EPITA / InfoS3 December 2018

NAME: ..... Firstname: ..... Group: .....

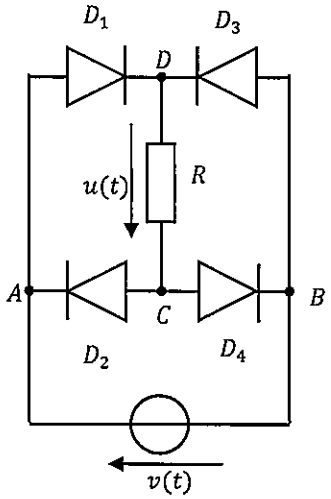
Electronics Final

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

Answer only on the exam sheet. If much space is needed, write on the back.

Exercise 1. Double alternation rectifier (6 points)

Consider the following circuit, where $v(t)$ is a triangular periodic signal, drawn in the questions e) and f). For the first questions, consider the ideal model for the diodes.



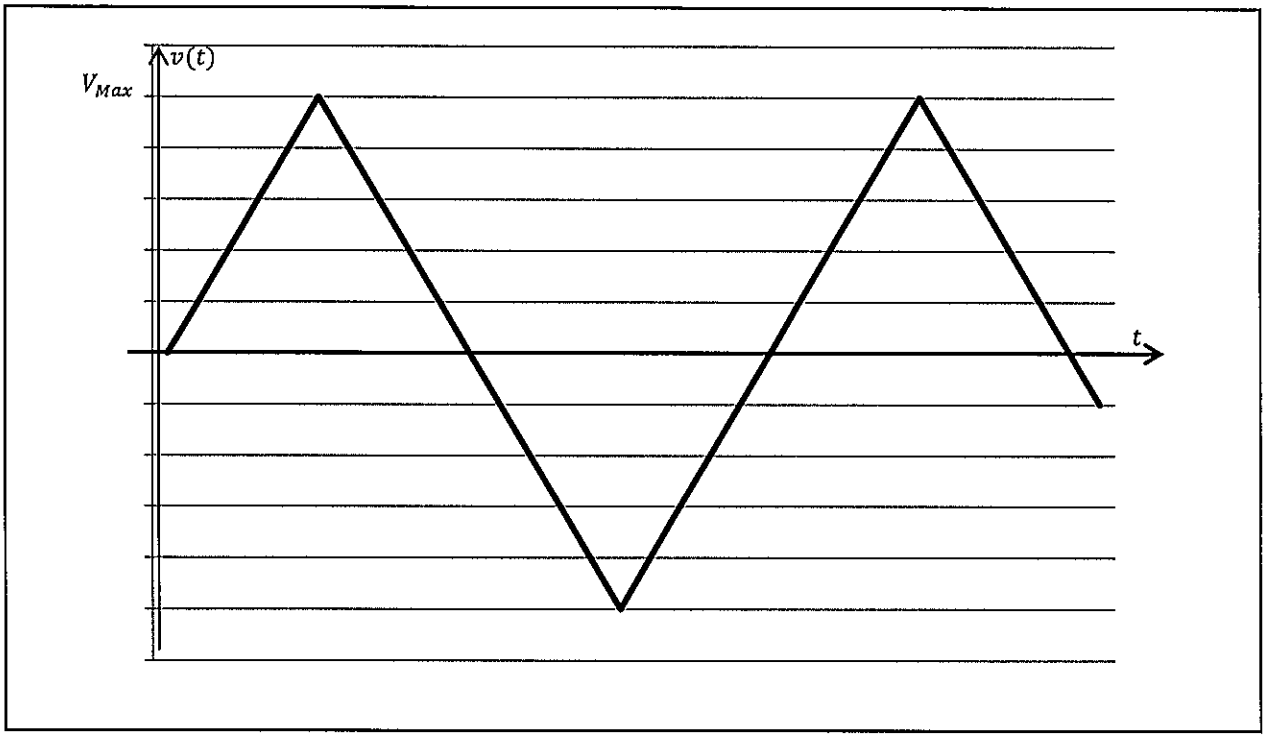
a) When the provided voltage $v(t)$ is positive ($0 \leq t \leq \frac{T}{2}$), which diodes are turned on? Explain your answer.

b) What is therefore the expression of u?

