Universidade do Vale do Itajaí
Computer Engineering
Basic Electronics

First Lab Assignment for Basic Electronics

Student: Lucas Mateus Gonçalves
Teacher Advisor: Walter Antonio Gontijo

September
2021

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First Lab Assignment for Basic Electronics presented for the class of the Twenty Fourth of September, 2021.

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Conteúdo

1 Objectives

1.1 1

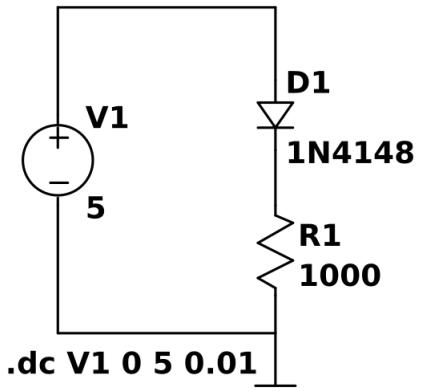
Data expected to be gathered in lab.

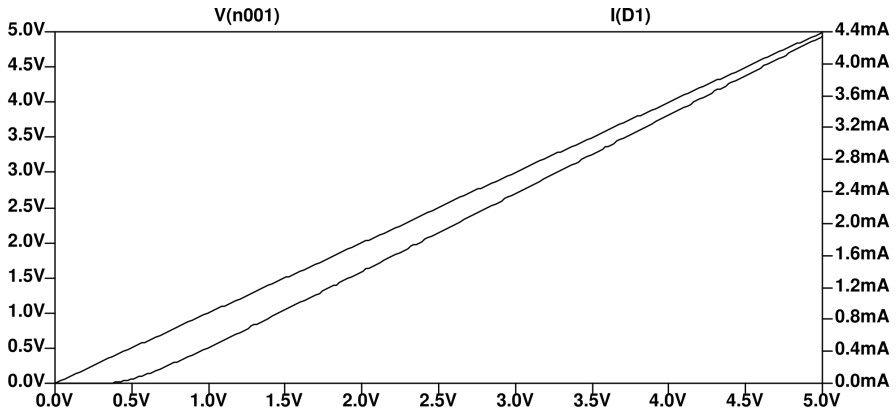
1.2 2

Data expected to be gathered in lab.

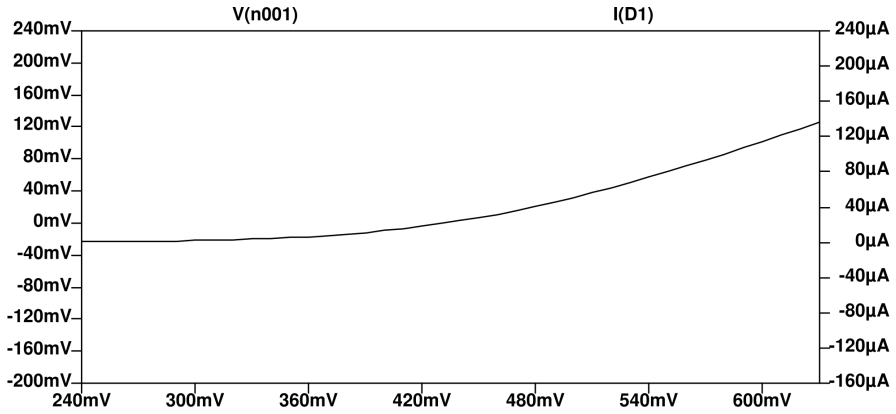
1.3 3

The following plot used the `1N4148` silicon diode.





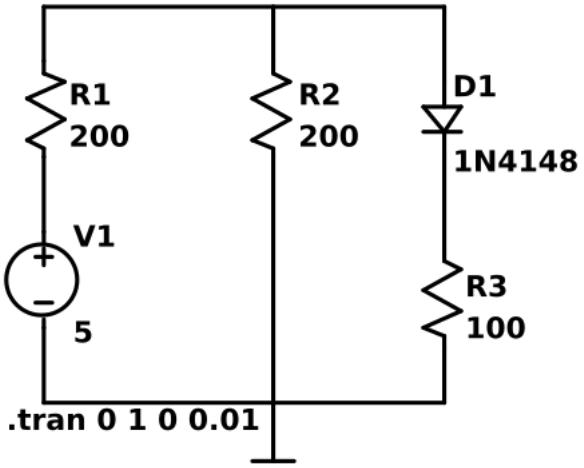
`V(n001)` is the power supply, `I(D1)` is the diode.



Plot zoomed in.

1.4 4

The following circuit was analysed.



Simulated values through *LTSpice XVII*.

