STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Materials engineering		**1010341731010311578**
Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics in Technology	**general academic**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
First-cycle studies (Polish Qualifications Framework level six)	**full-time**	
No. of hours		No. of credits
Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**		**5**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
Major	**university-wide**	
Education areas and fields of science and art		ECTS distribution (number and %)
technical sciences		**5 100%**
technical sciences		**5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Mathematics, chemistry and physics fundamentals [K_W03 (P6S_WG), K_W04 (P6S_WG)]
2	**Skills**	Students can assemble the measurement system, can perform measurements of basic physical quantities. Is able to develop test results and work in a group [K_U05 (P6S_UW), K_U07 (P6S_UW)]
3	**Social competencies**	The student is aware of the need to expand their skills and competences, understands the importance of teamwork [K_K01 (P6S_KK), K_K02 (P6S_KK)]

Assumptions and objectives of the course:

Knowledge of basic materials used in electrical engineering, phenomena occurring in them and characterized them properties. Learning new techniques and research methods.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student has structured and theoretically founded knowledge of the structure and operation of electrical equipment, is knowledgeable about the exploitation of technical systems [K_W04 (P6S_WG), K_W11 (P6S_WG)]
2. The student has a basic knowledge of the properties and applications of materials used in electrical engineering [K_W10 (P6S_WG)]
3. The student has knowledge of the physical phenomena occurring in insulating, conductive, semi-conductive and magnetic materials [K_W04 (P6S_WG)]

Skills:

1. Students can compile the research documentation and discuss obtained research results [K_U12 (P6S_UK)]
2. The student can choose the right method and use the measuring equipment to determine the basic characteristics specific to tested materials [K_U07 (P6S_UW), K_U09 (P6S_UW), K_U10 (P6S_UW)]

Social competencies:

1. The student understands the aspects and consequences of the use of materials, including the impact on the environment, and the related responsibility for decisions [K_K03 (P6S_KO)]
2. The student is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork and shared responsibility for the implementation of tasks [K_K05 (P6S_KR)]

Assessment methods of study outcomes

Lectures:

- assessment of knowledge and skills in written and oral exams

Laboratory:

- tests, continuous evaluation for each course
- evaluation of the knowledge and skills associated with the implementation of the practice tasks
- the assessment of exercise reports.

Course description

Insulating materials - gases (air, nitrogen, SF6, hydrogen, freon, mixtures), liquids (vegetable, mineral and synthetic oils), fibrous materials (cellulose, glass, carbon and fibres), elastomers (natural and synthetic rubbers), thermoplastics, hardening plastics, inorganic dielectric (mica, glass, ceramics) - conductivity in dielectrics. Magnetic materials - theory of magnetism, ferromagnetic, paramagnetic, ferri- and antiferrimagnetic materials, materials magnetically soft and hard. Conductive materials - theory of conduction, scattering centres, conductive and resistive materials. Superconductors - the theory of superconductivity, classic, mixed and high temperature superconductors, cryogenics. Semiconductors - types, applications. Methods for testing the mechanical, electrical and chemical properties of materials - hardness test, impact resistance, tensile strength, electric polarization, volume and surface resistivity, complex permittivity, humidity, acidity, polymerisation degree.

Update 2017:

new electro-insulating liquids, in particular biodegradable synthetic and natural liquids, their mixtures and nanofluids based on these liquids

Update 2018:

Fire safety of modern insulating liquids (fire and flash points, net calorific value)

Applied methods of education:

lectures - lecture with multimedia presentation (including: drawings, pictures) supplemented with examples given on the board and presentation of samples of discussed materials. Theory presented in close connection with practice

laboratories - team work, detailed review of lab reports and discussion of comments

Basic bibliography:

1. Celiński Z., Materiałoznawstwo elektrotechniczne, Wydawnictwo Politechniki Warszawskiej,1998
2. Florkowska B., Furgał J., Szczerbiński M., Włodek R., Zydroń P., Materiały Elektrotechniczne, Podstawy teoretyczne i zastosowania, Wyd. AGH, Kraków 2010
3. Kolbiński K., Słowikowski J., Materiałoznawstwo Elektrotechniczne, WNT, Warszawa, 1988
4. Gielniak J. - red. Ćwiczenia laboratoryjne z inżynierii materiałowej w elektrotechnice, Wydawnictwo Politechniki Poznańskiej, Poznań 2009

Additional bibliography:

1. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom I, 1996
2. Mościcka-Grzesiak H., Inżynieria wysokich napięć w elektroenergetyce, Wydawnictwo Politechniki Poznańskiej, tom II, 1999
3. Flisowski Z., Technika wysokich napięć, WNT W-wa, 2005
4. Gielniak J., Przybyłek P., Mościcka-Grzesiak H.,Wytrzymałość elektryczna nanomodyfikowanych dielektryków ciekłych, Przegląd Elektrotechniczny, ISSN 0033-2097, R. 91 NR 2/2015
5. Gielniak J., Dombek G., Wróblewski R., Fire Safety and Electrical Properties of Mineral Oil/Synthetic Ester Mixtures, 8th International Symposium on Electrical Insulating Materials, September 12-15, 2017, Toyohashi Chamber of Commerce & Industry, Toyohashi City, Japan, Conference Proceedings of ISEIM 2017, V1-10, p. 227-230

Result of average student's workload

Activity	Time (working hours)
1. participation in class lectures	30
2. participation in laboratory classes	30
3. current preparation for the laboratory classes,	20
4. preparation for final test	20
5. consultation on laboratory classes,	10
6. preparation of laboratory reports	20

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	130	5
Contact hours	66	2
Practical activities	75	3