

# ECE 3110: Midterm I Review GAMESHOW!!!

Your host: The Esteemed Prof. Cameron Charles

October 2, 2008

## Gameshow Rules

- ▶ Divide into two teams (down the middle).
- ▶ Each question is assigned a point value.
- ▶ First person to put their hand up gets the first shot at answering the question, if they are correct their team scores the point value of the question. If they are incorrect, their team loses the point value of the question and the other team gets a chance to answer.
- ▶ The entire winning team is excused from writing the midterm next week.

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- ▶ The entire winning team is excused from writing the midterm next week.
- ▶ **Just kidding!** Your prize is the feeling of satisfaction at knowing you just dominated the ECE 3110 Gameshow.

## 5 points

*Question:* An amplifier has a **power** gain of 100, what is this expressed in dB?

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*Answer:* 20 dB (Use  $10 \cdot \log(X)$  for power gain,  $20 \cdot \log(X)$  for voltage or current gain)

## 5 points

*Question:* What are the two signal components that are analyzed separately in small signal analysis?

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*Answer:* The bias point (1) and the signal component (2).

5 points

*Question:* Who is the Prime Minister of Canada?

5 points

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*Answer:* Stephen Harper, of the Progressive Conservative Party.

5 points

*Question:* What is the **physical** difference between the source and the drain of an integrated MOSFET?

## 5 points

*Question:* What is the **physical** difference between the source and the drain of an integrated MOSFET?

*Answer:* Nothing, the source and drain are physically identical and are determined by biasing.

5 points

*Question:* What are the **two** conditions that must be satisfied to place a MOSFET in the **saturation** region?

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*Question:* What are the **two** conditions that must be satisfied to place a MOSFET in the **saturation** region?

*Answer:*  $V_{GS} > V_t$  to form an inversion layer, and  $V_{DS} \geq V_{GS} - V_t$  to pinch it off at the drain end.

5 points

*Question:* Who won the Tour de France this past July?

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*Answer:* Carlos Sastre, of Team CSC.

## 5 points

*Question:* What small signal model parameter does the early voltage ( $V_A$ ) determine?

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*Answer:*  $r_o$ , which is due to channel length modulation.

## 5 points

*Question:* What is the most important part of the small signal model, and should its value be high or low?

## 5 points

*Question:* What is the most important part of the small signal model, and should its value be high or low?

*Answer:* The transconductance,  $g_m$ , is the most important part, and we typically prefer that it be as high as possible.

## 5 points

*Question:* Which male hollywood personality is most often spotted with no shirt on?

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*Answer:* Matthew McConaughey.

5 points

*Question:* What advantage do BJTs have over MOSFETs?

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*Question:* What advantage do BJTs have over MOSFETs?

*Answer:* The transconductance,  $g_m$ , is linearly related to the bias current (for a MOSFET it is a square root relationship) so we can get more gain for less current (and thus less power consumption).

# 5 points

*Question:* Give **2 reasons** why most modern integrated circuit design is done with MOSFETs instead of BJT's?

## 5 points

*Question:* Give **2 reasons** why most modern integrated circuit design is done with MOSFETs instead of BJT's?

*Answer:* Higher integration levels, easy to construct complementary devices, infinite input impedance (at DC) leads to reduced power consumption.

5 points

*Question:* Where would your life be without ECE 3110?

5 points

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*Answer:* In shambles.

5 points

*Question:* What are coupling capacitors used for?

## 5 points

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*Answer:* They allow biasing by blocking dc current flow while allowing high frequency signals to pass.

5 points

*Question:* What ideal component does a current mirror replace?

## 5 points

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*Answer:* A current source.

## 5 points

*Question:* When did Sarah Palin (John McCain's running mate) first obtain a passport and venture outside of the US and A?

## 5 points

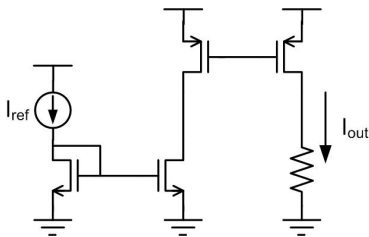
*Question:* When did Sarah Palin (John McCain's running mate) first obtain a passport and venture outside of the US and A?



*Answer:* July, 2007 (!?!)

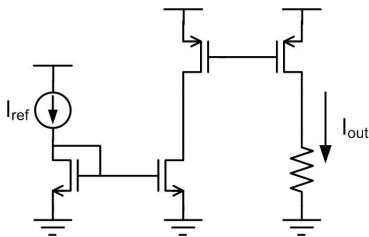
## 5 points

*Question:* Would this current mirror work, and if not, why not?



## 5 points

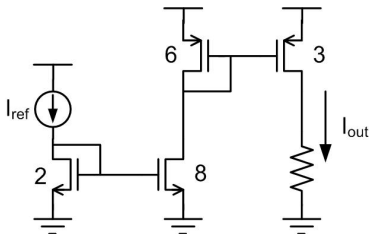
*Question:* Would this current mirror work, and if not, why not?



*Answer:* No, it is missing the gate-drain connection on the leftmost PMOS.

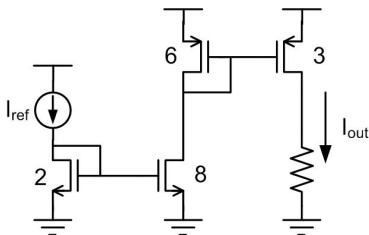
5 points

Question: What is  $I_{out}$  for this current mirror (in terms of  $I_{ref}$ )?



