

ID # _____

NAME _____

EE-255 EXAM 1 February 5, 1998

Instructor (circle one) Ogborn Lundstrom

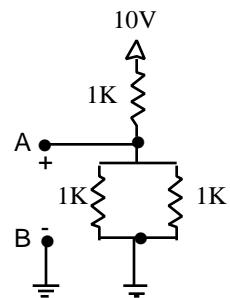
This exam consists of 20 multiple choice questions. Record all answers on this page, but you must turn in the entire exam. There will be no partial credit, but you must show your work.

Circle the one best answer for each question. Five points per question.

Do not open and begin until you are instructed to do so!

- | | | | | | |
|-----|---|---|---|---|---|
| 1) | a | b | c | d | e |
| 2) | a | b | c | d | e |
| 3) | a | b | c | d | e |
| 4) | a | b | c | d | e |
| 5) | a | b | c | d | e |
| 6) | a | b | c | d | e |
| 7) | a | b | c | d | e |
| 8) | a | b | c | d | e |
| 9) | a | b | c | d | e |
| 10) | a | b | c | d | e |
| 11) | a | b | c | d | e |
| 12) | a | b | c | d | e |
| 13) | a | b | c | d | e |
| 14) | a | b | c | d | e |
| 15) | a | b | c | d | e |
| 16) | a | b | c | d | e |
| 17) | a | b | c | d | e |
| 18) | a | b | c | d | e |
| 19) | a | b | c | d | e |
| 20) | a | b | c | d | e |

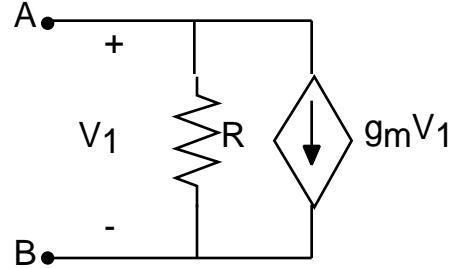
- 1) What is the value the voltage measured between terminals A and B?
 (a) 1 V; (b) 3.33V; (c) 6.67V; (d) 7.5V; (e) 10 V



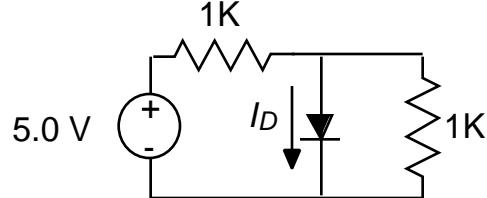
- 2) What is the Thevenin equivalent resistance seen between terminals A and B in the circuit above?
 (a) 0.33 K ; (b) 0.5 K ; (c) 1.0 K ; (d) 1.5 K ; (e) 3 K

- 3) What is the Thevenin equivalent impedance between terminals A and B for the circuit below?

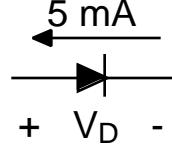
$$(a) Z_{in} = R \quad (b) Z_{in} = 1/g_m \quad (c) Z_{in} = R + 1/g_m \quad (d) Z_{in} = R \parallel \frac{1}{g_m} \quad (e) Z_{in} =$$



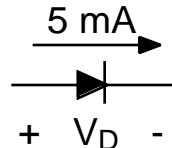
- 4) What is the current, I_D , through the diode in the circuit below? You may use a model with $V_f = 0.60$ V and $r_f = 0$.
 (a) 0.00 mA; (b) 2.5 mA; (c) 3.8 mA; (d) 4.4 mA; (e) 5.0 mA



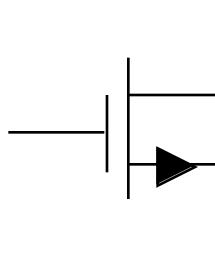
- 5) A silicon diode has 5 mA flowing through it in the direction shown. What is the most likely value for V_D ? (Assume room temperature)
- (a) +0.10 V (b) -0.10 V (c) +0.75 V (d) -0.75 V (e) -55.0 V



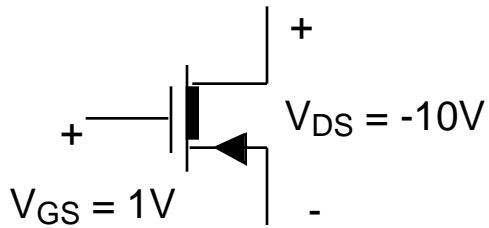
-
- 6) A silicon diode has 5 mA flowing through it in the direction shown. What is the small-signal ac resistance of this diode? (Assume room temperature and $n = 1$)
- (a) 0.0 (b) 5 (c) 12 (d) -12 (e) 120



-
- 7) Identify the transistor shown below.
- (a) n-channel enhancement mode MOSFET; (b) n-channel depletion mode MOSFET;
(c) p-channel enhancement mode MOSFET; (d) p-channel depletion mode MOSFET;
(e) n-channel JFET;

