c_{ox} = 50\text{uA/V}^2$, $k_n' = \mu_n c_{ox} = 100\text{uA/V}^2$, $V_{An} = V_{Ap} = 100\text{V}$, $V_{T0,p} = -1\text{V}$, $V_{T0,n} = 1\text{V}$, $W_P = 16\text{u}$, $L_P = 1\text{u}$, $W_n = 8\text{u}$, $L_n = 1\text{u}$,.

a. Determine the small signal gain $\boldsymbol{v_{out}/v_{in}}$ and the small signal output resistance $\boldsymbol{r_{out}}$ of the amplifier shown below.



Common Source Amplifier

b. Determine the small signal gain v_{out}/v_{in} of the cascaded amplifier shown below.



Two-stage (Cascaded) Amplifier