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

Instruction
for a specialistic workshop on

Electrical Circuits 2

Subject code: **IS-FEE-10085S**

(Erasmus+)

THREE-PHASE SYSTEMS

Instruction Number

EC2_03

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Contents

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.

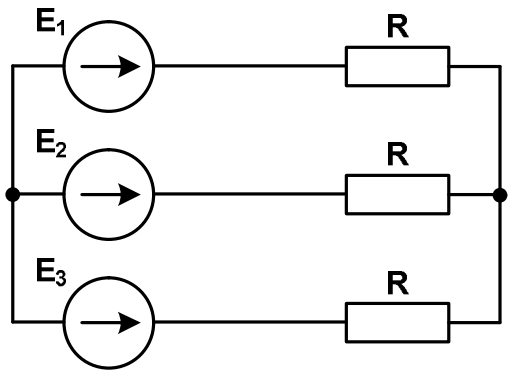
1.2. Software

The computers are equipped with the PSpice program.

2. Exercises Procedure

Complete the tasks below and prepare a report on the activities according to the provided instructions.

1. The electric circuit represents a 3-phase, balanced Y-Y system with a resistive load. Simulate the circuit using PSpice. Observe the waveforms of the phase and line-to-line voltages across the generator and load, as well as the phase currents. Assume: frequency f = 50 Hz, resistance of the load R = 100 Ω. Select the remaining circuit parameters yourself.



The report should include:

- a description of the purpose and scope of the task,
- values of the elements used,
- the electrical circuit diagram (from PSpice),

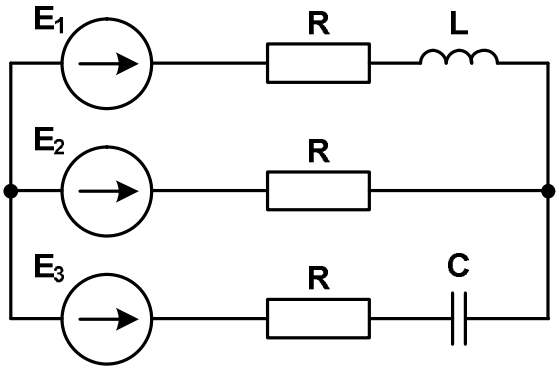
- waveforms of the phase and line-to-line voltages of the generator (for one period),
- voltage and current waveforms of the load (for one period),
- conclusions (do the analyses of the obtained waveforms confirm the theoretical relationships between currents and voltages?).

2. The electric circuit represents a 3-phase, unbalanced Y-Y system. Simulate the circuit using PSpice. Consider two cases:

   a) without a neutral wire,

   b) with a neutral wire.

   Observe the waveforms of voltages and currents. Assume: frequency f = 50 Hz, R = 100 Ω, L = 200 mH, C = 25 μF. Select the remaining circuit parameters yourself.



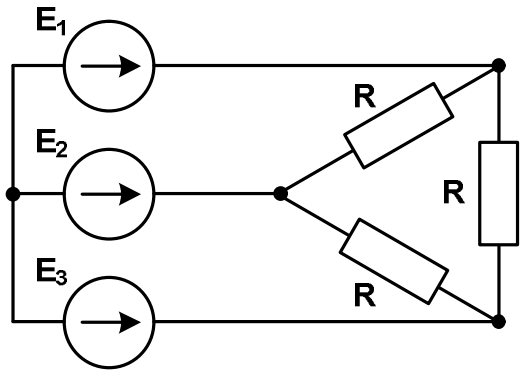
   The report should include:

- a description of the purpose and scope of the task,
- values of the elements used,
- for the system without neutral wire:
  - the electrical circuit diagrams (from PSpice),
  - waveforms of the phase and line-to-line voltages of the generator (for one period),
  - waveforms of the phase voltages of the load and voltage between neutral points (for one period),
  - voltage and current waveforms of the load (for one period),

- conclusions (do the analyses of the obtained waveforms confirm the theoretical relationships between currents and voltages?),

- for the system with the neutral wire:
  - the electrical circuit diagram (from PSpice),
  - waveforms of the phase and line-to-line voltages of the generator (for one period),
  - waveforms of phase voltages of the load (for one period),
  - voltage and current waveforms of the load, and the current in the neutral wire (for one period),
  - conclusions (do the analyses of the obtained waveforms confirm the theoretical relationships between currents and voltages?).

3. The electric circuit represents a 3-phase, balanced Y-Δ system with a resistive load. Simulate the circuit using PSpice. Observe the waveforms of the phase and line-to-line voltages across the generator and the load, as well as the phase and line currents. Assume: frequency f = 50 Hz, resistance of the load R = 100 Ω. Select the remaining circuit parameters yourself.



The report should include:

- a description of the purpose and scope of the task,
- values of the element used,
- the electrical circuit diagram (from PSpice),
- waveforms of the phase and line-to-line voltages of the generator (for one period),

- waveforms of the line currents and phase currents of the load (for one period),
- voltage and current waveforms of the load (for one period),
- conclusions (do the analyses of the obtained waveforms confirm the theoretical relationships between currents and voltages?).

3. Literature

[1] Thomas R.E., Rosa A. J., Toussaint G.J.: The Analysis & Design of Linear Circuits. 8th Edition. Wiley Inc., 2016.

[2] Tung L.J., Kwan B.W.: Circuit Analysis. World Scientific, 2001.

[3] Irvin J.D., Nelms R.M.: Basic Engineering Circuits Analysis. International Student Version. John Willey&Sons Inc., 2008.

[4] https://www.electrical4u.com/electrical-engineering-articles/circuit-theory

[5] https://www.khanacademy.org/science/electrical-engineering

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.