5 points

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Answer:  $I_{out} = 2 \times I_{ref}$

5 points

*Question:* Who is 7-time Tour de France winner Lance Armstrong currently dating?

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*Question:* Who is 7-time Tour de France winner Lance Armstrong currently dating?

**Lance Armstrong Relationships**

**Who is Lance Armstrong dating?**

Click on the photos to find out Who's Dated Who...

Photo coming very soon

[Lisa Ziehl](#)  
2008 - 01

[Krista Armstrong](#)  
2008 - 01

[Sandra Bullock](#)  
2007 - Leo

[Phenyl Creeve](#)  
2004 - 06 Aquarius

[Tary Burch](#)  
2007

[Ashley Olsen](#)  
2007 - 08 Gemini

[Kate Hudson](#)  
2002 - 04 Aries

[Profile](#) [Married](#) [Relationship](#) ["Encounter"](#) [On-Screen Romance](#)

*Answer:* Kate Hudson.

5 points

*Question:* When a current mirror is used as an active load, what operating region should it be biased in?

## 5 points

*Question:* When a current mirror is used as an active load, what operating region should it be biased in?

*Answer:* The saturation region.

5 points

*Question:* What small signal parameter do we care most about for an active load transistor?

5 points

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*Answer:*  $r_o$

## 5 points

*Question:* How much money did Congress recently allocate to bail out troubled Wall Street companies?

5 points

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*Answer:* \$700 Billion

## 5 points

*Question:* Does  $r_o$  for the active load change as the bias current increases, and if so, in what direction?

## 5 points

*Question:* Does  $r_o$  for the active load change as the bias current increases, and if so, in what direction?

*Answer:* Yes, it decreases.

## 5 points

*Question:* Name one advantage of using an active load for a common source amplifier (as compared with using a passive resistive load).

## 5 points

*Question:* Name one advantage of using an active load for a common source amplifier (as compared with using a passive resistive load).

*Answer:* The active load will be smaller, and will typically present a higher load impedance for a given voltage drop and bias current.

5 points

*Question:* Who is the man in the picture below?



5 points

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*Answer:* Ali G (as played by Sasha Baron Cohen).

## 5 points

*Question:* What large signal differential voltage must be applied to a differential pair to steer the current entirely to one side?

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*Answer:*  $\sqrt{2} \cdot V_{OV}$

## 5 points

*Question:* What is the differential gain of a resistively loaded differential pair (with the output taken differentially)?

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*Answer:*  $g_m R_D$

5 points

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*Answer:* Ottawa, Ontario.

5 points

*Question:* What is the definition of the CMRR?

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*Answer:* Common-mode rejection ratio =  $A_{dm}/A_{cm}$

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*Question:* What is the CMRR of a resistively loaded differential pair with the output taken differentially?

*Answer:* Infinite.

## 5 points

*Question:* Which American president spoke the following quote: “I hear there’s rumors on **the Internets** that we’re going to have a draft.”

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*Answer:* George W. Bush.

## 5 points

*Question:* What non-ideal effect does a mismatch in the resistive loads of a differential pair introduce in the opamp?

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*Answer:* Input offset voltage.

## 5 points

*Question:* What do we do with (a) transistor capacitances, and (b) coupling capacitors when determining the midband gain for an amplifier?

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*Question:* What do we do with (a) transistor capacitances, and (b) coupling capacitors when determining the midband gain for an amplifier?

*Answer:* Open circuit the transistor capacitances and short circuit the coupling capacitors.

5 points

*Question:* Who is the lead singer of Black Sabbath?

5 points

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*Answer:* Ozzy Osbourne.

## 5 points

*Question:* In order to reduce  $\omega_L$ , the low frequency cutoff for an amplifier, should we increase or decrease the size of the coupling capacitors?

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*Question:* In order to reduce  $\omega_L$ , the low frequency cutoff for an amplifier, should we increase or decrease the size of the coupling capacitors?

*Answer:* Increase.

## 5 points

*Question:* If a transfer function has two poles, at  $\omega_1 = 100$  rad/s and  $\omega_2 = 1000$  rad/s, what is the phase shift for a 1000 rad/s input signal?

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*Answer:*  $-135^\circ$

5 points

*Question:* What sport is pictured below:



5 points

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*Answer:* Cyclocross!!!

## 5 points

*Question:* Name three ways of estimating the 3-dB point of a circuit.

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*Answer:*

1. Dominant pole approximation.
2. Root-sum-of-squares with poles and zeros.
3. Open Circuit Time Constants.

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*Question:* Why does  $C_{GD}$  play a significant role in the frequency response of a common source amplifier, despite being much smaller than  $C_{GS}$ ?

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*Question:* Why does  $C_{GD}$  play a significant role in the frequency response of a common source amplifier, despite being much smaller than  $C_{GS}$ ?

*Answer:* The Miller Effect leads to a larger effective capacitance (by a factor of the amplifier gain) appearing at the gate terminal.

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*Question:* Which single-transistor amplifier topology would be a good choice to get gain at high frequencies?

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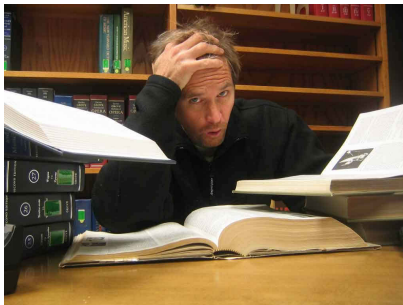
*Answer:* The common-gate topology (no Miller effect increasing the impact of  $C_{GD}$ ).

## 5 points

*Question:* What are your plans for this weekend?

5 points

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*Answer:* Study hard for ECE 3110 midterm!