Name : ..... First name : ..... Groupe : .....

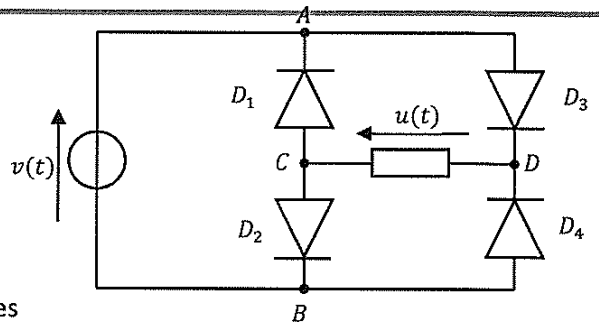
Final exam of Electronics

Calculators and documents are not allowed. The number of points per question is indicative.

Answers to be written on this document only.

Exercise 1 : Rectifier (6 points)

We consider the following circuit :



The voltage $v(t)$ is a periodic signal given in question e and f. We use the ideal model for all diodes.

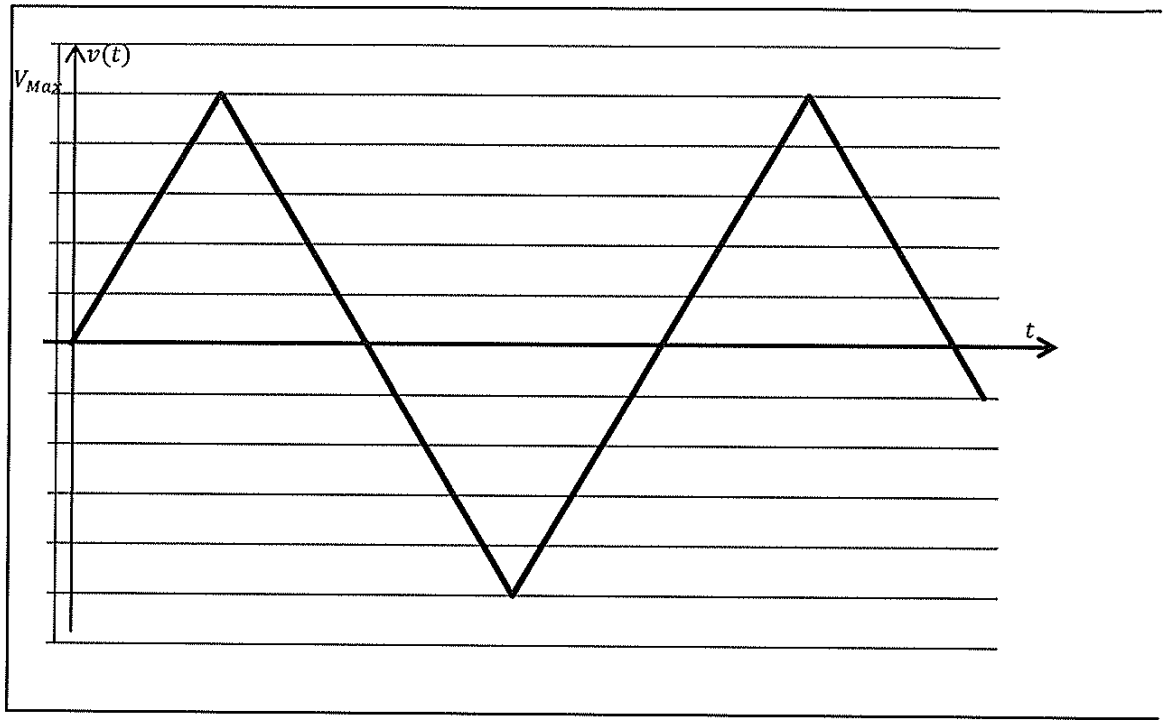
a) If v is positive ($0 \leq t \leq \frac{T}{2}$), which diodes are on ? justify your answer

b) what is the expression of the voltage u ?

