Student Names
Student Numbers

MANDATORY EXPERIMENTS

Experiment 1

Tab. 1 includes the measured voltage and current pairs for an unknown LTI resistor. Use linear curve fitting to estimate the characteristic curve of the resistor and its resistance.

Voltage (V)	02.03	04.12	06.25	08.65	10.00	14.26	16.76	17.56	19.75	21.28
Current (mA)	00.97	01.90	03.18	03.94	05.41	05.61	06.66	07.43	08.34	10.73
Voltage (V)	26.13	25.70	26.37	32.52	32.27	33.38	36.68	36.40	38.72	47.89
Current (mA)	11.17	12.11	12.07	14.98	15.36	15.52	17.04	17.64	17.38	18.95

Table 1: Measured voltages and currents for an LTI resistor.

Experiment 2

Tab. 2 collects the measured voltage and current pairs for an unknown diode. Use MATLAB/Python curve fitting tool to estimate the characteristic curve of the diode and find its reverse bias saturation current, thermal voltage, and forward voltage.

Voltage (V)	0.19516	0.21303	0.23218	0.23917	0.26267	0.28080	0.28193
Current (A)	0.00007	0.00013	0.00024	0.00043	0.00080	0.00149	0.00265
Voltage (V)	0.29333	0.31349	0.32892	0.34734	0.36528	0.36424	0.38561
Current (A)	0.00514	0.00877	0.01604	0.02907	0.05329	0.09917	0.17844
Voltage (V)	0.42234	0.40499	0.45886	0.46548	0.46946	0.48880	0.48686
Current (A)	0.34544	0.59965	1.06564	2.08610	3.82848	6.61591	11.6574

Table 2: Measured voltages and currents for a diode.

Experiment 3

The experimental setup of Fig. 1 is used to display the Lissajous curve constructed by $v_x(t)$ and $v_y(t)$, where D is an LTI basic circuit element. How can the displayed Lissajous curve be used to determine the type of the unknown element D and check if D is a resistor, or a capacitor, or an inductor.

Experiment 3 continued on next page...

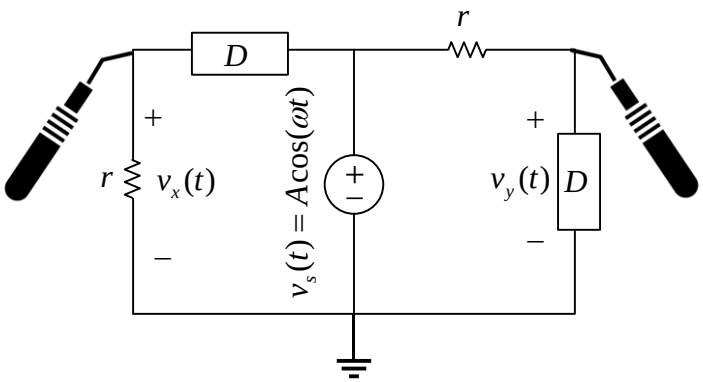

Figure 1: An experimental setup to display Lissajous curves.

Experiment 4

A real capacitor is modeled as Fig. 2. Use this model to describe why a real capacitor does not work as a capacitor when the applied terminal voltage is a high frequency sinusoidal signal.

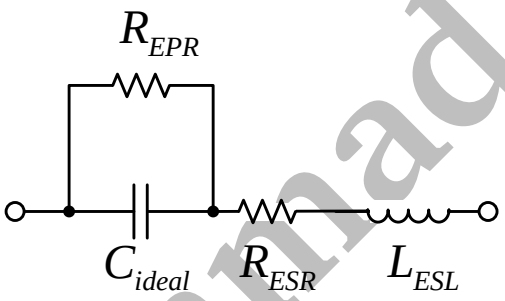

Figure 2: Real capacitor model.

Experiment 5

A real inductor is modeled as Fig. 3. Use this model to describe why a real inductor does not work as an inductor when the applied terminal voltage is a high frequency sinusoidal signal.

Experiment 5 continued on next page...

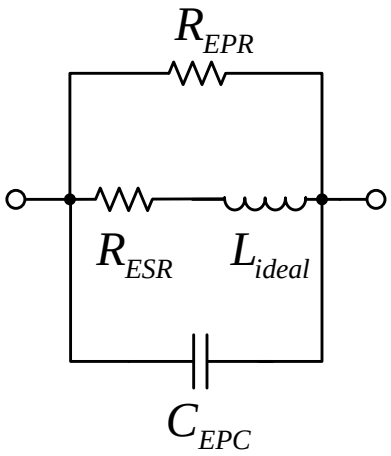

Figure 3: Real inductor model.

BONUS EXPERIMENTS

Experiment 6

Write a MATLAB/Python code that receives the data set $(x_i, y_i), i = 1, \cdots, n$ and determines the optimal coefficients of the linear curve $y = ax + b$ that fits the data set with the least square error $\epsilon = \sum_{i=1}^{n}(y_i - ax_i - b)^2$.

Experiment 7

Return your answers by filling the LaTeXtemplate of the manual.