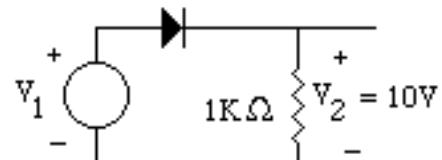


-
- 8) Identify the operating region for the transistor shown below. (Assume $|V_T| = 2\text{V}$)
- (a) cutoff; (b) ohmic; (c) saturation; (d) forward bias; (e) reverse bias

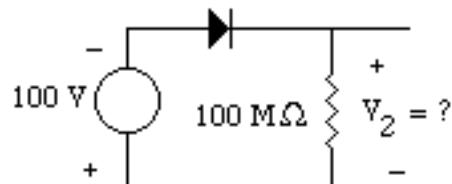


- 9) If a p-channel transistor with $V_{Th} = -2V$ gives $I_D = 4.0\text{mA}$ when $V_{GS} = V_{DS} = -4V$, what is k_p ?
- (a) 0.1mA/V^2 ; (b) 0.25 mA/V^2 ; (c) 0.50 mA/V^2 ; (d) 1.0 mA/V^2 ; (e) 4.0 mA/V^2 ;
-

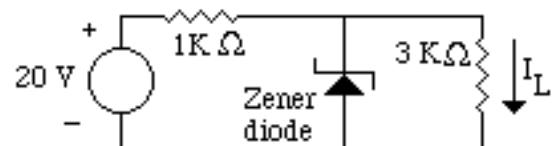
- 10) The diode below has $I_S = 10^{-9} \text{ A}$ and $n = 1$. The voltage V_2 is 10 volts. The voltage V_1 is:
- (a) -10.0 V (b) -0.419 V (c) 0.0 V (d) 10.0 V (e) 10.419 V



- 11) The diode in the circuit below is the same as in Prob. 10. The voltage V_2 across the 100 Megohm resistor is:
- (a) -100 mV (b) -26 mV (c) 0.0 V (d) 26 mV (e) 100 V

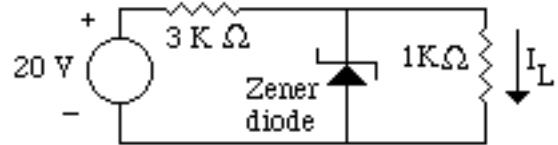


- 12) The zener diode has $V_Z = 9.0 \text{ volts}$ and $r_Z = 0.0$. The current $I_L =$:
- (a) 0 mA (b) 3 mA (c) 5 mA (d) 9 mA (e) 11 mA



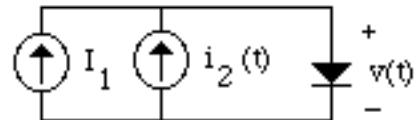
- 13) The resistors were changed but the zener diode is the same as in Prob. 12. The new value of I_L is:

(a) 0 mA (b) 3 mA (c) 5 mA (d) 9 mA (e) 11 mA



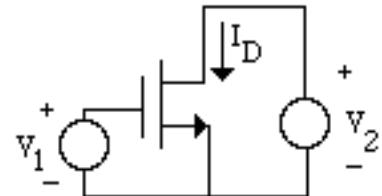
- 14) Consider the diode circuit below with two sources. I_1 is a constant 10 mA and $i_2(t) = (1.0 \text{ mA})\cos(400t + 45^\circ)$. The diode has $I_S = 10^{-9}$ amps and $n = 1$. The value of $v(t)$ is:

(a) $1.2 + (2.6 \text{ mV})\cos(400t + 45^\circ)$ (b) $0.419 + (2.6 \text{ mV})\sin(400t)$
 (c) $0.222 + (5.2 \text{ mV})\cos(400t + 45^\circ)$ (d) $0.419 + (2.6 \text{ mV})\cos(400t - 45^\circ)$
 (e) $0.419 + (2.6 \text{ mV})\cos(400t + 45^\circ)$



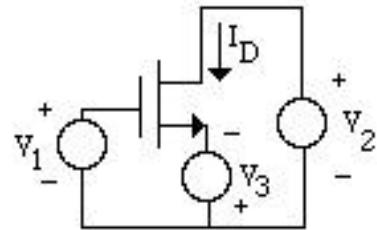
- 15) The MOSFET has $k_n = 2 \text{ mA/V}^2$ and $V_{th} = 3$ volts. $V_I = 6$ volts and $V_2 = 2$ volts. $I_D = :$

(a) 2 mA (b) 6 mA (c) 16 mA (d) 18 mA (e) 32 mA



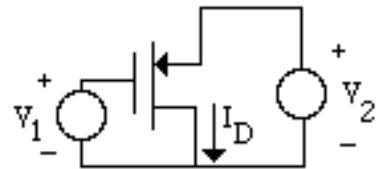
- 16) The MOSFET is the same as in Prob. 15. $V_I = 0 \text{ V}$, $V_2 = 2 \text{ V}$ and $V_3 = 4 \text{ V}$. $I_D = :$

