Quiz 11

Due 22 Aug 2021 at 23:59 **Points** 10 **Questions** 10 **Time limit** 30 Minutes

Instructions

- The quiz will be displayed one question at a time. After you answer a question you will not be allowed to go back and modify your answer.
- The quiz is time limited. You must complete the quiz in a single session.
- The quiz is open-book. You may check the lectures, the textbook, or even the internet.
- You may need a calculator. You can use the calculator application of your computer or smart phone.
- For multiple choice questions: Choose the best answer.
- For numerical questions: Write your answer as a decimal number with three digits of precision (ex: 1.33). Do NOT use fractions (ex: 4/3 is not accepted) and do NOT use commas (ex: 1,33 is not accepted).
- You are NOT ALLOWED to share questions and/or answers with anyone.
- Sharing questions and/or answers will be considered CHEATING.
- Remember: ئال رسول الله صلى الله عليه وسلم: من غش فليس منا
- If you share questions you will get ZERO marks for this quiz.
- If you share answers you will get ZERO marks for this quiz and the next one.
- You will be able to access the questions, your answers, and the correct answers after the due date of the quiz.ك بالتوفيق
- دعواتي

Attempt history

	Attempt	Time	Score
LATEST		16 minutes	9 out of 10

Correct answers are hidden.

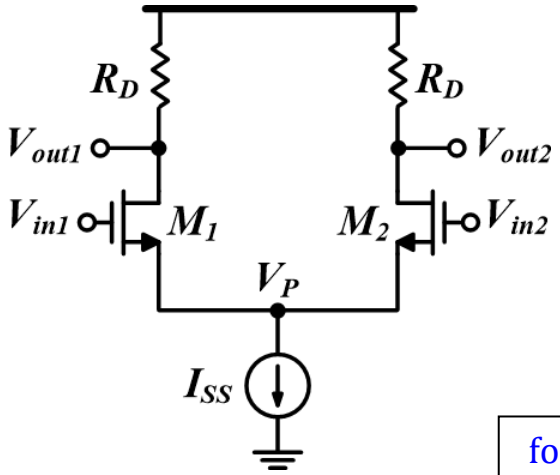
Score for this quiz: out of 10
Submitted 22 Aug 2021 at 23:52
This attempt took 16 minutes.

Question 1

1 / 1 pts

For the differential amplifier below, if a large signal Vid = Vin1 - Vin2 = -1 V is applied, then the voltage at Vout2 is approximately equal to_____.

Hint: For MOS diff amp, the current is fully steered when a large signal Vid > sqrt(2)*Vov,eq is applied, where Vov,eq is the equilibrium overdrive voltage.



for − Vid the current is fully steered to M2

the $I_{D2} = I_{SS}$

$V_{out2} = V_{DD} - I_{SS}R_D$

VDD - ISS*RD

- VDD
- 0
- VDD - (ISS/2)*RD

Question 2

1 / 1 pts

Compare the gain of a differential pair with that of a CS stage if both circuits are designed for equal power consumption, drain resistances (RD << ro), bias point (Vov), and supply voltages.

- The gain of diff pair is four times that of CS
- The gain of diff pair is half that of CS
- The gain of diff pair is equal to that of CS
- The gain of diff pair is twice that of CS

$\because I_{Cons}$ is the same $\rightarrow I_D$ of CS device $= 2I_D$ of diff pair device

