

Unit 4 - Week 2 - Nonlinear two ports; MOS transistor; Common source amplifier

Course outline

How does an NPTEL online course work?

Week 0

Week 1 - Obtaining power gain and need for nonlinearity

Week 2 - Nonlinear two ports; MOS transistor; Common source amplifier

- Two port nonlinearity
- Small signal equivalent of a two port network
- Small signal equivalent circuit of a two port network
- Gain of a two port network
- Constraints on small signal parameters to maximize the gain
- Constraints on large signal characteristics to maximize the gain
- Implications of constraints in terms of the circuit equivalent
- MOS transistor-description
- MOS transistor large signal characteristics
- MOS transistor large signal characteristics-graphical view
- MOS transistor small signal characteristics
- Linear (Triode) region of the MOS transistor
- Small signal amplifier using the MOS transistor

Quiz : Assignment 2

Analog Circuits: Week 2 Feedback form

Assignment 2 Solutions

Week 3 - Common source amplifier using the MOS transistor

Week 4 - Biasing a MOS transistor at a fixed drain current; CS amplifier using drain feedback bias and current mirror bias

Week 5 - CS amplifier using source feedback bias; Controlled sources using a MOS transistor-VCVS

Week 6 - Controlled sources continued-VCCS, CCCS, CCVS

Week 7 - Opamp controlled sources; Virtual short; Swing limits; Summary of amplifiers

Week 8 - pMOS transistor; Converting pMOS circuits to nMOS

Week 9 - Common source amplifier with active load; CMOS inverter

Week 10 - Differential pair with current mirror load; Single-stage opamp

Week 11 - Two-stage opamp; Opamp characteristics

Week 12 - Bipolar transistors

Lecture Notes

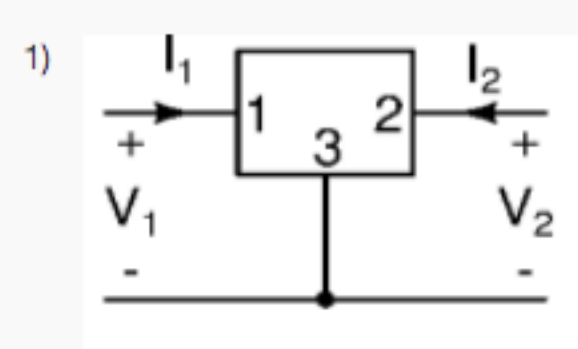
Text Transcripts

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Assignment 2

The due date for submitting this assignment has passed. **Due on 2020-02-12, 23:59 IST.**
As per our records you have not submitted this assignment.



The equations below describe the currents of the nonlinear two port in the above figure.

$$I_2 = \left[I_s \exp\left(\frac{V_1}{V_T}\right) \right] \left(1 + \frac{V_2}{V_A} \right)$$

$$I_1 = \frac{I_2}{\beta}$$

Thermal voltage $V_T = 25 \text{ mV}$, parameters $V_A = 25 \text{ V}$, $\beta = 40$. At the operating point, $I_2 = 6 \text{ mA}$, $V_2 = 5 \text{ V}$. Determine the small signal y - parameters at this operating point.

$y_{11} =$

(The answer must be in **millisiemens (mS)**. Round off fractional answers to one decimal place.)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 6

1 point

2) $y_{12} =$ (Answer must be in microSiemens(μS). Round off fractional answers to one decimal Place)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 5

1 point

3) $y_{21} =$

(The answer must be in **millisiemens (mS)**. Round off fractional answers to one decimal place.)

