

# SOLUTION



## Habib University

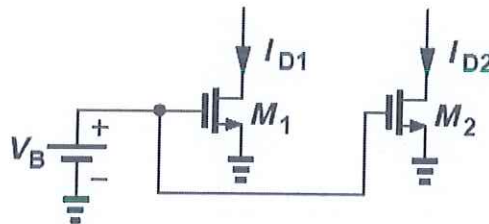
### Electrical Engineering Department

### Dhanani School of Science & Engineering

Course	EE/CE – 211 – Basic Electronics
Semester	Spring 2024
Section	Section L2
Exam	Quiz – 5
Instructor	Dr. Ahmad Usman
Total Marks	10

#### Question – 1 (CLO 2, Points: 10)

Two current sources realized by identical MOSFETs (as shown in the figure below) match to within 1%, i.e.,  $0.99I_{D2} < I_{D1} < 1.01I_{D2}$ . If  $V_{DS1} = 0.5 \text{ V}$  and  $V_{DS2} = 1 \text{ V}$ , what is the maximum tolerable value of  $\lambda$ ?



Remember:

$$I_D = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH})^2 (1 + \lambda V_{DS})$$

CASE # 1

$$0.99 I_{D2} = I_{D1} \quad ; \quad V_{DS1} = 0.5 \text{ V} , \quad V_{DS2} = 1 \text{ V}$$

$$(0.99) \left[ \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH})^2 (1 + \lambda V_{DS1}) \right] = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH})^2 (1 + \lambda V_{DS2})$$

$$(0.99) (1 + 0.5\lambda) = 1 + \lambda$$

$$\lambda = 0.0204 \text{ V}^{-1}$$

CASE # 2

$$V_{DS1} = 0.5; \quad V_{DS2} = 1V$$

$$I_{D1} = 1.01 I_{D2}$$

$$\frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{th})^2 (1 + \lambda V_{DS1}) = (1.01) \left[ \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_{th})^2 (1 + \lambda V_{DS2}) \right]$$

$$1 + \lambda (0.5) = (1.01) (1 + \lambda)$$

$$\lambda = -0.0196 \text{ V}^{-1}$$

$$\text{Maximum allowable: } \lambda = 0.0204 \text{ V}^{-1}$$

ANS