$\because g_m = \frac{2I_D}{V_{ov}} \rightarrow g_m CS = 2g_m$ Diff pair

$A_v = g_m R_D$

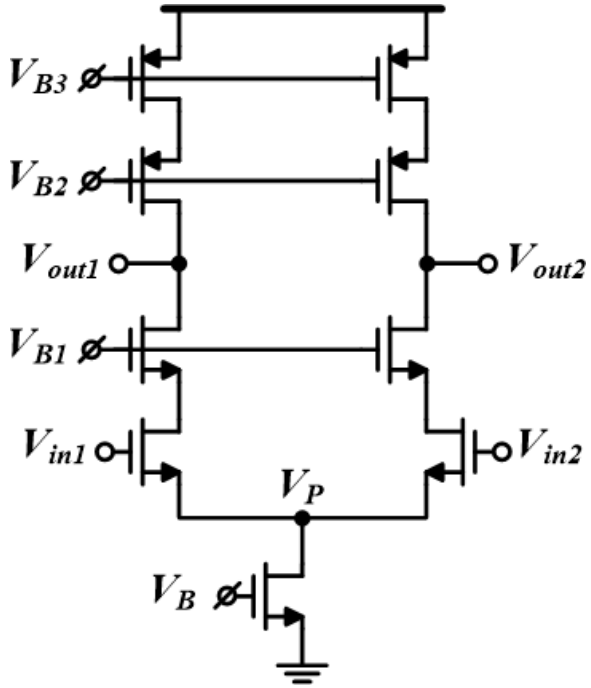
$\therefore$ the gain of diff pais is half that of CS

Question 3

1 / 1 pts

If VDD = 3 V and Vov for all transistors = 0.2 V, then the maximum possible peak-to-peak differential output swing is approximately equal to_____V.

Hint: You need to make sure that all transistors are in saturation. For each transistor, VDS > Vov. Note that the differential voltage swing is twice the single ended voltage swing. This is one of the important advantages of differential circuits.



- 3
- 2
- 1
- 4

$$\text{for half circuit} \rightarrow V_{out}\ \max = V_{DD} - 2V_{ov} = 2.6\ \text{v}$$

$$V_{out}\ \min = 3\ V_{ov} = 0.6$$

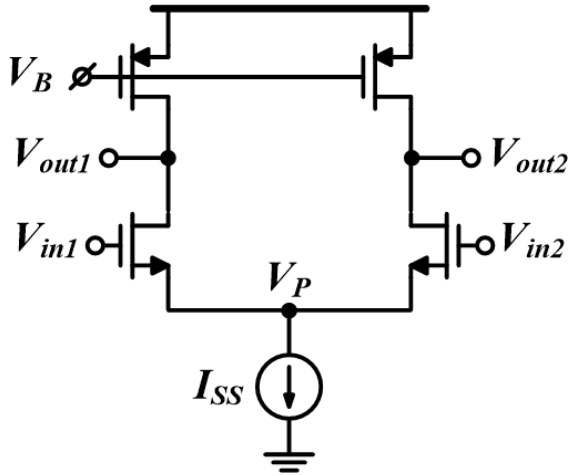
$$\therefore \max \text{swing} = 2.6 - 0.6 = 2\ \text{V}$$

$$\text{for diff swing} = 2\ \text{SE swing} = 2 \times 2 = 4$$

Question 4

1 / 1 pts

If VA = 10 V and Vov = 0.2 V, then the differential gain is approximately equal to_____.



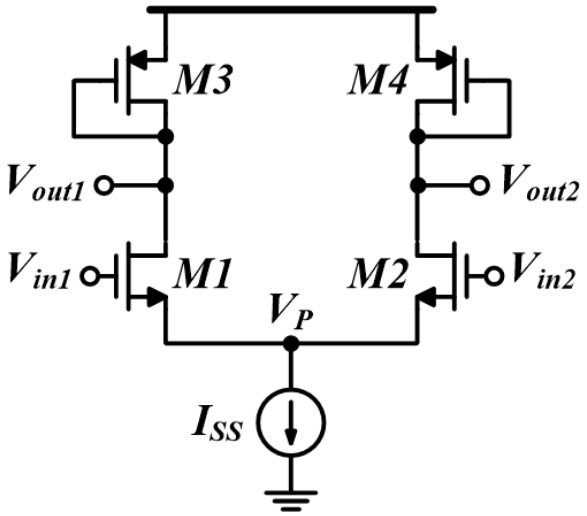
- 25
- 200
- 100
- 50

$$A_v = \frac{g_m r_o}{2} = \frac{2I_D}{V_{ov}} \times \frac{V_A}{I_D} \times \frac{1}{2} = \frac{V_A}{V_{ov}} = 50$$

Question 5

1 / 1 pts

If mobility of NMOS is three times that of PMOS, W/L of M1,2 = 10u/1u and W/L of M3,4 = 2u/1u, then the differential voltage gain is approximately equal to_____.