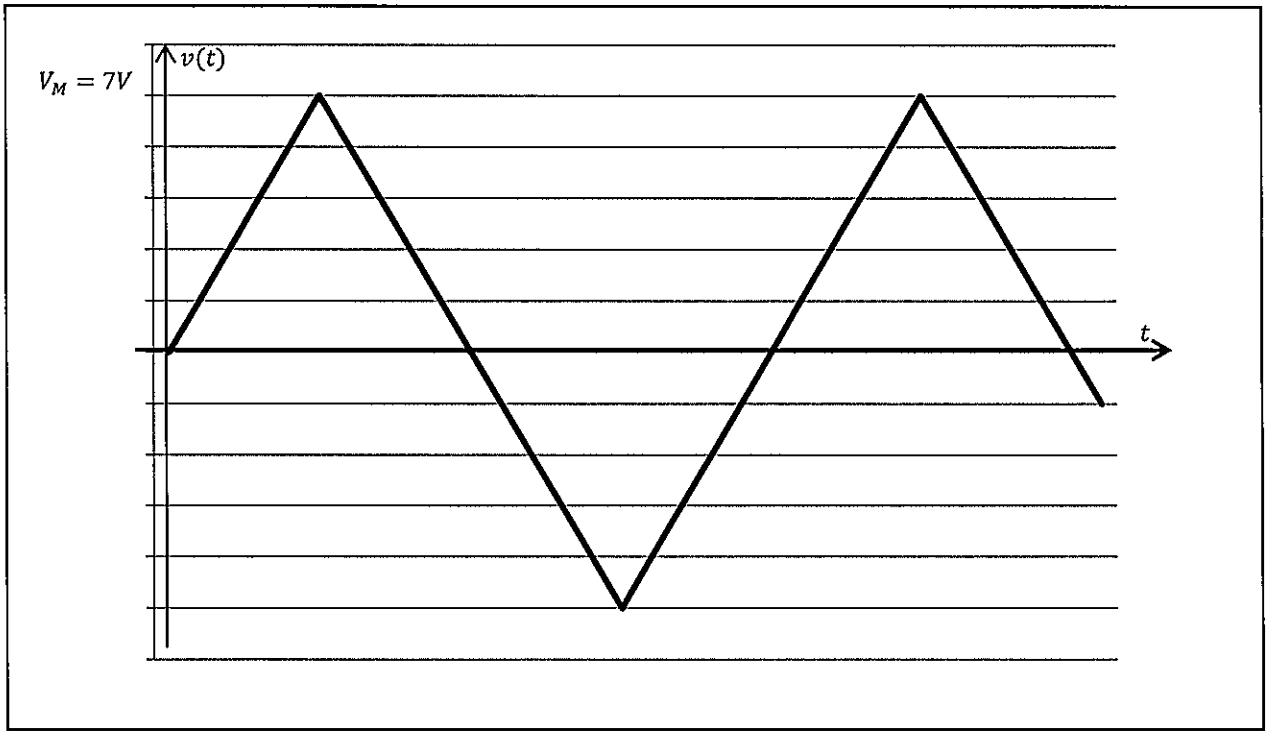
c) When the provided voltage $v(t)$ is negative ($\frac{T}{2} \leq t \leq T$), which diodes are turned on? Explain your answer.

d) What is therefore the expression of u?

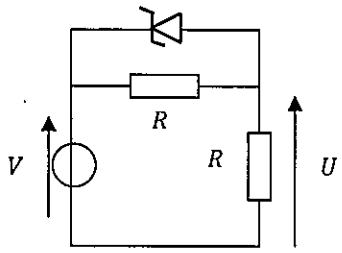
e) Draw $u(t)$.



f) The diodes are modelled now by the threshold model. Sketch $u(t)$ and explain your reasoning. The threshold voltage of each diode is denoted by V_0, where $V_0 = 0{,}7\ V$.



Exercise 2. Zéner's diode (4 points)

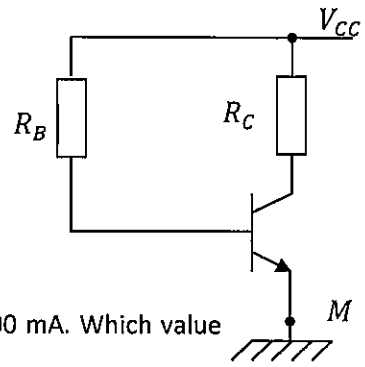


Consider the following circuit, with $V \in \mathbb{R}$.

