

<i>Full name</i>			<i>Group</i>	<i>Grade</i>
<i>Full name</i>				
<i>Date: Time: Lab No.</i>				

PW 2 : Diode Characteristics and Rectification

I. Objectives:

1. Study of the diode characteristic.
2. Study of half-wave rectification.

II. Equipment used :

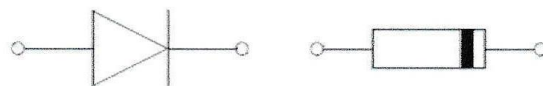
For this lab session, the equipment is as follows:

- ☐ A regulated power supply.
- ☐ Two digital multimeters.
- ☐ Connecting cables and probes.
- ☐ Two resistors of **1kΩ** and **100Ω**.
- ☐ An oscilloscope.
- ☐ Rectifier diodes.
- ☐ Two capacitors of 100μF and 1000μF.

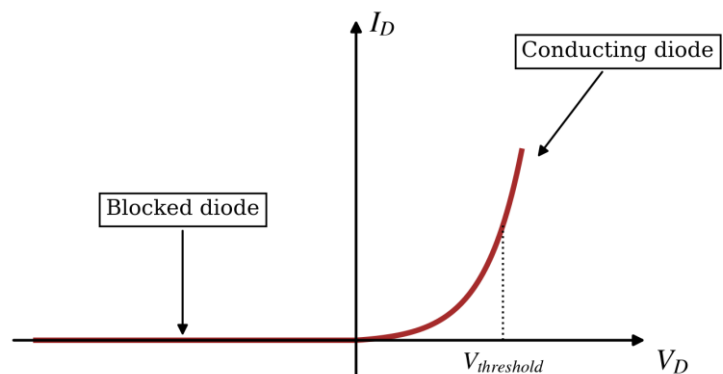
III. Theoretical background:

III.1) Definition:

The diode is a **non-linear, polarized two-terminal device** (or asymmetrical). A diode consists of a PN junction, in which current flows from the p-type material (anode) to the n-type material (cathode). The diode is the basic **semiconductor component**. Its operation can be likened to that of a switch (which lets current pass in one direction only) controlled by a voltage.



The typical characteristic of a diode has the shape shown in the following diagram:



$$r_d = \frac{\Delta V}{\Delta I}$$

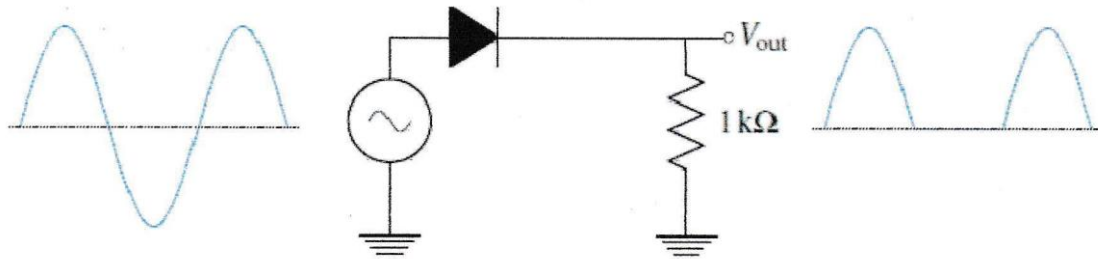
(r_d : the dynamic resistance)

III.2) Applications:

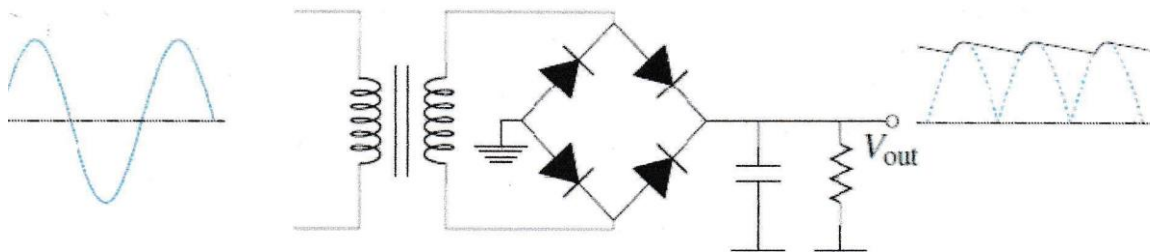
One of the main applications of diodes is to convert an alternating signal, in which the direction of electron flow reverses every half-period, into a signal in which the electrons flow in a single direction.

