

Course name	Electrical engineering and electrical safety
The study course code	Fizi1048
Field of science	Physics
Credits	3
ECTS Credits	4.50
The total number of hours	48
The number of lectures (hours)	32
Laboratory work hours	16

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Annotation

The course is intended for students of Bachelor study program "Physics". Main goals of this study course are:
 1.increasing knowledge about electrical engineering and electrical safety;
 2. acquiring practical skills in working with electric measuring instruments, electric machines, transformers.

Results

Finishing the study course **Electrical engineering and electrical safety**, students have:

- Knowledge about electrical engineering and electrical safety.
- Ability to explain the operating principles of electric measuring devices and electric machines.
- Ability to discuss about electrical engineering and electrical safety issues, to argue his/her point of view.
- Ability to study the corresponding scientific literature independently.

Course plan

Lectures – 32 credit hours, laboratory assignments – 16 credit hours, assignments -32 KS.

Topics

1. Labour safety equipment. Hazard of electric current.(Electricity hazards). Protective grounding. Warning signs (labels) and protective equipment. Basic safety rules (regulations) for work in the laboratories and offices (lecture-rooms).
2. Electrical energy in Latvia and its perspectives (prospects) for development. The scheme of electricity generation, transmission and use.
3. Linear electric circuits. Classification of electric circuits. Elements of AC circuits and its characteristics. Single-phase electric circuits. Obtainment of alternating current. Characteristic quantities of alternating current. Different types of loads (resistive, inductive, capacitive) in the AC circuit.
4. Triangles of voltage, current, load, conductivity and power. Power factor and its enhancement. The symbolic method for calculation of AC circuits.
5. Three-phase circuits. Wye and delta connection. Power of the three-phase system.
6. Fundamentals of electrometry. Classification of electrical measuring instruments. Indicators (signs labels) on the scales of measuring instruments. Systems of measuring instruments (devices) and basic elements of mechanisms. Measuring of electrical quantities. Shunts and series resistors.
7. Plotters and oscilloscopes. Measurements of non-electrical quantities by electrical methods. Parametric and generating transducers (sensors).
8. Transformers. One-phase transformer design and operation principle. Idle and load mode of transformers. Power loss in the transformer and its determination. Transformer efficiency factor.
9. Three-phase transformers. Winding connection group. Autotransformers.
10. Induction motors (machines). Rotating magnetic field of three-phase current, its rotational speed. Construction and operating principle of an induction engine. Rotor slide. Basic types of three-phase induction motors. Current, frequency and EMF of rotor. Characteristic curves of induction motors. Security technology working with electric motors (machines).
11. Start, reverse and rotor speed control of asynchronous motors. Single-phase asynchronous (induction) motors. Three-phase induction motor connection to single-phase circuit. Operation of induction motor in generator mode, electric braking.
12. Synchronous motors. The construction of the synchronous machine and operating principle of the generator. Power supply of excitation winding. Idling mode of generator. Armature reaction. An external (terminal) characteristic curves of the synchronous generator. Connection of the generator for parallel operation. Operating principle of synchronous motor. Start of motor. Synchronous compensator.

13. DC (direct current) machines. DC generator. EMF and armature reaction. Commutation. Classification of DC machines by type of excitation.
14. DC motors. Opposite EMF of armature. Start of motor and speed control of rotor. Motors with series, shunt and compound excitation. Operating characteristics and electric braking of DC motors. Use of DC machines.
15. Devices used in automation and control systems. Electric micromachines. Electronic rectifiers. Filters. Stabilizers. Switches. Magnetic starter. Fuses. Photoelements, photoresistors, thermoresistors.
16. Types of electrical power plants. (International) Systems of energetics. High voltage and low voltage power transmission and distribution principles. Power supply of laboratories and offices. The choice of electrical components and wires. Electrical safety in the laboratories of educational establishments.

Topics of laboratory assignments:

1. Exploration (investigation) of single-loop electric circuits.
2. Exploration (investigation) of multiloop electric circuits.
3. Exploration of induction energy meter.
4. Determination of power and power factor in the single-phase AC circuits.
5. Exploration of single-phase transformer.
6. Electrical measuring instruments and measurements.
7. Exploration of rectifiers and electric filters
8. Electrical micromachines(devices).

Students' independent work: Reports of laboratory assignments, literature sources studies.

Requirements for awarding credit points

8 laboratory assignments completed and reported - 50% of the final assessment.

Oral exam: an oral presentation of two topics from study course - 50% of the final assessment.

Mācību pamatliteratūra

1. Zolbergs J. Vispārīgā elektrotehnika. - R.: Zvaigzne, 1974.- 535 lpp.
2. Kasatkina A., Perekajins M. Elektrotehnika. - R.: LVI, 1961.- 424 lpp.
3. Drošības tehnikas instrukcija fizikas kabinetam e –pasts gimnazija(laboratorijai) @tukums.parks.lv. ,
4. DROŠĪBAS PRASĪBAS VEICOT DARBUS ELEKTROIETAISĒS <http://www.osha.lv>; <http://www.vdi.gov.lv>
5. Spūlis L. Elektrotehnika un elektrības izmantošana. Višķi 2012, 303 lpp.

Papildliteratūra

1. Blūmentāls M. Elektronika un iekārtu elektroniskā vadība. Višķi 2011.
2. Elektrotehnika un radiotehnika vidusskolām. Izdevniecība „Zvaigzne”, Rīga, 1975
3. Fundamentals of Engineering Electromagnetics 4. Zītars U. Elektronikas pamati. Mācību līdzeklis Ceturtais izdevums RTU, Rīga – 2007

Periodika un citi informācijas avoti

1. Nature. Physics.” Nature publishing group.
2. „Ilustrētā zinātne”. 3. Interneta avoti.

Piezīmes

Bakalaura studiju programmas “Fizika” B daļa