Sketch the transfer characteristic, i.e. $U = f(V)$, considering the real model for the diode.

Write explicitly the different equations of the patch-defined characteristic. We will denote by V_0 the threshold voltage in direct polarization, by r_D the internal resistance of the diode in direct polarization, V_Z the Zéner voltage, and r_Z the internal resistance of the diode in reverse polarization.

Exercise 3. Polarization of the transistor (3 points)



Consider the following circuit, with:

- $R_C = 60\ \Omega$, $V_{CC} = 12V$

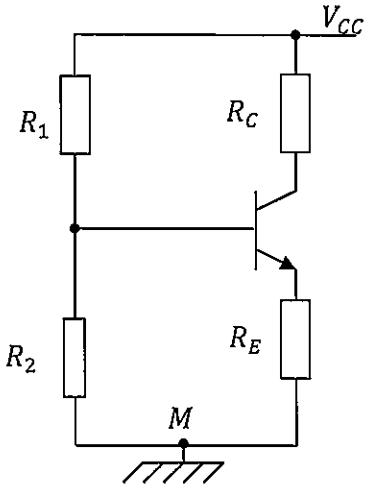
Transistor characteristics: $\beta = 100$, $V_{BE} = 0{,}7V$ when the Base-Emitter junction is turned on and $V_{CE_{SAT}} = 0{,}2V$.

1. We want to tune the current in the resistance R_C to a value of 100 mA. Which value of R_B must be chosen?

2. If R_B varies, so does I_B and thus I_C too. What is the maximal value that can be got for I_C (saturated transistor)?

3. What is the minimal value of R_B to saturate the transistor?

Exercise 4. Polarization using resistance bridge (4,5 points)

