Syllabus
Course Program

Electrotechnical materials

Specialty
141 – Electric power, electrical engineering and electromechanics

Institute
Institute of Power Engineering, Electronics and Electromechanics

Educational program
Electrical engineering

Department
Electrical Insulation and Cable Engineering (131)

Level of education
Bachelor's level

Course type
General, Mandatory

Semester
2

Language of instruction
English,

Lecturers and course developers

Oleksandr Kiessaiev

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Candidate of Technical Science, Associate Professor, the Head of the Electrical Insulation and Cable Engineering Department

Author of more than 20 publications. Lector of such courses like "Fiber-optic cable systems", " Calculation and producing technology of optical cables", "Tests of insulation, cable and optical fiber systems" etc.
More about the lecturer on the department's website

General information

Summary

“Electrotechnical materials” is submitting of fundamental knowledge about current level of development of material science in conjunction with practical application of obtained knowledge in the field of electrical engineering.

Course objectives and goals

The course of "Electrotechnical materials" develops skills and knowledge necessary for future electrical engineers. Studying students will learn about materials used in electrical engineering branch, where, why and what can be destructive for electrical devices and humans etc..

Format of classes

Lectures, laboratory classes, self-study. Final control in the form of an exam.

Competencies

GC14. Ability to demonstrate basic knowledge in the field of natural sciences and readiness to use the methods of fundamental sciences for solution of general engineering and professional problems.
PC3. Ability to use basic knowledge in general physics, higher mathematics, theoretical basics of electrical engineering and electrical materials for solution of practical problems in the field of electric power engineering, electrical engineering and electromechanics.
PC8. Ability to use modern methods of calculation, simulation and analysis of operating modes of power electrical, electrotechnical and electromechanical equipment and design of electric and electromechanical systems.

Learning outcomes

SR5. To analyze processes in power electrical, electrotechnical and electromechanical equipment and corresponding complexes and systems.
SR15. To improve the skills of working with modern equipment and software at performing calculations of the modes of operation of electrical, power electrical and electromechanical equipment, as well as of corresponding complexes and systems.
SR16. To combine the methods of empirical and theoretical research to find ways to reduce the electric energy losses at its production, transportation, distribution and usage.

Student workload

The total volume of the course is 120 hours (4 ECTS credits): lectures - 32 hours, laboratory classes - 32 hours, self-study - 56 hours.

Course prerequisites

To successfully complete the course, student must have knowledge and practical skills in physics and mathematics.

Features of the course, teaching and learning methods, and technologies

Lectures are interactive using multimedia technologies. Laboratory classes use a project-based approach to learning, game methods, and focus on the application of information technologies.

Program of the course

Topics of the lectures

Topic 1. Conductivity of dielectric materials. Charge carriers in dielectric materials, their concentration and mobility in different types of dielectrics.
Volume resistance and surface resistance of dielectric materials.
Topic 2. Polarization of dielectric materials. Dielectric permeability.
Different types of polarization of dielectric materials. Polar and nonpolar dielectric materials.
Topic 3. Power losses in dielectric materials, tanδ of dielectric materials. Topic 3. Power losses in dielectric materials, tanδ of dielectric materials.
Equivalent scheme of dielectric materials with power losses and their vector diagrams.
Topic 4. Breakdown of dielectric materials. Breakdown voltage and electrical strength of dielectric materials.
Impact of temperature frequency and other factors on electrical strength of dielectric materials.
Topic 5. Mechanical and thermal properties of dielectric materials.
Deterioration of dielectric materials under impact of different external factors.
Topic 6. Gaseous dielectrics and their properties.
Applying of gaseous insulation in electrical engineering.
Topic 7. Synthetic liquid dielectric materials.
Topic 8. Organic polymers. Polar and nonpolar dielectric films.
Components of insulation materials based on organic polymers.
Topic 9. Fibrous materials.
Electric mechanical and physiochemical properties of papers and special papers.
Topic 10. Electrical varnishes and compounds.
Topic 11. Ceramic dielectric materials. Porcelain insulators. Various ceramic dielectrics.
Topic 12. Mica and mica materials.
Topic 13. Spontaneous electric polarization. Ferroelectrics and their application.
Topic 14. Conductive materials: copper, aluminum, alloys of high resistance and their application.
Main factors that affect the value of conductivity of conductive materials.
Topic 15. Semiconductive materials.
Intrinsic semiconductors extrinsic semiconductors.
Topic 16. Magnetic materials and their properties.
Soft magnetic materials. Hard magnetic materials. Power losses in magnetic materials.

Topics of the workshops

There are no workshops in this course

Topics of the laboratory classes

Topic 1. Research of solid conductive materials
Topic 2. Determination of electrical strength of solid dielectrics
Topic 3. Determination of magnetic materials characteristics
Topic 4. Determination of the dependences of the dielectric permeability and the angle tangent of dielectric losses of insulating materials on frequency and temperature
Topic 5. Determination of the tangent of the dielectric loss angle and the dielectric permittivity of dielectrics at alternating voltage
Topic 6. Research of ferroelectrics
Topic 7. Measurement of dielectric resistance

Self-study

This course provides writing of abstract work in themes passed. Students are also recommended additional materials (videos, articles) for independent study and analysis.

Course materials and recommended reading

1. Jaromir Drepala. Materials for electrical engineering. Chosen chapters. Ostrava. 2014. 151 p.
2. Ramesh Chandra Prusty. Electrical engineering material lecture notes. Odisha. 1989. 53 p.
3. E. Helerea, M. D. Calin. Materials in electrical engineering. Publishing House Transilvania University Brasov. 2015.378p.
4. O. Milton. Engineering materials science. 1995. 827 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final mark consists of assessment results in the form of an exam (40%) and ongoing assessment (60%).

Exam: written assignment (2 theory questions + problem solving) and oral presentation.
Current assessment: 2 online tests and a calculation task (20% each).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by

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Oleksandr KIESSAIEV

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Halyna OMELIANENKO