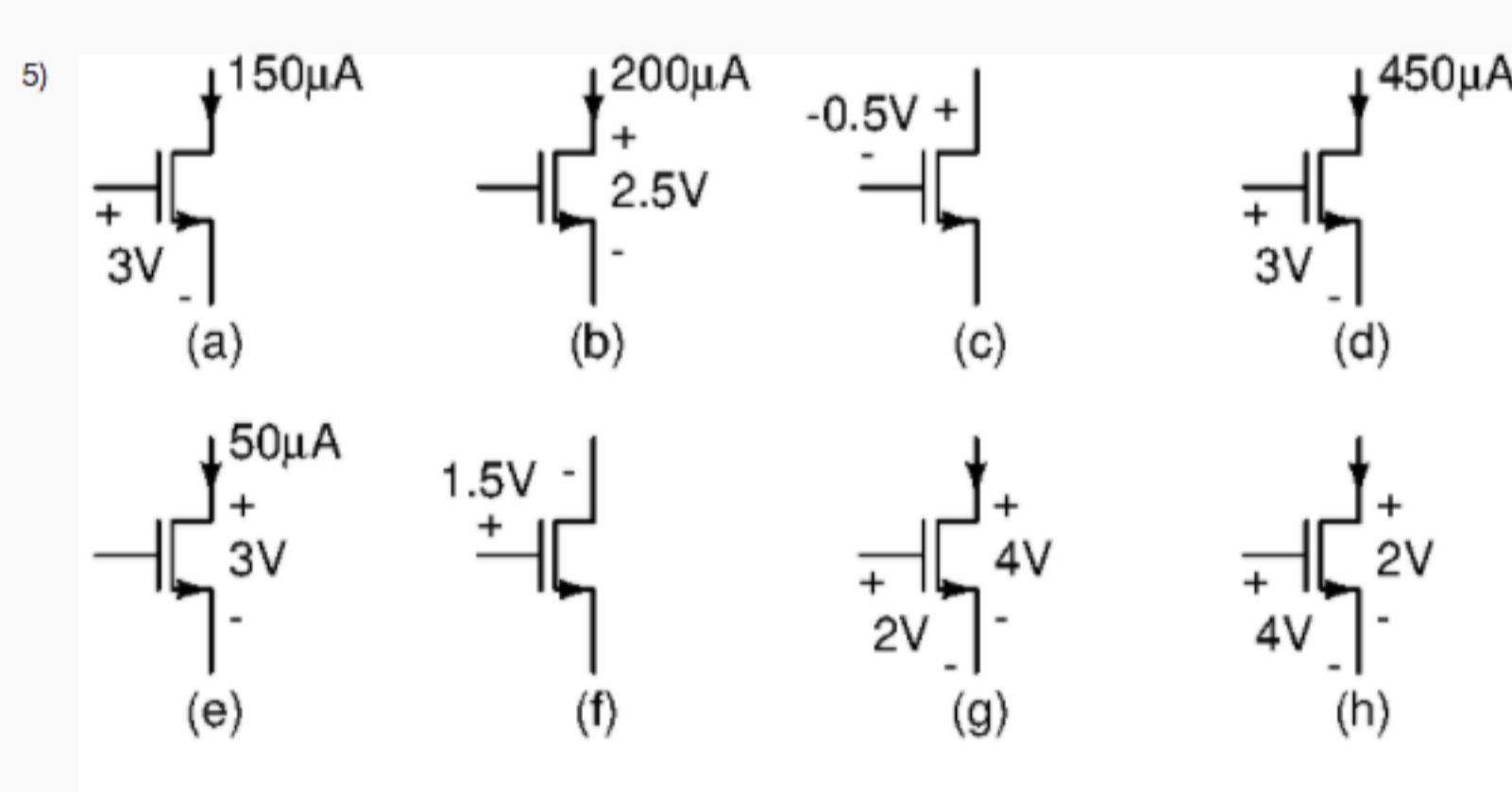
No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 240

1 point

4) $y_{22} =$ (Answer must be in microSiemens(μS). Round off fractional answers to one decimal Place)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 200

1 point



$\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $W/L = 1$, $V_T = 1 \text{ V}$. The figure above shows the MOS transistor in various bias conditions. Pick the ones that are in triode (linear) region. (There may be more than one).

