Bialystok University of Technology
Faculty of Electrical Engineering
Department of Electrotechnics, Power Electronics
and Electrical Power Engineering

Instruction
for a specialist workshop on

**Python Programming 1**

Subject code: **CP1S02005E**

(Full-Time Studies)

# PYTHON - FUNCTIONS

Instruction Number

**PP_07_EN**

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# Contents



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**Teaching Materials for Students of the Faculty of Electrical Engineering at BUT.**

# 1. Workstation Description

## 1.1. Equipment used

A PC-class computer with the Microsoft Windows 10 operating system is used during classes.

## 1.2. Software

The computers are equipped with the Visual Studio Code 1.86 (or newer) source code editor along with the appropriate extension (Python extension for Visual Studio Code).

# 2. Exercises Procedure

In the specialist workshop, selected tasks assigned by the instructor must be completed. Different groups may perform different tasks.

1. Write a program that contains a function printing a business card on the screen in the following format (don't forget the frame made of asterisks). Call the function you wrote.

```
**********************************
*            John Smith          *
*    e-mail: j.smith@gmail.com   *
*        tel. 123-456-789        *
**********************************
```

2. The electric energy **W** consumed over time **t** by a device with power **P** is calculated using the following formula:

$$W = P \cdot t \tag{1}$$

   Write a function that calculates and returns the electric energy consumption (in **kWh**) of a device with power **P** used over time **t**. Read the values of **P** and **t** from the keyboard, call the function you wrote, and display the value it returns.

3. Write a function that converts a distance given in **kilometers** to **land miles**, and another function that converts **kilometers** to **nautical miles**. Read the distance in kilometers from the keyboard, call both functions, and display the values they return.

   Note: 1 land mile = 1609.344 meters, 1 nautical mile = 1851.852 meters.

4. Write a function that calculates and returns the resistance **R** of a homogeneous conductor with a cross-sectional area **S** and length **l**, made from a material with resistivity **ρ**. Using the function, calculate the resistance **R** of a conductor with length **l = 100 m** and cross-sectional area **S = 2.5 mm²** for copper, aluminum, silver, and gold (call the same function four times with different arguments)

Table 1. Resistivity of selected materials at 20 ºC

| **Material** | **Resistivity [Ω·m]** |
|---|---|
| copper | $1.72 \cdot 10^{-8}$ |
| aluminum | $2.82 \cdot 10^{-8}$ |
| silver | $1.59 \cdot 10^{-8}$ |
| gold | $2.44 \cdot 10^{-8}$ |

5. Write a program that contains a function to calculate and return the **resonant frequency (fr)** of a circuit with resistance **R**, inductance **L**, and capacitance **C**, which are entered from the keyboard in the **main()** function.

| Example of program execution | Equation |
|---|---|
| `Inductance L [H]:  0.04`<br>`Capacitance C [F]:  2.0e-6`<br>`----------`<br>`Frequency fr [Hz]:  562.697693` | $f_r = \frac{1}{2\pi\sqrt{LC}}$ (2) |
| `Resistance R [Om]:  5000`<br>`Inductance L [H]:  0.02`<br>`Capacitance C [F]:  4.0e-5`<br>`----------`<br>`Frequency fr [Hz]:  177.942413` | $f_r = \frac{1}{2\pi\sqrt{LC - \left(\frac{L}{R}\right)^2}}$ (3) |

| | |
|---|---|
| `Resistance R [Om]:  500`<br>`Inductance L [H]:  0.03`<br>`Capacitance C [F]:  6.0e-5`<br>`----------`<br>`Frequency fr [Hz]:  118.508408` | $f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{1}{(RC)^2}}$ (4) |
| `Resistance R [Om]:  10`<br>`Inductance L [H]:  1`<br>`Capacitance C [F]:  1.0e-6`<br>`----------`<br>`Frequency fr [Hz]:  159.146988` | $f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$ (5) |
| `Resistance R [Om]:  100`<br>`Inductance L [H]:  0.05`<br>`Capacitance C [F]:  5.0e-3`<br>`----------`<br>`Frequency fr [Hz]:  10.060807` | $f_r = \frac{1}{2\pi\sqrt{LC}}\sqrt{1 - \frac{L}{R^2C}}$ (6) |
| `Resistance R [Om]:  10`<br>`Inductance L [H]:  0.1`<br>`Capacitance C [F]:  1.0e-6`<br>`----------`<br>`Frequency fr [Hz]:  503.54397` | $f_r = \frac{1}{2\pi\sqrt{LC - (RC)^2}}$ (7) |

6. Fig. 1 shows the waveform of a trapezoidal pulse. Write a function that, based on the given time **t**, calculates and returns the corresponding voltage value **u**. Then, using this function, calculate and display the voltage values for time **t** ranging from **0** to **6** seconds, with a step of **0.25** seconds (use a **for** loop). Display the results in two columns: (**time**, **voltage**)

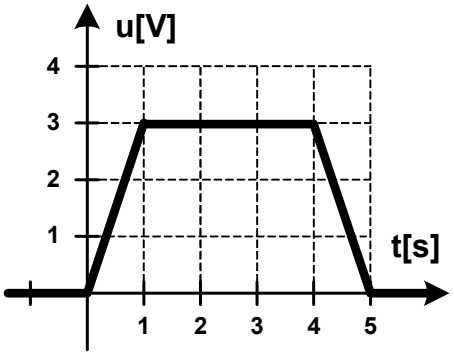


Fig. 1. Trapezoidal pulse waveform

# 3. Literature

[1] Ramalho L., Fluent Python: clear, concise, and effective programming. Sebastopol, O'Reilly, 2022.

[2] Matthes E., Python Crash Course, San Francisco, CA, No Starch Press, 2019.

[3] Sweigart A., Automate the Boring Stuff with Python, San Francisco, CA, No Starch Press, 2020.

[4] Lutz M., Learning Python, Sebastopol, CA, O'Reilly Media, 2013.

[5] https://www.python.org/doc/ Python, documentation.

# 4. Health and Safety Requirements

To begin the practical part of the exercise, it is mandatory to familiarize yourself with the health and safety instructions and fire safety guidelines and to adhere to the rules contained therein.

During laboratory sessions, the following rules must be observed:

- Verify that the devices available at the laboratory workstation are complete and show no signs of physical damage.
- If possible, adjust the workstation conditions to suit individual ergonomic needs. Position the computer monitor to ensure constant and comfortable visibility for all team members.
- Check the correctness of device connections.
- The computer may only be turned on with the instructor's permission.
- Eating and drinking are prohibited while working with the computer.
- Upon completion of work, log out before leaving the workstation. The operating system may only be shut down upon explicit instruction from the instructor.
- Making any modifications, switching components, or replacing elements of the workstation is strictly prohibited.

- Changing the computer's configuration, including the operating system and software, is not allowed unless it is part of the class program and performed under the instructor’s supervision.
- In the event of a power failure, immediately turn off all devices.
- Any missing equipment or malfunctions must be reported to the instructor.
- It is forbidden to operate, manipulate, or use devices not included in the current exercise.
- In case of electric shock, immediately disconnect the workstation from the power supply. Do not touch the affected person before the power is turned off.