University of Kasdi Merbah Ouargla
Faculty of New Information and Communication Technologies
Department of Electronics and Telecommunications

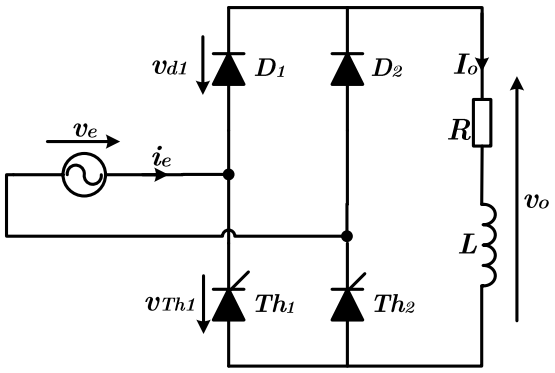
Power Electronics — ***Dr : M. Bouzidi***

L3 Automation — ***Exam*** — ***01/02/2024 Duration :*** *1h :30 min*

Full name: ……. ***Groupe:*** …….	***Note:*** ____ ***20*** *

Exercise 1: (7 pts) The controlled Full-wave rectifier supplies an inductive load *R-L*. The load current is constant due to the large value of the inductance I_o=**10A**.

The input voltage RMS is $V_{e,rms} = 220V$. For $\alpha = \frac{\pi}{3}$:



1- Determine the conduction intervals of the power switches.
2- Represent the waveforms of v_o, i_e, v_{Th1}, and v_{d1}.
3- Calculate the average value of the output voltage.
4- Calculate the RMS value of the input current.
5- Calculate the active power, apparent power and the power factor.

Solution

1- *Conduction intervals*

- Th_1 ON: $\theta \in$ ……
- Th_2 ON: $\theta \in$ ……
- D_1 ON: $\theta \in$ ……
- D_2 ON: $\theta \in$ ……

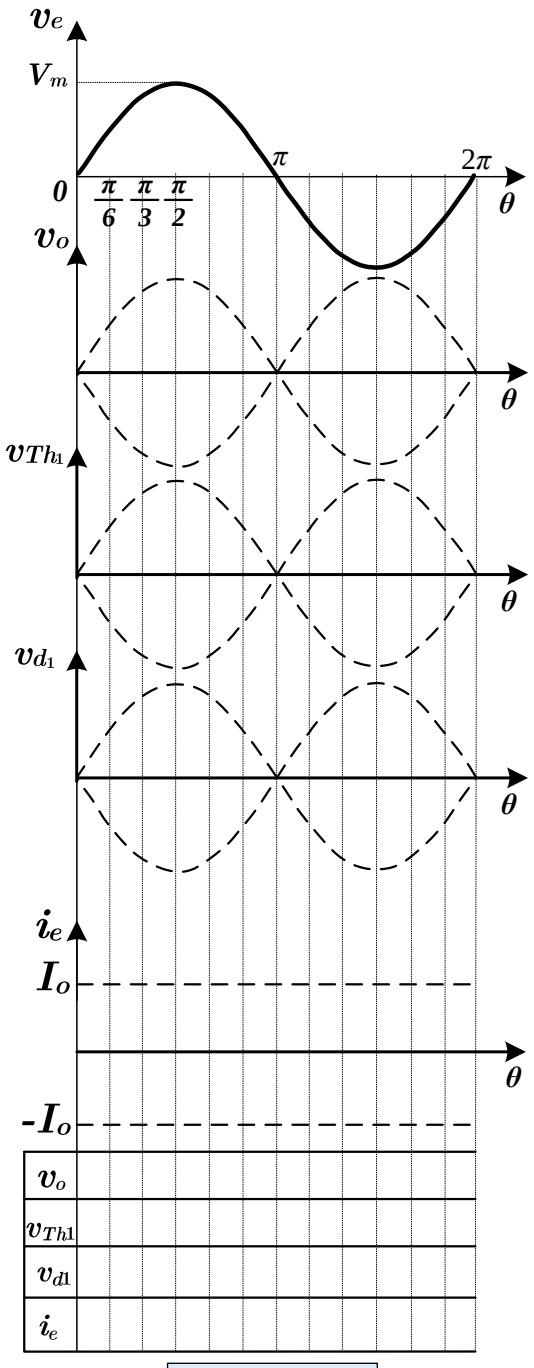


Figure (1)

Good luck

2- Waveforms representation:

Complete the table under ***Figure (1)*** for the variables v_o, i_e, v_{Th1}, v_{d1}.