- (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)
- (h)

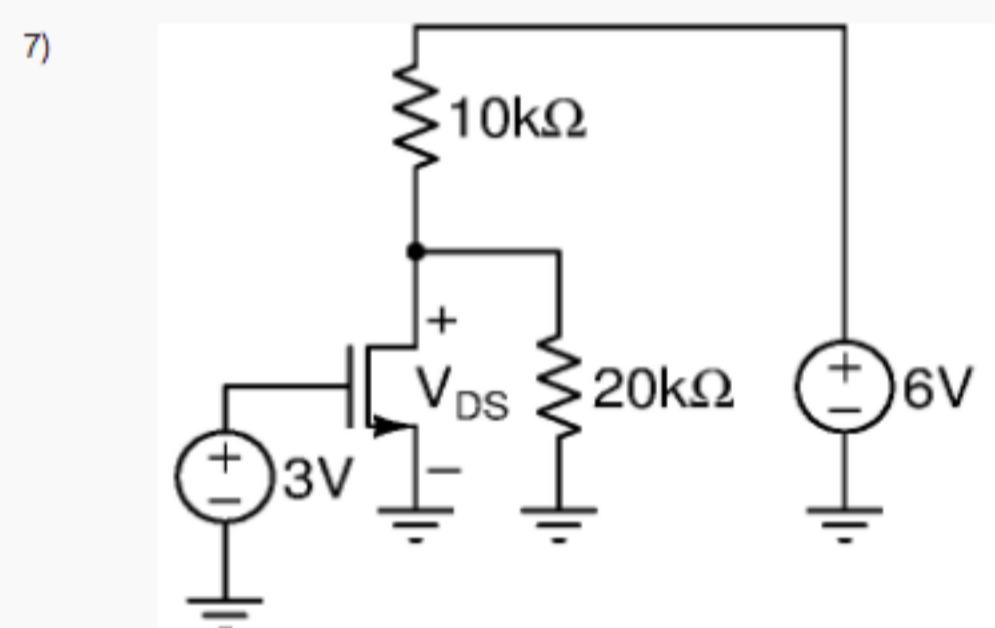
No, the answer is incorrect. Score: 0
Accepted Answers: (a), (f), (h)

1 point

6) $\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $W/L = 1$, $V_T = 1 \text{ V}$. In the figure above, identify the cases which are impossible in any region of operation. (There may be more than one).

- (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)
- (h)

No, the answer is incorrect. Score: 0
Accepted Answers: (d)