	V	mA
R1	3.4054	17.027
R2	1.5945	7.9729
R3	0.9054	9.0542
D1	0.6891	9.0542

Simulated values through *Falstad Circuit Simulator*.

	V	mA
R1	3.389	16.94
R2	1.611	08.05
R3	0.889	08.89
D1	0.722	08.89

Calculated with a simplified diode model.

	V	mA
R1	3.4	17
R2	1.6	08
R3	0.9	09
D1	0.7	09

Calculated voltage and current through diode through *real model*.

V_t	2.5V
R_t	100Ω

$$R_t = 100\Omega + 100\Omega = 200\Omega$$
$$I_d = \frac{5V}{200\Omega} = 0.025$$
$$V_d = V_f = 2.5V$$
$$Calculated = 0.8188A$$

1.5 5

Data expected to be gathered in lab.

1.6 6

Calculate peak voltage from given `RMS`.

$$V_{rms} = 220V$$

$$V_{peak} = V_{rms} \times \sqrt{2} = 311.13V$$

Calculate peak voltage in secondary of the transformer with the given ratio.

$$Ratio = 55 : 3 = \frac{3}{55} = 0.054$$
$$V_{AC_{out}} = 311.13 \times 0.054 = 16.97V$$

Calculate the voltage and current through the load at peak `DC` and average using the simplified model.

$$V_{DC_{peak}} = 16.97 - 0.7 = 16.27V$$

$$I_{peak} = \frac{16.27}{1000} = 0.01627A$$

$$V_{DC_{avg}} = \frac{V_p}{\pi} = \frac{16.27}{\pi} = 5.18V$$

$$I_{avg} = \frac{5.18}{1000} = 0.00518A$$

Comparison between simulation and calculated peak values. Simulation made with *Falstad Circuit Simulator*.

	V	mA
1N4004	16.954	16.954
Calculated	16.27	16.27

1.7 7

Calculate peak voltage from given `RMS`.

$$V_{rms} = 220V$$

$$V_{peak} = V_{rms} \times \sqrt{2} = 311.13V$$

Calculate peak voltage in secondary of the transformer with the given ratio.

$$Ratio = 55 : 3 : 3 = \frac{6}{55} = 0.109$$

$$V_{AC_{out}} = 311.13 \times 0.109 = 33.91V$$

Peak voltage through load will be as follows.

$$V_{DC_{peak}} = \frac{33.91 - 0.7}{2} = 16.60V$$

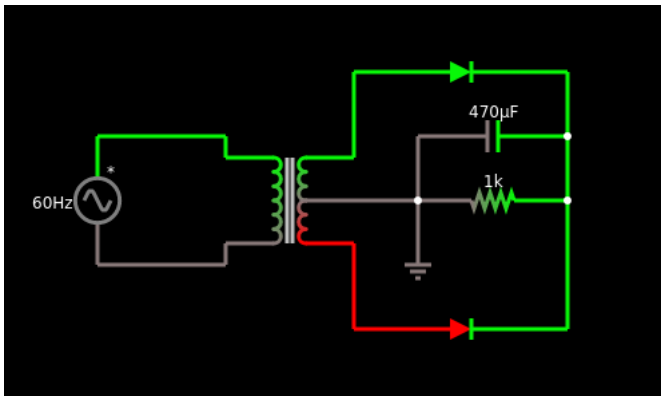
The average current will be as follows.

$$V_{DC_{avg}} = \frac{16.60}{\pi} = 5.28V$$

Comparison between simulation and calculated peak values. Simulation made with *Falstad Circuit Simulator*.

	V	mA
1N4004	16.094	16.094
Calculated	16.60	16.60

1.7.1 With the $470\mu F$ capacitor is added in parallel



Circuit with the capacitor.

The `DC` voltage should remain steady at $16.60V$ at the load with the following ripple voltage.

$$V_r = \frac{V_{peak}}{fRC} = \frac{16.60}{60Hz \times 2 \times 1000\Omega \times 0.00047F} = 0.294V$$

As such the voltage with ripple will be as follows.

$$V_{DC} = V_{peak} - \frac{V_r}{2} = 16.45V$$

1.8 8

Neither simulator has the `1N4733A` zener diode, the only diode with close specifications has a zener range of $5.63V$.

$$V_{z_{simulated}} = 5.63V$$
$$V_{z_{1N4733A}} = 5.1V$$

By the simulation, on a voltage sweep the diode should start to conduct and thus regulate the voltage at the $1k\Omega$ load at $5.63V$, only allowing a current of $5.63mA$ to the load.

The simulator measures a voltage of $-5.627V$ and a current of $-14.25mA$ on the diode at a supply of $10V$.

The simulator measures a voltage of $-5.64V$ and a current of $-23.27mA$ on the diode at a supply of $12V$.