We have:

$$V_0(V_{avg}) = \frac{1}{T} \int_0^T V(t) dt, \quad V_{rms}^2 = \frac{1}{T} \int_0^T V^2(t) dt, \quad f = \frac{1}{T}, \quad \omega = 2\pi f, \quad \theta = \omega t$$

III.2.1) Half-wave rectification:

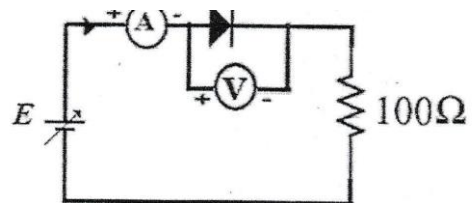
$$V_0 = \frac{1}{2\pi} \int_0^{2\pi} \sin(\theta) d\theta, \quad \theta = \omega t$$

III.2.2) Full-wave rectification and filtering:

-Ripple factor: $\frac{\Delta V}{V_m} \approx \frac{1}{2RCf}$, $V_0 = V_m - \frac{\Delta V}{2}$, ($V_m = V_{max}$)

IV) Experimental study**1. Diode characteristic:**

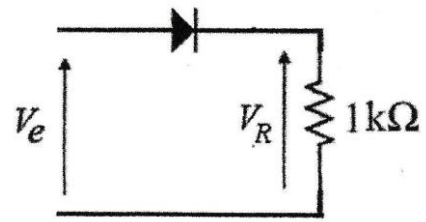
- Build the circuit shown in the following figure:
- Fill in the following table:



V(volt)	0	0.55	0.60	0.65	0.67	0.69	0.71	0.73	0.75	0.77
I(mA)										

2. Half-wave rectification

- Build the circuit shown in the following figure:
 - Supply voltage: $V_e(t) = V_{e-m} \sin(314t)$,
- Observe on the oscilloscope the alternating supply voltage $V_e(t)$, then the voltage $V_R(t)$. Record the following values:



- Maximum value of $V_e(t)$: $V_{e-m} =$
- Period of $V_e(t)$: $T_e =$
- Maximum value of $V_R(t)$: $V_m =$
- Period of $V_R(t)$: $T =$
- Qualitatively reproduce the observed curves ($V_e(t)$ and $V_R(t)$) on graph paper.
- Using the digital multimeter, measure:

- Average value of $V_e(t)$	(DC mode)	$V_{e-avg} =$
- RMS value of $V_e(t)$	(AC mode)	$V_{e-rms} =$
- Average value $V_R(t)$	(DC mode)	$V_0 =$

V. Calculation of the various parameters of the circuits from the previous steps.

- Using the measurements made and the values recorded:

1. Diode characteristic.

- Plot the diode characteristic on graph paper: $I = f(V)$.
- Deduce from this characteristic:
 - the threshold voltage of the diode $V_d =$
 - the dynamic resistance $r_d =$