3- Average value of the output voltage:

$\bar{V}_o = \ldots\ldots$ $\bar{V}_o = \ldots\ldots$, $\bar{V}_o = \ldots\ldots V$

4- RMS value of the input current:

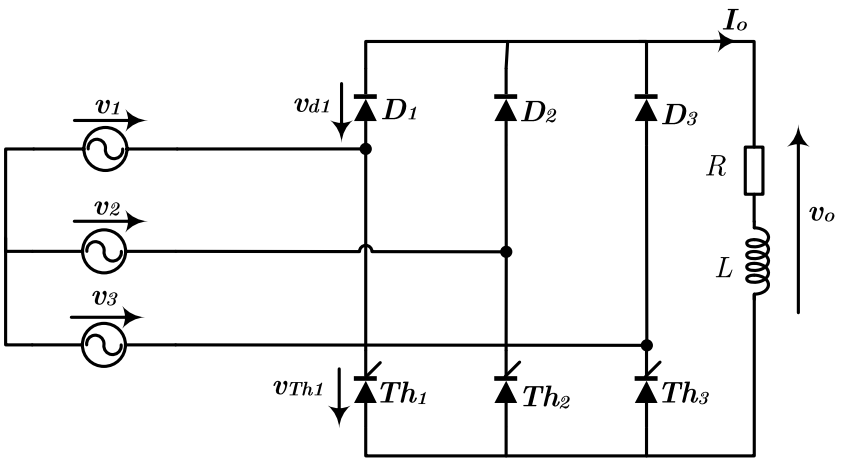
$I^2_{e,rms} = \ldots\ldots$ $I_{e,rms} = \ldots\ldots$, $I_{e,rms} = \ldots\ldots A$

5- Active power, apparent power, power factor:

- $P = \ldots\ldots$ $P = \ldots\ldots$, $P = \ldots\ldots W$
- $S = \ldots\ldots$ $S = \ldots\ldots$, $S = \ldots\ldots VA$
- $PF = \ldots\ldots$, $PF = \ldots\ldots$

Exercise 2: **(6pts)**

The controlled three-phase half-wave rectifier supplies an inductive load *R-L*. The load current is constant due to the large value of the inductance. The input voltage RMS is $V_{e,rms} = 220V$. For $\alpha = \frac{\pi}{6}$.



1- Determine the conduction intervals of the power switches.

2- Represent the waveforms of v_o, v_{Th1} and, v_{d1}.

