Electronics Midterm

Calculators and extra documents are not allowed. The marking scale is given as a rough guide.

Please answer only on exam sheets. If more space is needed, write on the back.

Exercise 1. Questions about lecture topics (MCQ without negative points – 5 points)

Q1. The doping increases the resistivity of a semiconductor.

a- TRUE b- FALSE

Q2. The doping increases the occurrence of thermal generation.

a- TRUE b- FALSE

Q3. One uses the semiconducting element Silicium with 4 electrons in its valence band. If one dopes it with Boron, which has 3 electrons in its valence band, which kind of doping do we get:

a- P-Doping c- NP-Doping

b- N-Doping d- No doping

Q4. In an intrinsic semiconductor, the number of free electrons is:

a- equal to the hole number c- smaller than the hole number

b- larger than the hole number d- none of the above

Q5. Which model is the most precise for representing the diode?

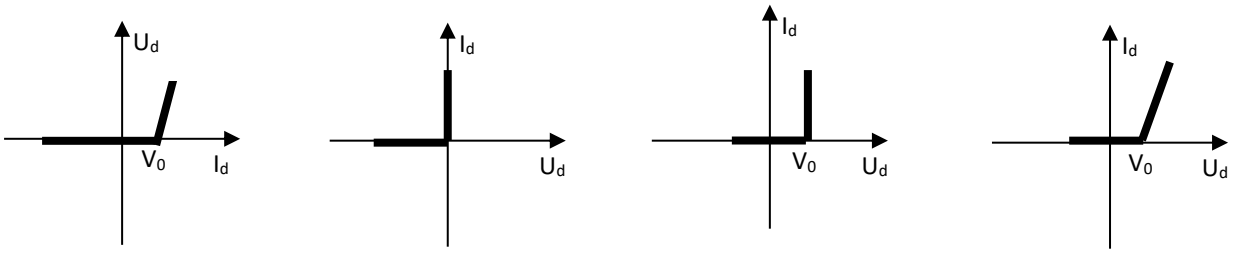
a- The ideal model c- The real model

b- The threshold model d- The three models are equivalent

Q6. The equation of the characteristic of the diode reads: $I_D = I_S(e^{\frac{V_D}{mV_T}} - 1)$ where I_D denotes the current flowing through the diode and V_D its voltage, where both current and voltage are oriented according to receptor convention. I_S corresponds to the inverse current. Its intensity is:

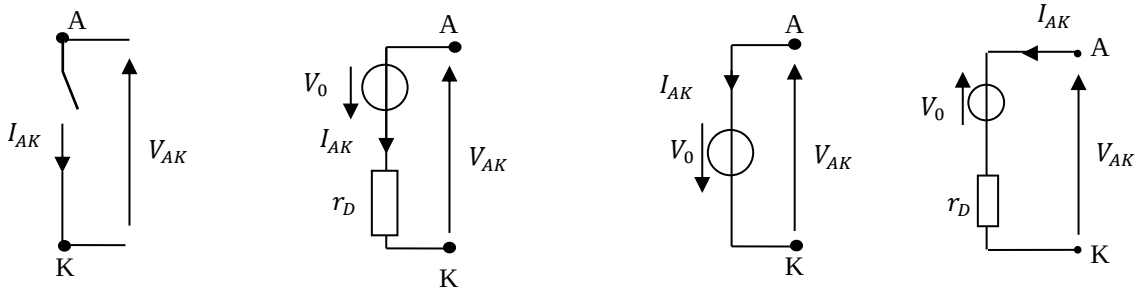
a- Very large (by the dozen of Ampères) b- Very small (few nano Ampères

Q7. Which characteristic corresponds to the current/voltage characteristic of the ideal model of the diode?