2. Half-wave rectification

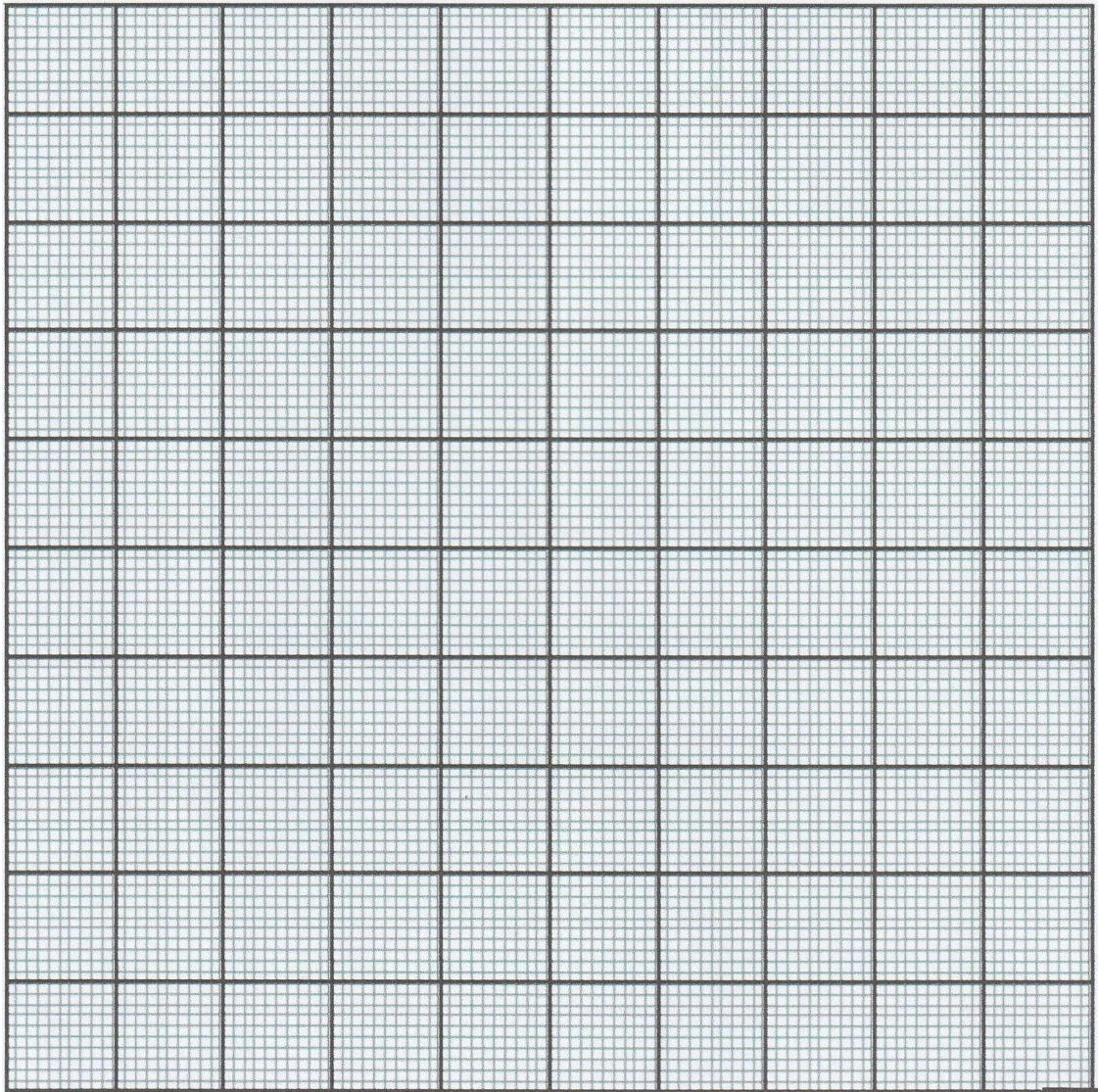
- Calculate:
 - The effective (RMS) value , average value and frequency of $V_e(t)$.
 $V_{e-rms} =$ $V_{e-avg} =$ $f_e =$
 - The RMS value, average value and frequency of $V_R(t)$.
 $V_{rms} =$ $V_0 =$ $f =$
 - Compare these calculated values with those measured with the multimeter and with the given frequency (of $V_e(t)$).
 - Compare the calculated values of V_0 with those measured with the multimeter.

VI. Conclusion

- Write an appropriate conclusion for this practical work.