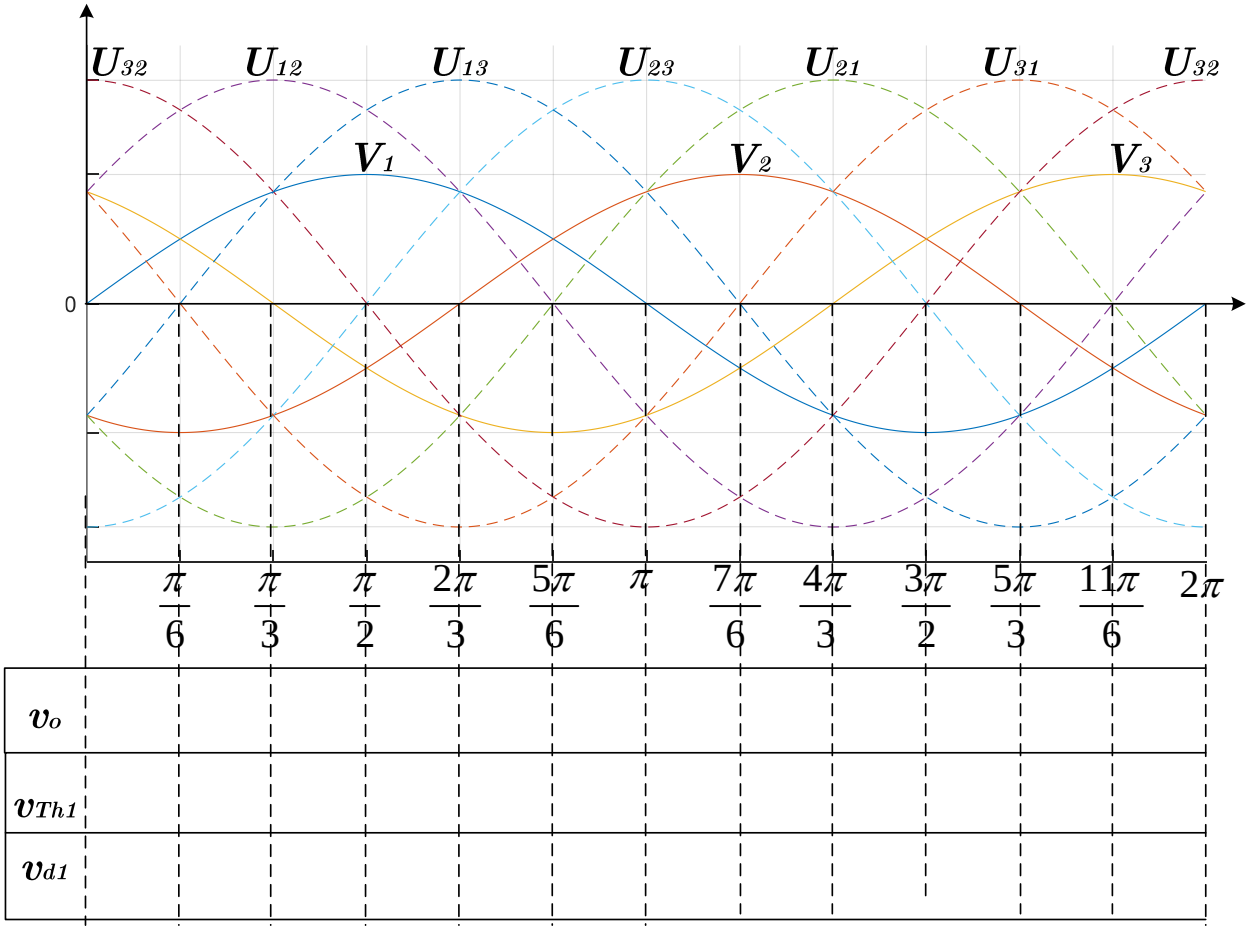
Solution

1- Conduction intervals

- Th_1 ON: $\theta \in$ ..... D_1 ON: $\theta \in$ .....
- Th_2 ON: $\theta \in$ ..... D_2 ON: $\theta \in$ .....
- Th_3 ON: $\theta \in$ ..... D_3 ON: $\theta \in$ .....

2- Waveforms representation

Complete the table below for the variables v_o, v_{Th1}, v_{d1}.



Exercise 3 **(7 pts)**

The DC-DC converter shown below is operated in a continuous conduction mode. The transistor is turned ON over the interval $[0\ DT_s]$, where T_s is the switching period, and D is its duty cycle. The capacitance C is assumed to have a sufficient value to keep the output voltage constant.

1- What is the type of this converter (Buck or Boost).

2- Represent the following waveforms over one period: $i_L(t), v_L(t), v_d(t)$ and $v_H(t)$.

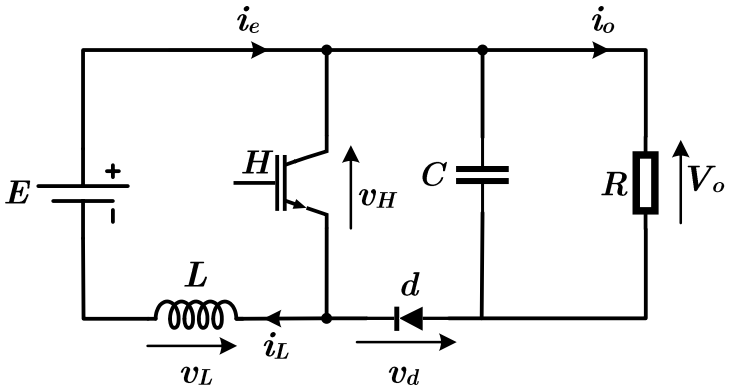
3- Calculate the average value of v_d as a function of E and D.