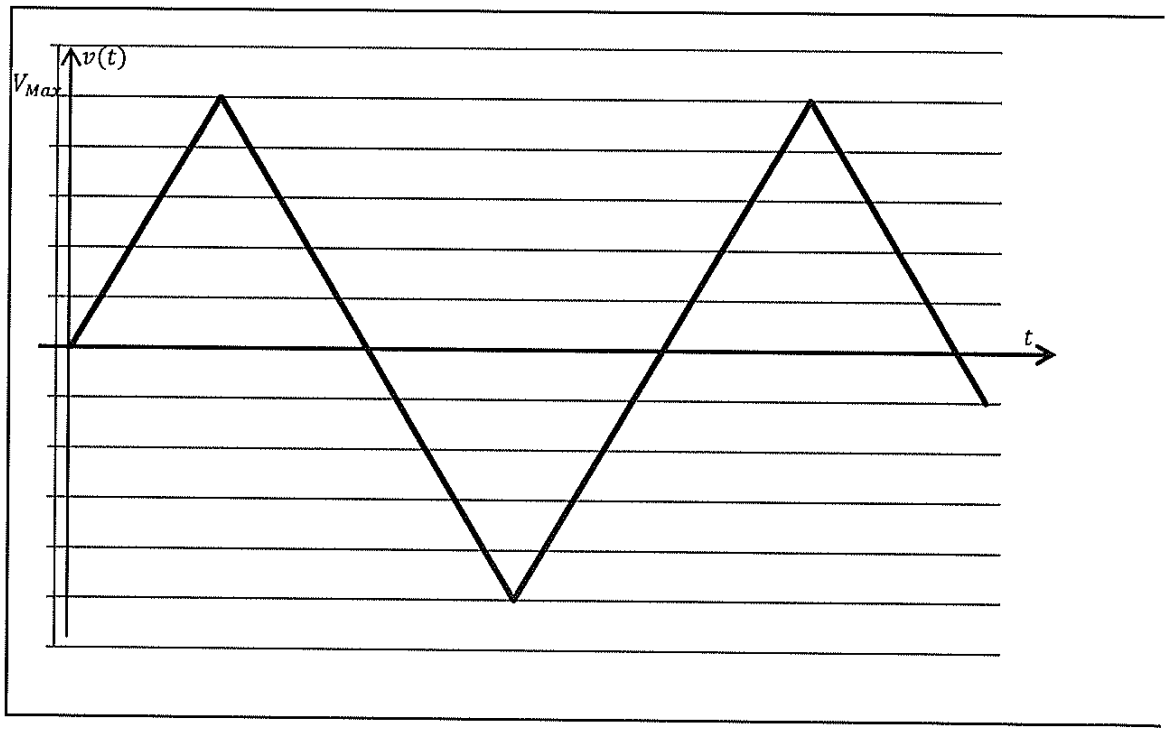
c) If v is negative ($\frac{T}{2} \leq t \leq T$), which diodes are on ? justify your answer

d) What is the expression of the voltage u ?

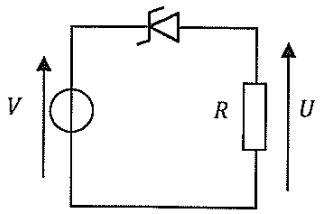
e) Plot $u(t)$.



f) We then replace the diodes with their model with threshold voltage. Plot u(t), and explain your answer. We note V_0 the threshold voltage of each diode and we assume $V_M > V_0$.



Exercise 2 : The Zener diode (4 points)

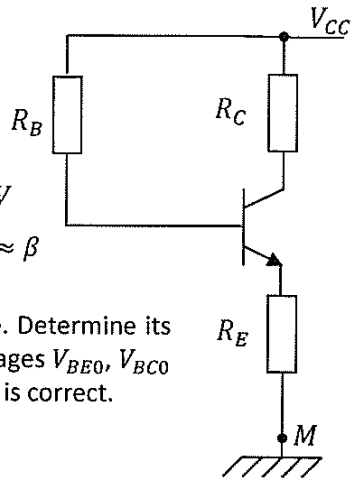


We consider the following diagram. $V \in \mathbb{R}$

Plot the transfer caracteristic $U = f(V)$ using the real model of the diode.