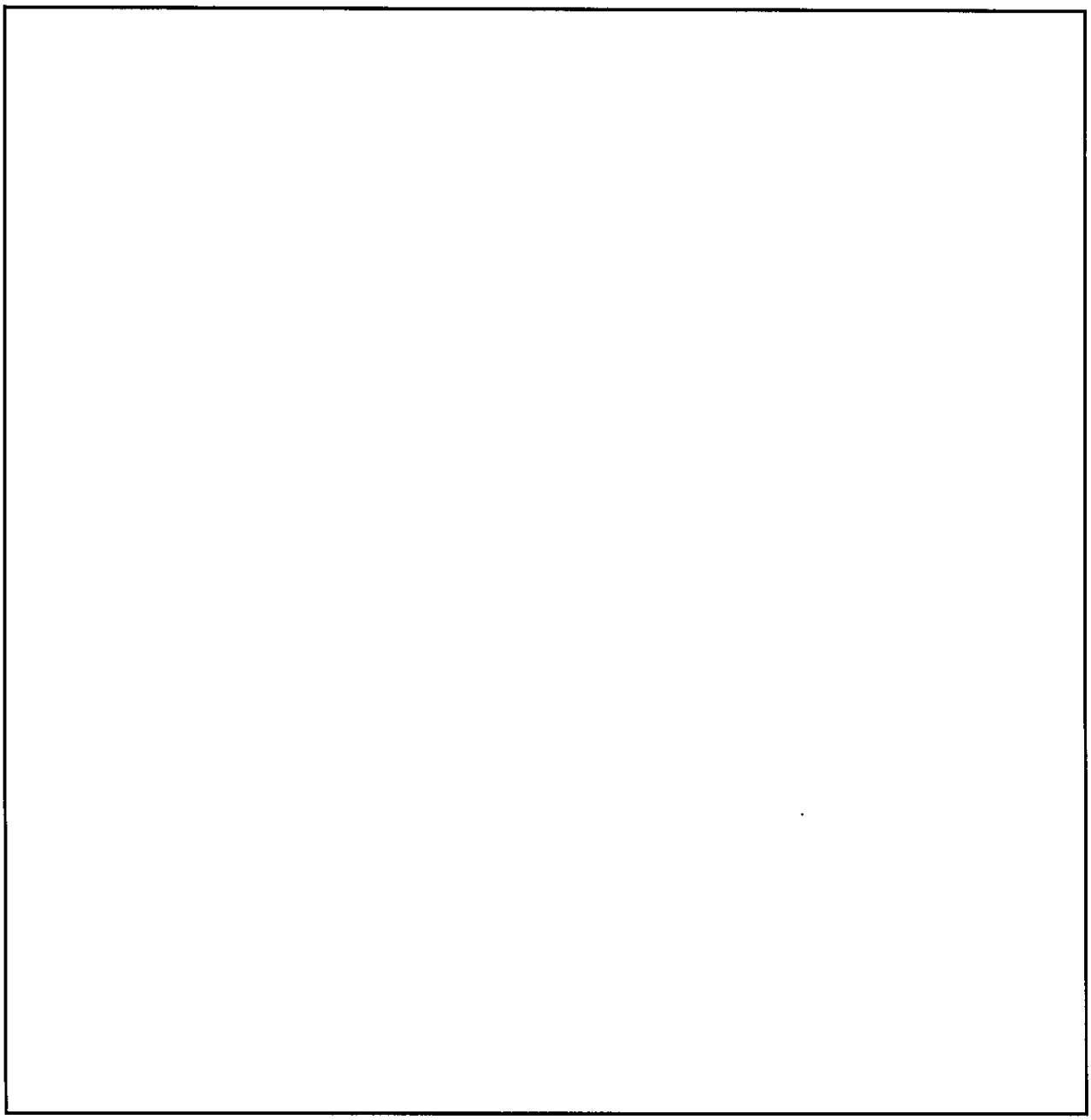


Consider the following circuit, with:

- $R_1 = 20k\Omega, R_2 = 4k\Omega,\ R_C = 1{,}2k\Omega,\ R_E = 80\Omega$
- $V_{CC} = 12V$
- Transistor characteristics: $\beta = 100,\ V_{BE} = 0{,}7V$ when the Base-Emitter junction is turned on and $V_{CE_{SAT}} = 0{,}2V$

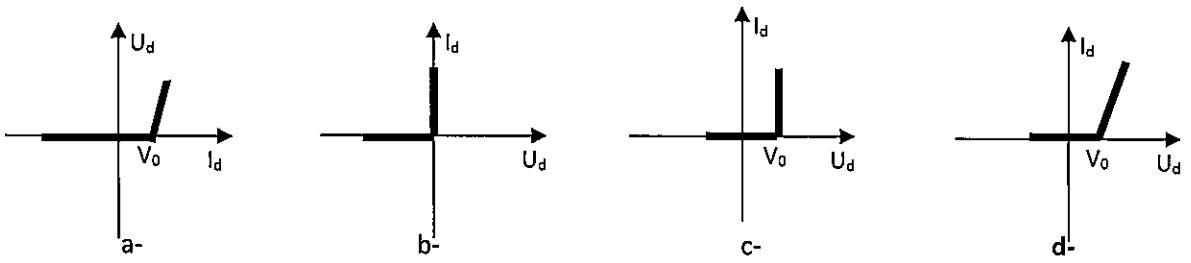
Notice: The numerical values are just given as orders of magnitude. NO NUMERICAL COMPUTATION IS EXPECTED!

We will assume that the transistor is polarized in its linear regime. Determine the polarization point of this transistor (i.e. the expressions of the currents I_{B0}, I_{C0} and I_{E0}, and the voltages V_{BE0}, V_{BC0} and V_{CE0}).



Exercise 5. MCQ (2,5 points – No negative point)

1. Which characteristic corresponds to the current/voltage characteristic of the ideal model of the diode:



2. In reverse polarization the Zéner diode can be modelled using one of these three models : ideal, threshold or linear ones.

   a- TRUE b- FALSE

3. The transistor effect is such that:
   a- An intense current can flow between the base and the collector
   b- An intense current can flow between the emitter and the collector.
   c- An intense current can flow between the emitter and the base.

4. When the transistor works as a switch:
   a- The transistor is equivalent to a closed switch when some current flows through the base.
   b- The transistor is equivalent to a closed switch when no current flows through the base.
   c- The transistor is equivalent to an open switch when no current flows through the base.
   d- The transistor is equivalent to an open switch when some current flows through the base