- 2.9
- 4.9
- 3.9
- 1.9

$$A_v = \frac{g_{mn}}{g_{mp}}$$

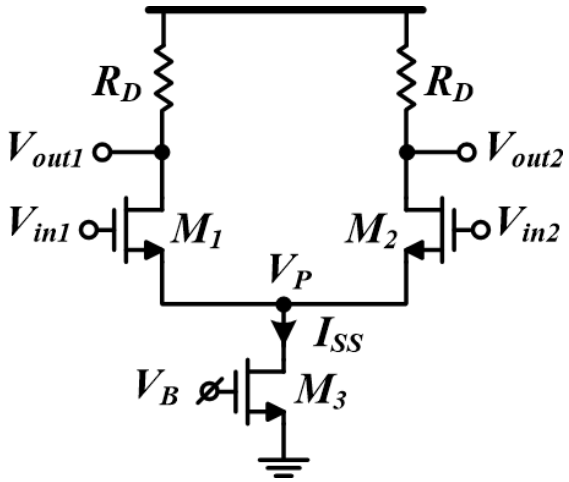
$$\because g_m = \sqrt{uC_{ox} \times \frac{W}{L} \times 2I_D} \rightarrow g_m \propto \sqrt{u} \text{ and } \sqrt{\frac{W}{L}}$$

$$g_{mn} = \sqrt{3} \times \sqrt{\frac{10u}{1u} / \frac{2u}{1u}} g_{mp} = 3.9\, g_{mp}$$

Question 6

1 / 1 pts

If VTH = 0.4 V and Vov = 0.2 V, then the minimum allowed Vicm is approximately equal to_____V.



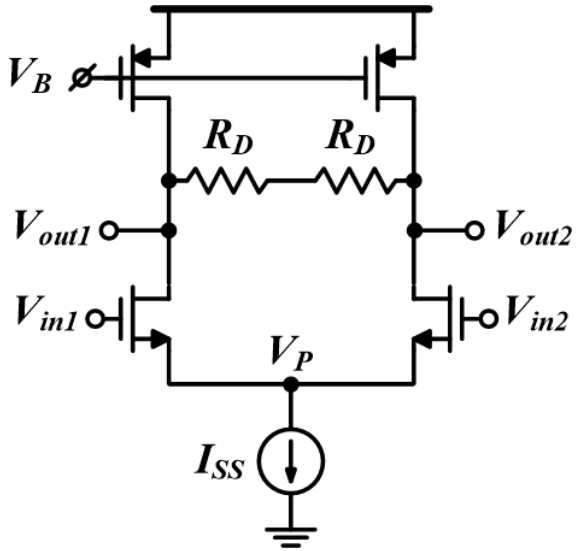
- 0.4
- 0.8
- 0.6
- 1

$$V_{ICM}\min = V_{GS1,2} + V_{ov} = 0.4 + 0.2 + 0.2 = 0.8\ \text{v}$$

Question 7

1 / 1 pts

If ISS = 1 mA, VA = 10V, Vov = 0.2 V, and RD = 10 kΩ, then the differential gain is approximately equal to _____.



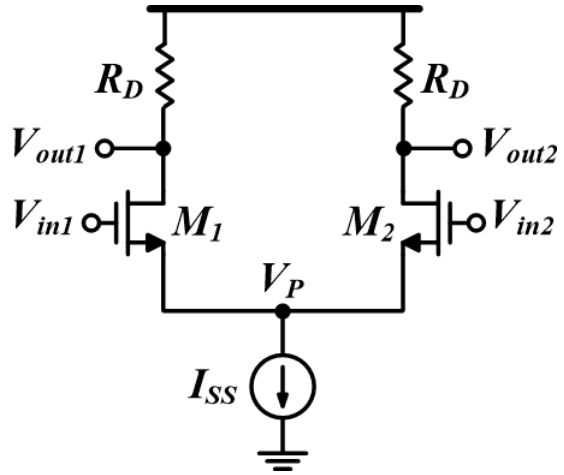
- 50
- 25
- 100
- 200

$$A_v = g_m[(R_D \parallel r_o) \parallel r_o] = \frac{2I_D}{V_{ov}} \times 5k = 25$$

Question 8

1 / 1 pts

For the shown differential pair assume RD << ro and the bias point (Vov) is kept constant. The maximum achievable gain is limited by_____.