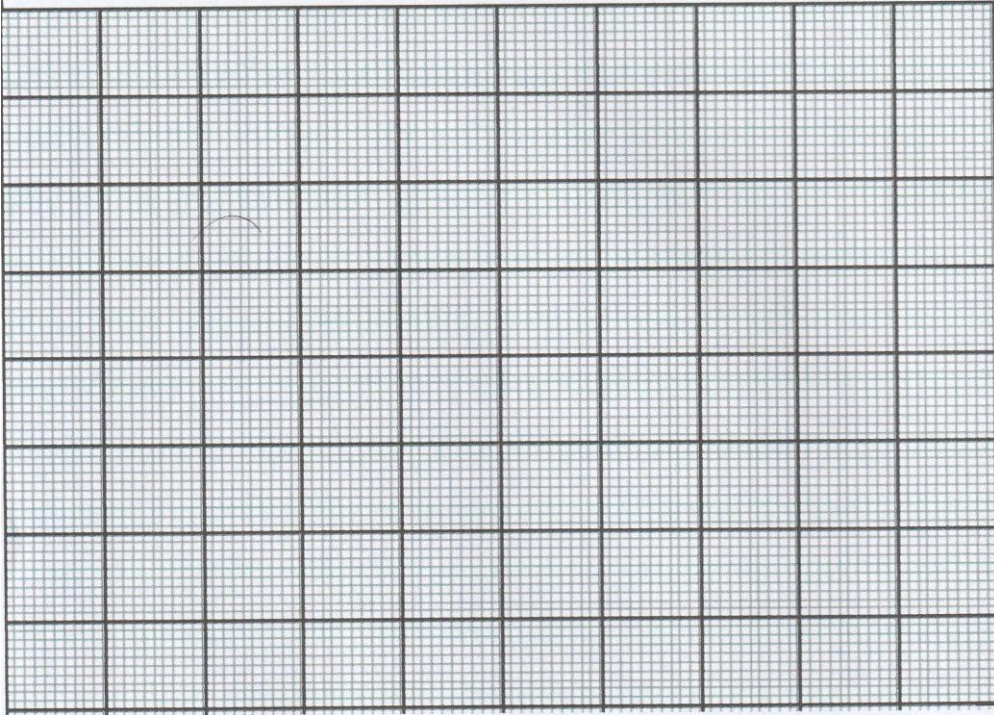
(1): Plot of the diode characteristic: $I=f(V)$.

Current (mA) →



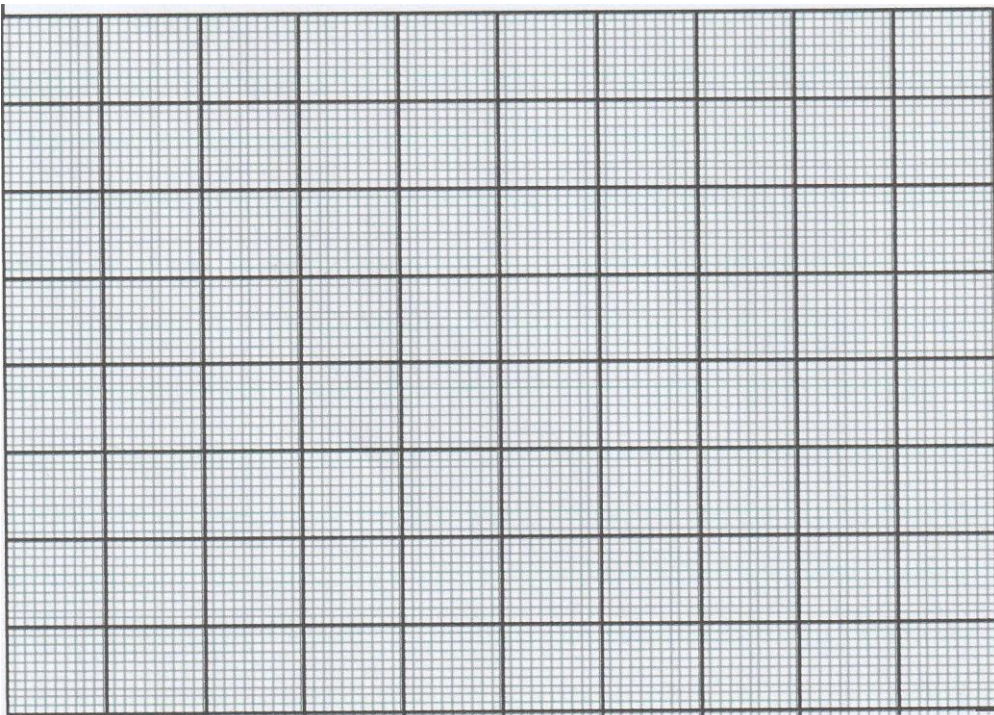
Voltage (V) →

? ↑ (2) Plot of $V_e(t)$, half-wave rectification.



t (ms) →

? ↑ (3) Plot of $V_R(t)$: half-wave rectification.



t (ms) →

VI) Comparison between theoretical and practical results

VII) Conclusion: write an appropriate conclusion for this practical work.