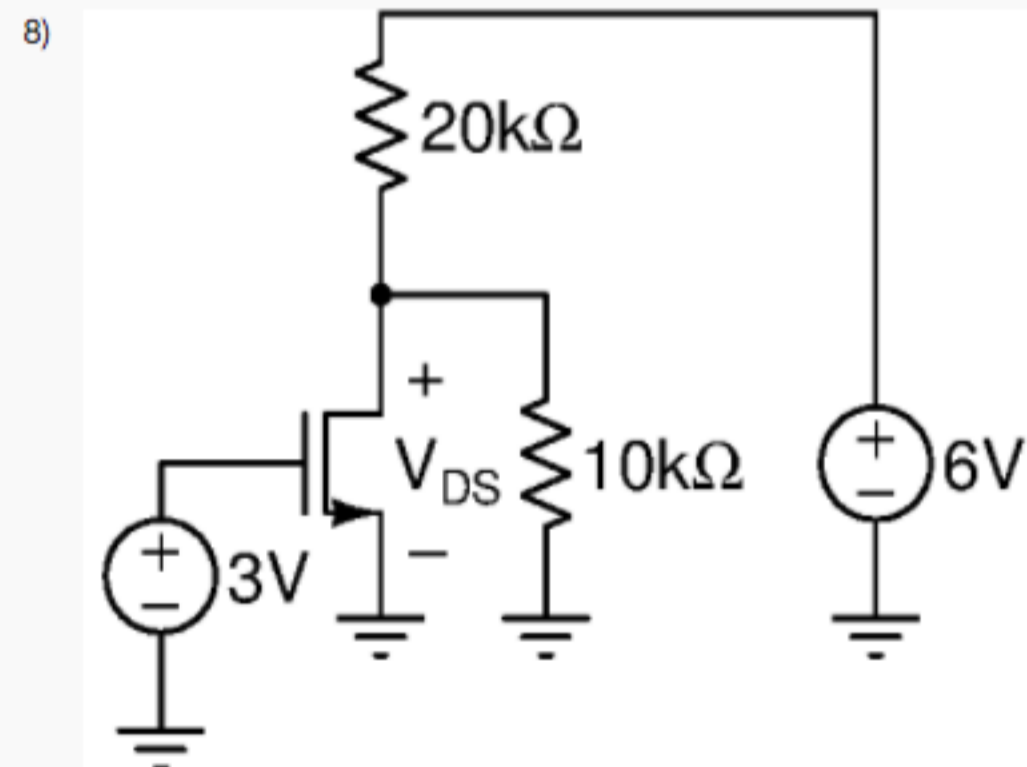


$\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $W/L = 1$, $V_T = 1 \text{ V}$. Determine V_{DS} . (The MOS transistor could be in any region. You have to guess the region, solve the problem, and see if the guess is correct).

(The answer must be in **volts (V)**. Round off fractional answers to two decimal places.)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Range) 2.66, 2.67

1 point



$\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $W/L = 1$, $V_T = 1 \text{ V}$. Determine V_{DS} . (The MOS transistor could be in any region. You have to guess the region, solve the problem, and see if the guess is correct).

(The answer must be in **volts (V)**. Round off fractional answers to one decimal place.)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 1

1 point

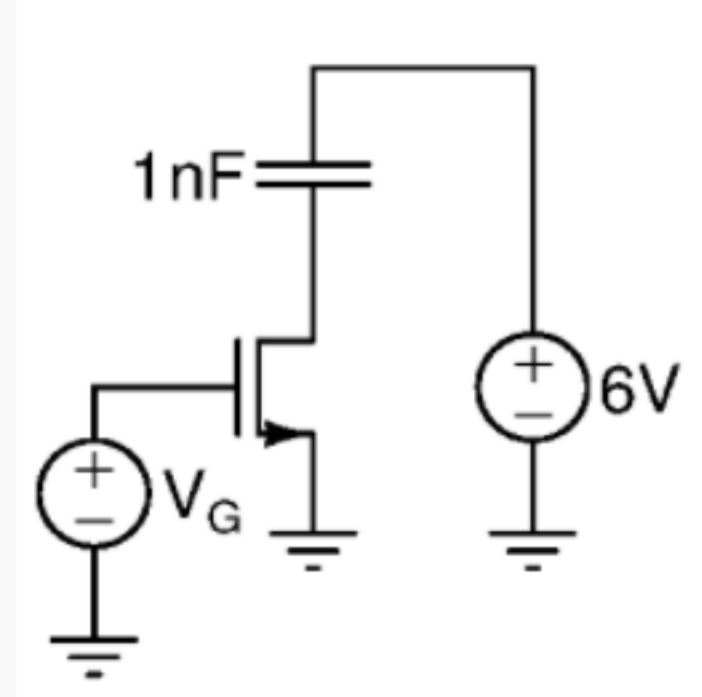
9) In the above problem, determine the drain current I_D of the MOS transistor.

(The answer must be in **microamperes (μA)**. Round off fractional answers to one decimal place.)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 150

1 point

10) $\mu_n C_{ox} = 100 \mu\text{A}/\text{V}^2$, $W/L = 1$, $V_T = 1 \text{ V}$.



In the figure above, V_G jumps from 0 to 2 V at $t = 0$. The capacitor voltage is zero at $t = 0^-$. Determine the time at which the MOS transistor enters triode region.

(The answer must be in **microseconds (μs)**. Round off fractional answers to one decimal place.)

No, the answer is incorrect. Score: 0
Accepted Answers: (Type: Numeric) 100

1 point