1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1. Metallic biomaterials

Module code: IM2A_ PS1_ BM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_BM_1	Students have knowledge about reactions and effects of living organisms interaction with metals and their alloys	IM2A_W14	2
IM2A_PS1_BM_2	Obtaining a detailed knowledge about physical, chemical and mechanical properties of metallic biomaterials and possibilities of their application for short- and long-term medical implants and surgical instruments	IM2A_W06	2
IM2A_PS1_BM_3	Students can show application possibilities for metallic nanocrystalline materials	IM2A_W07 IM2A_W12	2 2
IM2A_PS1_BM_4	Students are aware of consequences of metallic biomaterials improper use for production of implants and surgical instruments	IM2A_K05 IM2A_W18	1 1

3. Module description

Description	The module Metallic biomaterials provides students with a full knowledge about physical and chemical processes occurring on the metal - tissue interface, structure and properties as well as application possibilities of metallic biomaterials. Owing to that students shall achieve understanding of the specific nature of conditions to be met by metallic materials typical for those applied in medicine and veterinary medicine. The understanding of those relationships shall result in acquiring the skill to select, from individual metallic biomaterials, a material satisfying conditions of specific applications.
Prerequisites	It is required to achieve effects of level I modules education in physics, chemistry and rudiments of materials science or materials science

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS1_BM_w_1	Test	Assessment of mastering the issues necessary for individual performance of a practical exercise	IM2A_PS1_BM_1, IM2A_PS1_BM_2
IM2A_PS1_BM_w_2	Report	Assessment of the skill to perceive and understand the specific nature and properties of metallic biomaterials and possibilities of their application by a correct formulation of conclusions	IM2A_PS1_BM_1, IM2A_PS1_BM_2, IM2A_PS1_BM_3, IM2A_PS1_BM_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS1_BM_fs_1	lecture	The lecture shall enable understanding of issues related to metallic materials interaction with tissues, biomaterials properties. forming the properties in view of their application in medicine. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	25	IM2A_PS1_BM_w_1
IM2A_PS1_BM_fs_2	laboratory classes	Application of the acquired theoretical knowledge in practical learning of relationships: Tissue - metallic biomaterials; structure - properties, potential application possibilities. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results and formulation of proper conclusions	20	IM2A_PS1_BM_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1. X-ray, electron, and neutron diffraction

Module code: IM2A_ PS1_DREN

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_DREN_1	Learning and understanding basic definitions, mathematical descriptions of the theory of X-ray, electron and neutron diffraction on a single electron, atom and on atom groups, understanding assumptions and basics of kinematic and dynamic X-ray, electron and neutron diffraction.	IM2A_W05 IM2A_W13	5 5
IM2A_PS1_DREN_2	The skill to choose the structure studying methods adequate to the material type and its internal structure, proper interpretation and analysis of X-ray, electron and neutron diffraction patterns, determination of structural parameters from the analysis of various diffraction pattern types.	IM2A_U18	5
IM2A_PS1_DREN_3	The skill to apply a research technique to resolve scientific problems from the field of materials engineering.	IM2A_K04 IM2A_K05	5 1

3. Module description

Description	The module X-ray, electron, and neutron diffraction shall enable students understanding and mastering theoretical basics of engineering materials testing methods, using X-ray, electron, and neutron diffraction. Owing to that students shall achieve a better understanding of correlations between engineering materials structure and their properties. The understanding of those relationships and correlations shall result in deepening the skill to define a research problem, to choose properly research methods and analyses adequate to the engineering material type and degree of its ordering.
Prerequisites	It is required to achieve effects of education of the modules: physics (solid state physics), mathematics, crystallography, materials testing methods

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS1	Written test/conversation	Verification of the knowledge based on the lectures content, recommended literature and	

