

Full name			Group	Grade
Full name				
Date: Time:			Lab No.	

Practical Work 3: Full-wave rectification and filtering

I. Objectives:

1. Study of full-wave rectification.
2. Study of capacitive filtering.

II. Equipment used: For this lab, the equipment is as follows:

- ☐ A regulated power supply.
- ☐ Two digital multimeters.
- ☐ Connecting cables and probes.
- ☐ 1 k Ω resistors.
- ☐ An oscilloscope.
- ☐ Four rectifier diodes.
- ☐ Two capacitors, 100 μ F and 1000 μ F.

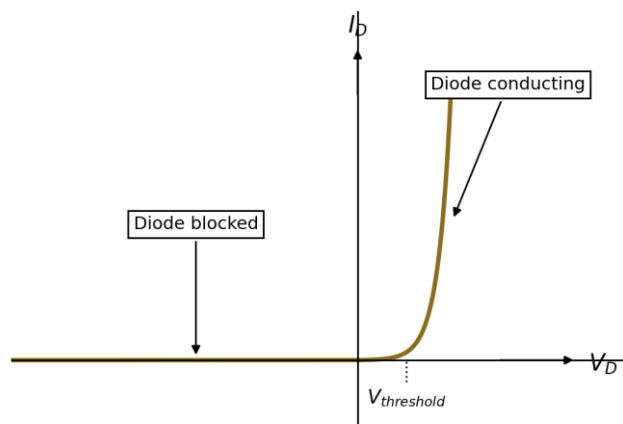
III. Theoretical background:

III.1) Definition:

The diode is a **non-linear, polarized** (or non-symmetrical) **two-terminal component**. 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 is comparable to that of a switch (which lets current pass in only one direction) controlled by a voltage.



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



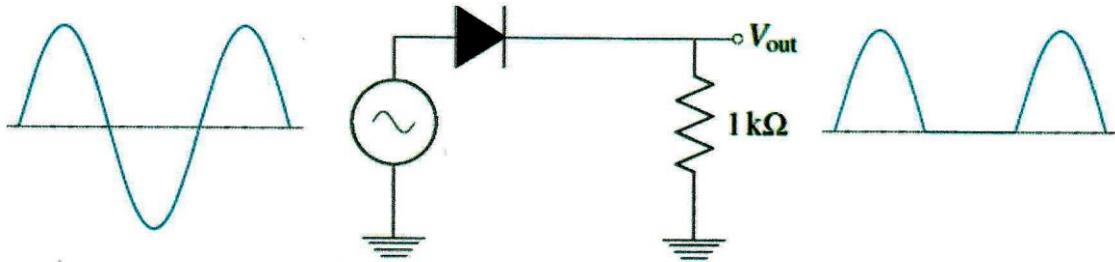
$$r_d = \Delta V / \Delta I \quad (r_d: \text{the dynamic resistance})$$

III.2) Applications:

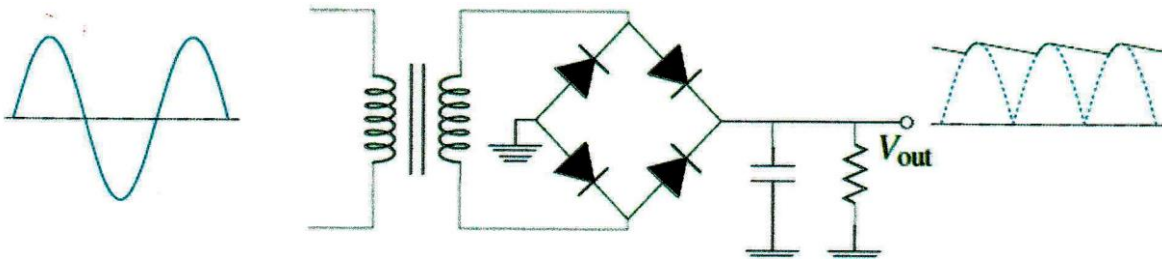
One of the main applications of diodes is to convert an alternating signal, in which the direction of electron flow reverses every half-period, into a signal in which electrons flow in a single direction.

We give:

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

III.2.1) Half-wave rectification:

$$- V_0 = (1/2\pi) \int_0^{2\pi} \sin(\theta) d\theta$$

III.2.2) Full-wave rectification and filtering:

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

IV) Experimental study

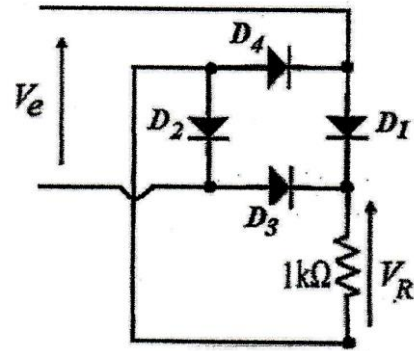
1. Full-wave rectification

➤ Build the circuit shown in the following figure:

➤ Observe the voltage $V_R(t)$ on the oscilloscope.