(a) 2 mA (b) 6 mA (c) 16 mA (d) 18 mA (e) 32 mA



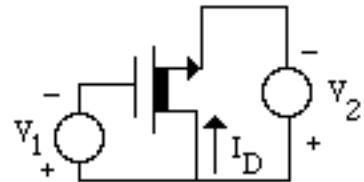
17) The MOSFET has $k_n = 2 \text{ mA/V}^2$ and $V_{Th} = -3$ volts. $V_I = 6 \text{ V}$ and $V_2 = 10 \text{ V}$. $I_D = :$

- (a) 0 mA (b) 2 mA (c) 6 mA (d) 16 mA (e) 18 mA



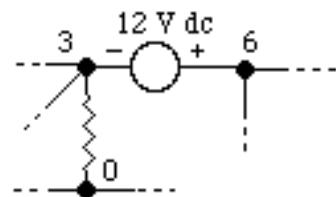
18) The depletion mode MOSFET has $k_n = 2 \text{ mA/V}^2$ and $V_{Th} = -3$ volts. $V_I = 10 \text{ volts}$ and $V_2 = 10 \text{ volts}$. $I_D = :$

- (a) 0 mA (b) 2 mA (c) 6 mA (d) 16 mA (e) 18 mA



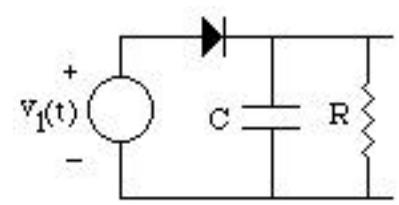
19) Choose the correct SPICE statement for the voltage source:

- (a) V4 3 0 DC 12
 (b) V4 3 6 DC 12
 (c) V4 0 3 AC -12
 (d) V4 6 3 DC 12
 (e) V4 0 6 DC -12



20) $V_1(t) = 50 \sin(2\pi 100t)$ volts. $R = 50 \text{ ohms}$. Assume the diode is ideal and only conducts for a small part of the period. If the dc voltage across the resistor is to drop only about 2 volts over the period (ripple voltage is about 2), a suitable value for C is about:

- (a) 50 μF (b) 500 μF (c) 5000 μF (d) 50,000 μF (e) 500,000 μF



EE-255 Formula Sheet: Exam 1

Data:

$$At \ 25 \ ^\circ C \ (R.T.) \quad V_T = kT/q = 0.026 \text{ volts}$$

$$k = 1.3806 \times 10^{-23} \text{ J / K} = 8.618 \times 10^{-5} \text{ eV / K} \quad q = 1.6022 \times 10^{-19} \text{ C} \quad 0^\circ C = 273.16K$$

Formulas: $e^x = 1 + x + x^2/2 + \dots$

Diodes:

$$I_D = I_S (e^{V_D/nV_T} - 1) \quad V_D = V + I_D r_f \quad C_j = C_{j0} (1 + V_R/V_{bi})^{-1/2}$$

$$r_d = \left. \frac{dV_D}{di_D} \right|_Q = \frac{V_T}{I_{DQ}} \quad (\text{forward bias}) \quad v_D = V_D + v_d$$

Rectifiers:

$$V_r = V_M \frac{T_p}{RC}$$

Monolithic Resistors: $R = R_s \frac{L}{W}$

n-channel MOSFETs:

$I_D = k_n [2(V_{GS} - V_{Th})V_{DS} - V_{DS}^2]$	(ohmic/triode)
$I_D = k_n [V_{GS} - V_{Th}]^2$	(saturation)
$V_{GS} > V_{Th}$	(NOT cut-off)
$V_{DS} > V_{GS} - V_{Th}$	(saturation)

p-channel MOSFETs:

$I_D = k_p [2(V_{GS} - V_{Th})V_{DS} - V_{DS}^2]$	(ohmic/triode)	$I_D = k_p [2(V_{SG} + V_{Th})V_{SD} - V_{SD}^2]$ (ohmic/triode)
$I_D = k_p [V_{GS} - V_{Th}]^2$	(saturation)	$I_D = k_p [V_{SG} + V_{Th}]^2$ (saturation)
$V_{GS} < V_{Th}$	(NOT cut-off)	$V_{SG} > -V_{Th}$ (NOT cut-off)
$V_{DS} < V_{GS} - V_{Th}$	(saturation)	$V_{SD} > V_{SG} + V_{Th}$ (saturation)

MOSFETs:

$$r_o = \frac{1}{I_D} = \frac{V_A}{I_D} \quad V_{Th} = V_{Th0} + \left[\sqrt{2 \cdot f + V_{SB}} - \sqrt{2 \cdot f} \right]$$