4- Express the output voltage V_o in terms of D and E.

5- Calculate the average value of the input current in terms of E, R, and D.

Solution

1- The type of this converter is: ……



2- Waveforms representation:

Complete the table below for variables:

v_H, v_d, v_L, and i_L and represent them.

3- ***Average value of v_d***

$\bar{V}_d$=……..

$\bar{V}_d$= ……..

4- $V_o=f\ (E,D)=?$

……

……

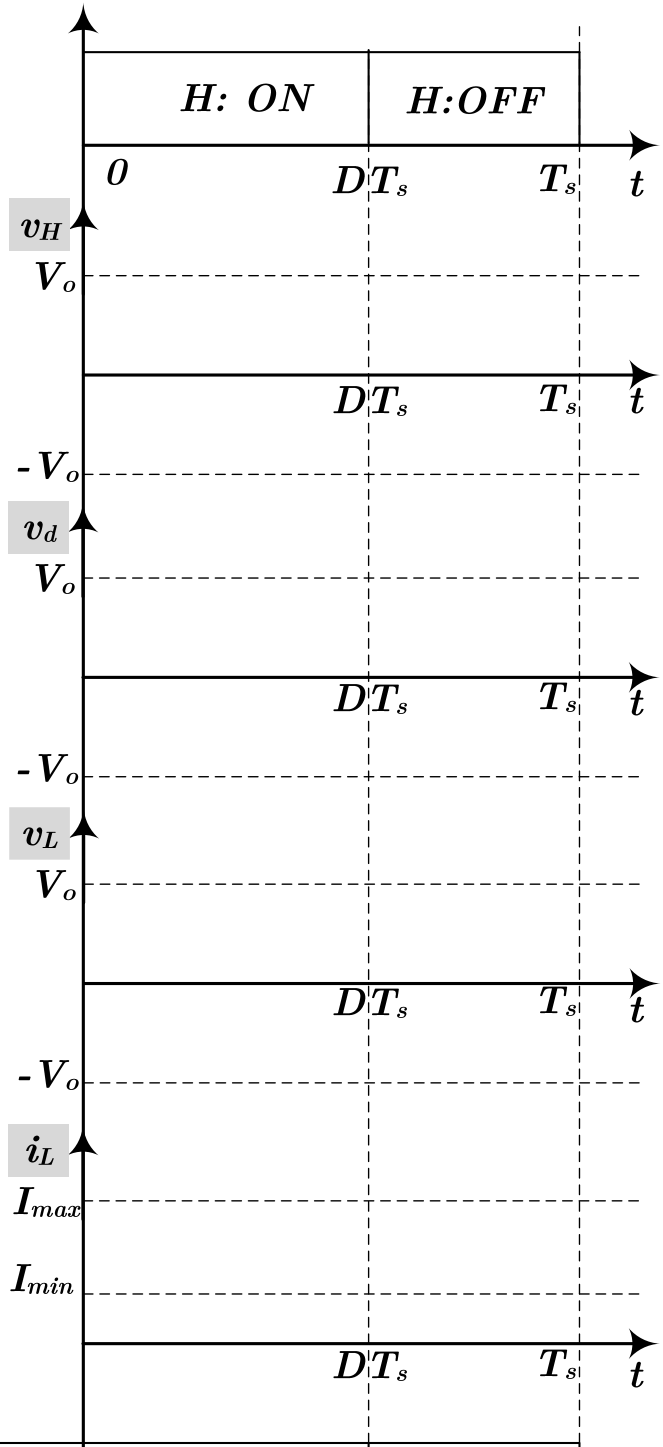
V_o= ……..

5- $\bar{I}_e=f\ (E,D)=?$

……

……

$\bar{I}_e$= ……..



v_H		
v_d		
v_L		
i_L		