- RD
- W/L
- VDD
- ISS

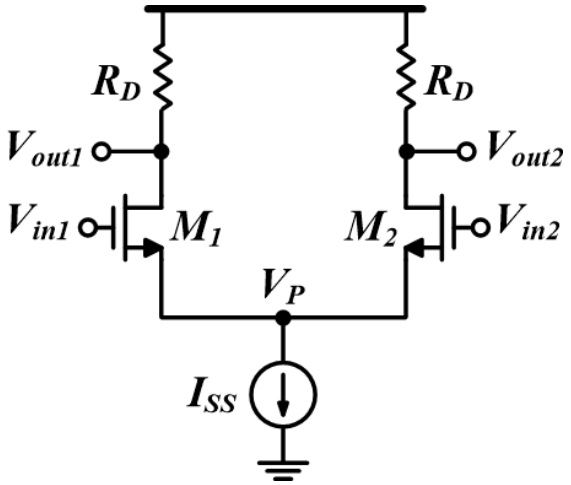
$$A_v = g_m R_D \rightarrow g_m = \frac{2I_D}{V_{ov}} \rightarrow \text{max gain @ max } I_D \rightarrow \text{the gain is limoted by } I_{SS}$$

Question 9

1 / 1 pts

For the differential amplifier below, if a large signal Vid = Vin1 - Vin2 = 1 V is applied, then the voltage at Vout2 is approximately equal to_____.

Hint: For MOS diff amp, the current is fully steered when a large signal Vid > sqrt(2)*Vov,eq is applied, where Vov,eq is the equilibrium overdrive voltage.



- VDD - (ISS/2)*RD
- VDD
- VDD - ISS*RD
- 0

for + Vid the current is fully steered to M1

the $I_{D2} = 0$

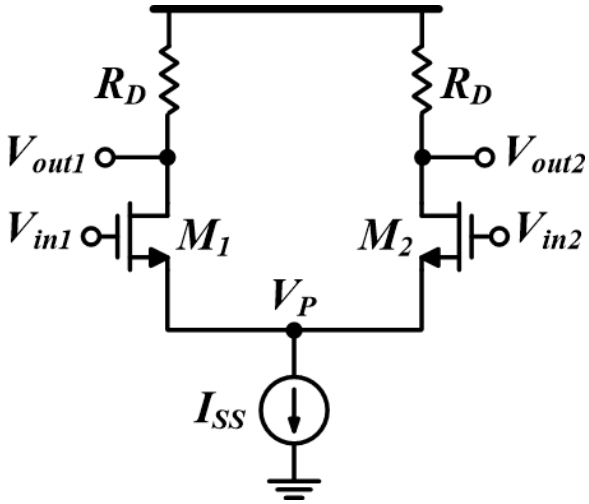
$V_{out2} = V_{DD} - 0 = V_{DD}$

Question 10

1 / 1 pts

If VDD = 3 V, ISS = 100 uA, VTH = 0.4 V, Vov = 0.2V, and RD = 20kΩ, then the maximum allowed common mode input voltage is approximately equal to_____V.

Hint: You need to make sure that M1,2 are in sat. Note that current splits equally at equilibrium.



- 3
- 1.4
- 2
- 2.4

$$\mathrm{CMIR_{max}} = \mathrm{V_{GS1,2}} - \mathrm{v_{ov}} - \mathrm{V_{RD}} + \mathrm{V_{DD}} = 0.4 - 50\mathrm{u} \times 20\mathrm{k} + 3 = 2.4\mathrm{v}$$