Record the following values:

- The maximum value of $V_R(t)$: $V_m =$
- The period of $V_R(t)$: $T =$



➤ Qualitatively reproduce the observed curve $V_R(t)$ on graph paper.

➤ Using the digital multimeter, measure:

- The average value of $V_R(t)$ (DC mode) $V_0 =$

2. Capacitive filtering

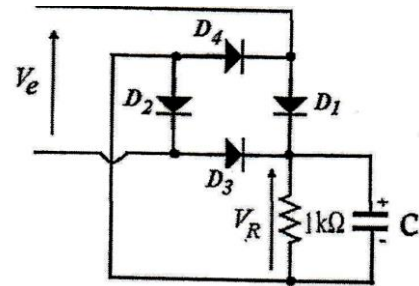
➤ Build the circuit shown in the following figure:

4.1. For $C = 100 \mu F$

➤ Observe the voltage $V_R(t)$ on the oscilloscope.

Record the following values:

- The maximum value of $V_R(t)$: $V_m =$
- The period of $V_R(t)$: $T =$
- The ripple: $\Delta V =$



➤ Qualitatively reproduce the observed curve $V_R(t)$ on graph paper.

➤ Using the digital multimeter, measure:

- The average value of $V_R(t)$ (DC mode) $V_0 =$

4.2. For $C = 1000 \mu F$

➤ Observe the voltage $V_R(t)$ on the oscilloscope. Record the following values:

- The maximum value of $V_R(t)$: $V_m =$
- The period of $V_R(t)$: $T =$
- The ripple: $\Delta V =$

➤ Qualitatively reproduce the observed curve $V_R(t)$ on graph paper.

➤ Using the digital multimeter, measure:

The average value of $V_R(t)$ (DC mode) $V_0 =$

V. Calculation of the circuit parameters from the previous steps.

- Using the measurements made and the values recorded:

1. Full-wave rectification

➤ Calculate:

- The RMS value, the average value and the frequency of $V_R(t)$.

$$V_{eff} = \quad V_0 = \quad f =$$

- Compare these calculated values with those measured with the multimeter and with the given frequency (of $V_e(t)$).

2. Capacitive filtering

► Calculate:

- The ripple factor and the average value of $V_R(t)$ for $C = 100 \mu F$.

$$\Delta V / V_m = \quad V_0 =$$

- The ripple factor and the average value of $V_R(t)$ for $C = 1000 \mu F$.

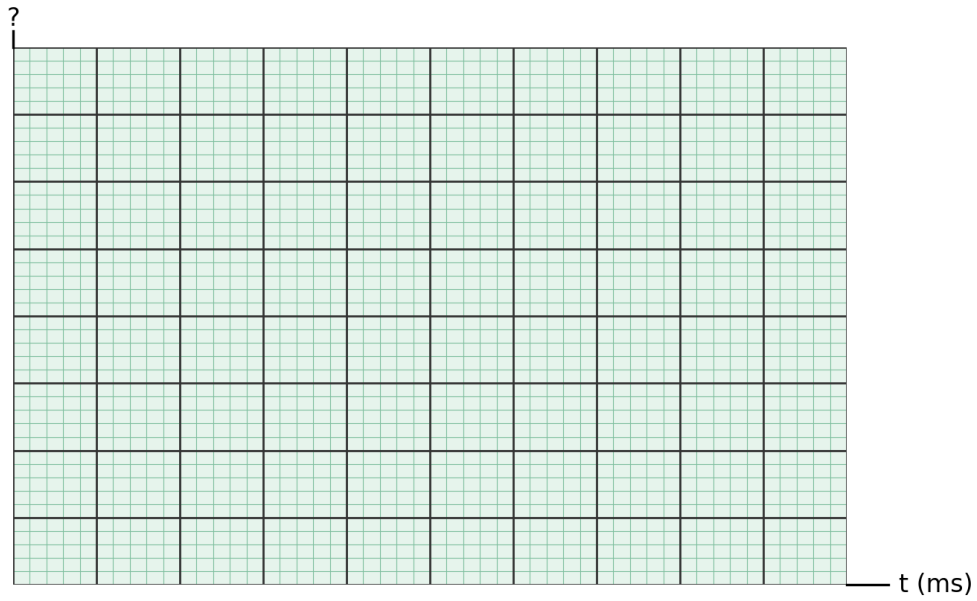
$$\Delta V / V_m = \quad V_0 =$$

- Compare the values of V_0 calculated with those measured with the multimeter.