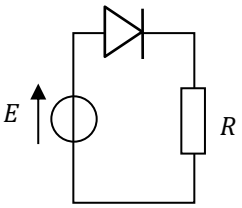
a- b- c- d-

Q8. Which dipole can replace the switched off diode if one considers the real model?



a- b- c- d-

Q9. Consider the following circuit where the diode D is assumed to be ideal:

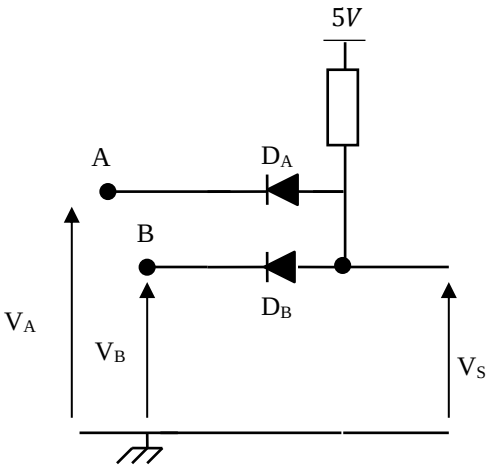


What is the voltage at terminals of D if $E = 10V$, $R = 100\Omega$?

a- $0\ V$ c- $1\ kV$

b- $10\ V$ d- $0{,}1\ V$

Consider the following circuit:

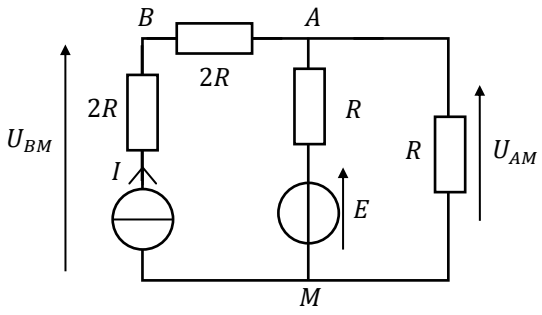


Q10. Which type of logic gate does this circuit produce?

a- AND c- NOT AND

b- OR d- NOT OR

Exercise 2. SUP Review (4 points)

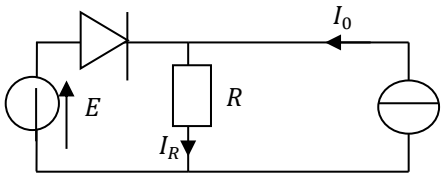


Let us consider the following circuit where E, I and R are known. The generators are independent.

1. By using the method that you prefer, determine the voltageU_{AM}.

2. Deduce the voltage U_{BM}.

Exercise 3. Diodes (5 points)



Consider the following diagram. We will model the diode by using the threshold model with $V_0 = 0{,}7V$. For the following questions, you will prove it by contradiction.

1. If $R = 100\Omega$, $I_0 = 60mA$ and $E = 5V$, prove that the diode is switched off. Then determine the current intensity flowing through the resistor.

2. If $R = 100\Omega$, $I_0 = 30mA$ and $E = 5V$, prove that the diode is turned on. Then determine the current intensity flowing through the resistor.

Exercise 4. Transfer characteristic (6 points)

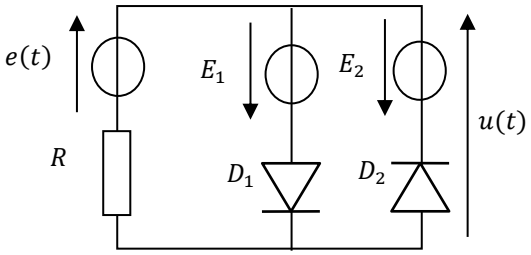
In the following circuit one wants to determine and draw the variation of $u(t)$. One has the following data:

$$e(t) = E_0 \sin(\omega t),$$

with $E_0 = 30V$ and $\omega = 2\pi \times 50 rad/s$

E_1 and E_2 are two ideal continuous voltage sources, $E_1 = 10V$ et $E_2 = 15V$

The diodes are assumed to be ideal.



1. Prove by contradiction that the diodes cannot be turned on simultaneously.

2. Write the expression of $u(t)$ if D_1 is turned on.

3. Write the expression of $u(t)$ if D_2 is turned on.

4. Write the expression of $u(t)$ if both diodes are switched off.

5. For which value of $e(t)$ are the 2 diodes switched off?

6. Draw the transfer characteristic of this circuit.

7. Draw the curve $u(t)$.