_DREN_w_1		attended classes	IM2A_PS1_DREN_1, IM2A_PS1_DREN_2, IM2A_PS1_DREN_3
IM2A_PS1 _DREN_w_2	Written test	Checking the acquired skills to apply engineering materials testing methods, using X-ray, electron, and neutron diffraction	IM2A_PS1_DREN_1, IM2A_PS1_DREN_2, IM2A_PS1_DREN_3
IM2A_PS1 _DREN_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_PS1_DREN_1, IM2A_PS1_DREN_2
IM2A_PS1 _DREN_w_4	Report	Assessment of the skill to understand theoretical basics of engineering materials testing methods, using X-ray, electron, and neutron diffraction by a proper choice of research methods and a proper formulation of conclusions	IM2A_PS1_DREN_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS1 _DREN_fs_1	lecture	The lecture shall enable understanding issues related to theoretical basics of engineering materials testing methods, using X-ray, electron, and neutron diffraction. The lecture is delivered with the use of multimedia, demonstrations and software used to analyse the radiation scattered on a material.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	15	IM2A_PS1_DREN_w_
IM2A_PS1 _DREN_fs_3	laboratory classes	Application of acquired theoretical knowledge in practical use at testing the engineering materials structure. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	15	IM2A_PS1_DREN_w_ IM2A_PS1_DREN_w_ IM2A_PS1_DREN_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Implants of alloys featuring shape memory effect

Module code: IM2A_PS2_ISME

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_ISME_1	Detailed learning of alloys featuring shape memory effect and examples of implants used so far in medicine and veterinary medicine necessary to design new implant models; understanding the designing methodology and principles of applying alloys featuring shape memory effect to implants and instruments in medicine and veterinary medicine.	IM2A_W06 IM2A_W07 IM2A_W08 IM2A_W10 IM2A_W11	2 2 3 1 2
IM2A_PS2_ISME_2	The skill to choose the alloy for an implant of specific designation; the skill to design implants and instruments applying alloys featuring shape memory effect;	IM2A_U02 IM2A_U03 IM2A_U15	2 1 5
IM2A_PS2_ISME_3	Understanding ethical, economic and ecological aspects of materials designing for applications in medicine	IM2A_K02 IM2A_W18	1 5

3. Module description

Description	The module Implants of alloys featuring shape memory effect shall enable that students are knowledgeable about alloys featuring shape memory effect and showing features of a biocompatible material and which may be used for medical implants. Moreover, the learning of examples of implants used so far shall enable mastering principles of their designing useful to develop new applications in medicine and veterinary medicine.
Prerequisites	Achievement of effects of education in modules: shape memory alloys, selected issues from biomaterials toxicology, materials degradation in a biological environment.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS2_ISME_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_PS2_ISME_1, IM2A_PS2_ISME_2, IM2A_PS2_ISME_3
IM2A_PS2_ISME_w_2	Written test	Checking the knowledge and skills to interpret phenomena occurring in shape memory alloys for application to medical implants	IM2A_PS2_ISME_1, IM2A_PS2_ISME_2, IM2A_PS2_ISME_3
IM2A_PS2_ISME_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_PS2_ISME_1, IM2A_PS2_ISME_2, IM2A_PS2_ISME_3
IM2A_PS2_ISME_w_4	Report	The assessment of the skill of designing simple implants for medical and veterinary applications	IM2A_PS2_ISME_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS2_ISME_fs_1	lecture	The lecture shall enable understanding the issues related to properties of alloys used in medicine as well as mechanisms of used medical implants operation. The lecture is delivered with the use of multimedia	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	30	IM2A_PS2_ISME_w_1
IM2A_PS2_ISME_fs_2	laboratory classes	The application of the acquired theoretical knowledge in practical learning the operation of implants made of shape memory alloys as well as in designing new ones. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation to classes through independent studying of recommended issues.	30	IM2A_PS2_ISME_w_2 IM2A_PS2_ISME_w_3 IM2A_PS2_ISME_w_4

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Computer modelling of materials structure and properties