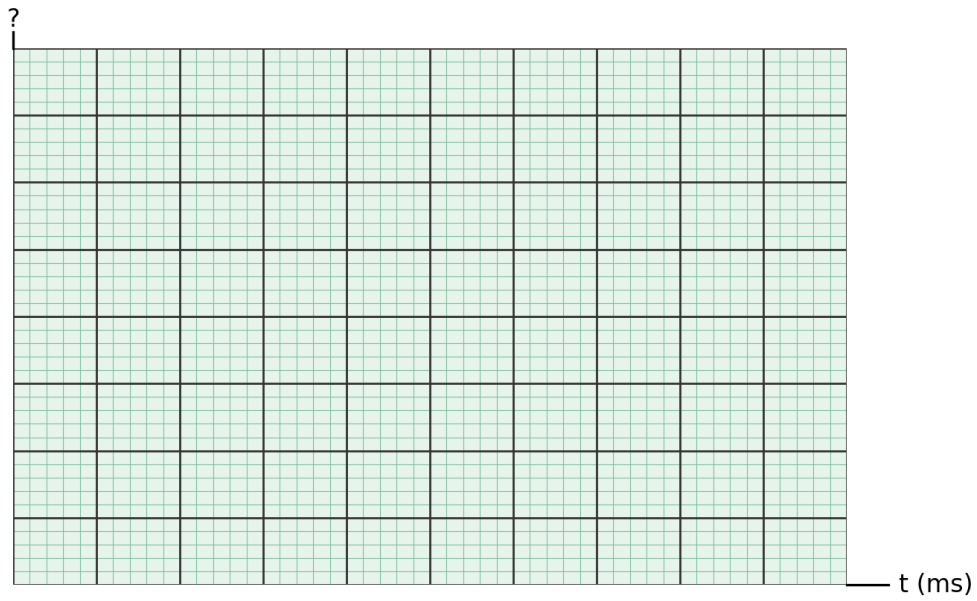
VI. Conclusion

- Write an appropriate conclusion for this practical work.

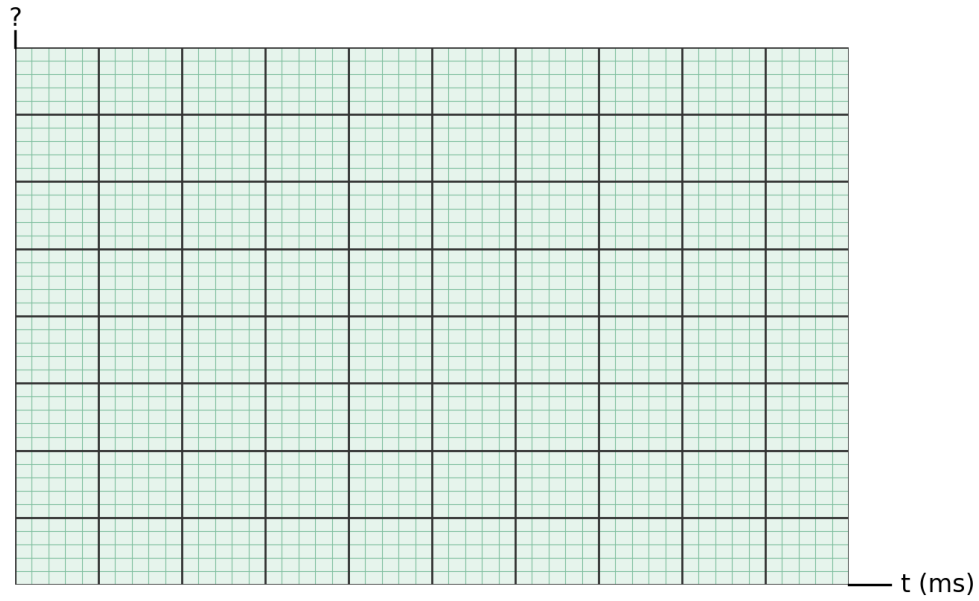
(1) Plot of $V_R(t)$: full-wave rectification.



(2) Plot of $V_R(t)$: capacitive filtering, $C = 100 \mu F$.



(3) Plot of $V_R(t)$: capacitive filtering, $C = 1000 \mu F$.



VI) Comparison between theoretical and practical results

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