You have to prcise the equation of each part of the caracteristic. We denote V_0 the forward threshold voltage, r_D, the resistor when the diode is forward on, V_Z, the reverse threshold voltage and r_Z, the resistor when the diode is reverse on.

Exercise 3 : Transistor Biasing (6 points)



We consider the following circuit, where :

- $R_B = 200k\Omega$, $R_C = 500\Omega$, $R_E = 1k\Omega$, $V_{CC} = 10V$
- The transistor caracteristcs : $\beta = 100$, $V_{BE} = 0{,}7V$ when the Base-Emetter junction is forward on and $V_{CE_{SAT}} = 0{,}2V$

Rq : For the numerical applications only, you are allowed to consider $\beta + 1 \approx \beta$ in order to simplfy the calculations !

1. We assume that the transistor is working in the active mode. Determine its operating point (ie the currents I_{B0}, I_{C0} and I_{E0}, and the voltages V_{BE0}, V_{BC0} and V_{CE0}). You have to verify if this assumption (active mode) is correct.

2. What is the expression of the saturation current $I_{C_{Sat}}$ of the transistor ?

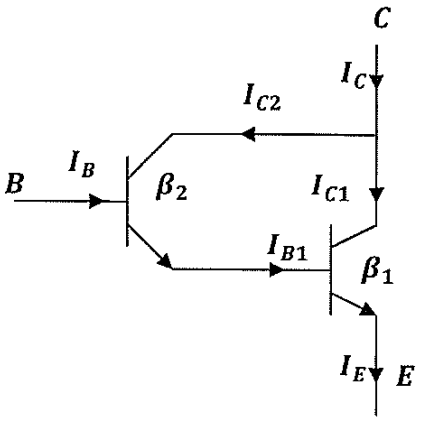
Exercise 4 : Darligton Circuit (2 points)

We consider the following circuit.

β_1 is the current gain of the right transistor and β_2 the current gain of the left transistor, determine the current gain β of the equivalent transistor, as a function of β_1 and β_2.

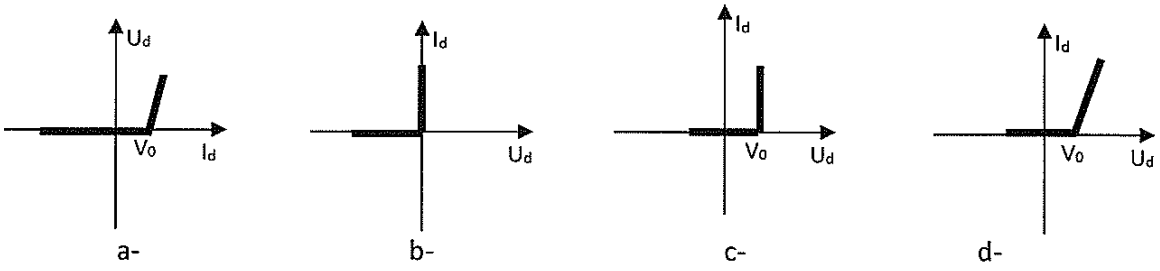
We assume that the two transistors are working in the active mode.

Rq : You can start by the expression of I_C function of I_B.



Exercise 5 : MCQ (2.5 points – without negative points)

Q1. Which of these diode characteristics corresponds to the one of the 'real' model?



Q2. When the Zener diode is reverse on, it can be described by one of the two following models: model with a threshold voltage or real model; the ideal model does not exist for such a diode.

a- True b- False

Q3. The transistor effect : (choose the correct answer)

a- Allows to control a big current flowing trougth the emitter and the collector.

b- Allows to control a big current flowing trougth the base and the collector.

c- Allows to control a big current flowing trougth the emitter and the base.

Q4. When we want that the transistor operates as a switch:

a- The transistor is equivalent to a closed switch when a 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 a current flows through the base

d- The transistor is equivalent to an open switch when no current flows through the base.

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