Module code: IM2A_KMSM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_KMSM_1	Students know and understand basic notions and postulates of quantum mechanics and have basic knowledge in the field of precise quantum modelling of small systems. They have basic knowledge in the field of electron structure models for periodic systems: nearly free electrons model, a tight bond approximation. They know and understand approximate quantum mechanic methods: perturbation theory, calculus of variations.	IM2A_W01 IM2A_W11	5 1
IM2A_KMSM_2	Students have basic knowledge about the quantum description of multi-electron systems - understand the essence of Born-Oppenheimer approximation, of quantum single-particle methods (Hartree, Hartree-Fock, Thomas-Fermi) and the method of Hohenberg-Kohn-Sham density functional. On a basic level they know at least one dedicated software package used for quantum computations of microscopic and macroscopic properties of engineering materials.	IM2A_W01 IM2A_W15	5 5
IM2A_KMSM_3	In an understandable way students can formulate quantum mechanics definitions and postulates. They use quantum calculus for simple quantum-mechanical systems. In an understandable way they can discuss assumptions and fundamental results of basic quantum models of periodic systems electron structure.	IM2A_U02 IM2A_U09	5 1
IM2A_KMSM_4	In an understandable way students can present limitations of quantum mechanics applied to the problem of multi-electron systems and discuss approximations necessary for a quantum resolution of the problem. They can carry out computations ab initio of the electron structure of atomically ordered systems and interpret computation results with the use of WIEN2k software	IM2A_U07 IM2A_U08	4 4
IM2A_KMSM_5	Students are aware of individual research method limitations and see the need of a thorough scientific analysis of problems in the field of materials engineering. They are aware of and know possibilities of further learning in the field of modern computer simulation methods applied to materials engineering.	IM2A_K01 IM2A_K04	3 3
IM2A_KMSM_6	Ma świadomość ograniczenia jednostkowej metody badawczej i widzi konieczność wszechstronnej, naukowej analizy problemów z zakresu inżynierii materiałowej. Ma świadomość i zna możliwości dalszego dokształcania się w zakresie nowoczesnych metod symulacji komputerowych w zastosowaniu w inżynierii materiałowej.	IM2A_K01 IM2A_K04	3 3

3. Module description	
Description	The module Computer modelling of materials structure and properties shall enable students learning the quantum formalism applied to numerical computations of microscopic properties of small (finite) and bulk (periodical) physical systems. Owing to that students will be prepared to use the software, available in research laboratories, for electron structure computations and thermodynamic modelling of new materials as well as to use the results to determine physical and chemical properties of materials studied and designed.
Prerequisites	It is required to achieve effects of education of the modules: calculus, solid state physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_KMSM_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_KMSM_1, IM2A_KMSM_2, IM2A_KMSM_3, IM2A_KMSM_4, IM2A_KMSM_5, IM2A_KMSM_6
IM2A_KMSM_w_2	Written test	Checking the acquired skills in the field of quantum computations for model quantum systems	IM2A_KMSM_1, IM2A_KMSM_2, IM2A_KMSM_3, IM2A_KMSM_4
IM2A_KMSM_w_3	Practical test	Assessment of mastering the basic knowledge necessary for individual performance of quantum computations of engineering materials.	IM2A_KMSM_1, IM2A_KMSM_2
IM2A_KMSM_w_4	Report	Assessment of the skill to understand results of computations and to connect them with engineering materials properties by a correct formulation of conclusions.	IM2A_KMSM_3, IM2A_KMSM_4, IM2A_KMSM_5

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_KMSM_fs_1	lecture	The lecture shall enable learning basics and procedures for quantum description of small quantum systems and periodic multi-electron structures and to teach students the principles and procedures for quantum modelling applied to materials engineering. The lecture is delivered with the use of multimedia, demonstrations and the WIEN2k software.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	20	IM2A_KMSM_w_1
IM2A_KMSM_fs_3	laboratory classes	Application of the acquired theoretical knowledge to practical computations of the structure and microscopic and macroscopic properties of engineering materials. Exercises are performed by students individually with the use of teaching laboratories equipment.	60	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	15	IM2A_KMSM_w_2, IM2A_KMSM_w_3, IM2A_KMSM_w_4

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Computer networks and their use in materials engineering

Module code: IM2A_SIECI

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_SIECI_1	Students have basic knowledge of computer networks, comprising: network design and computer networks classification; protocols role and organisation in the data transmission; the role of routing and DNS services. Students know the rules of server resources management, including: user account and account groups handling and making the disk resources and printers available in a computer network.	IM2A_W04	5
IM2A_SIECI_2	Students have basic knowledge about using and managing computers operating under the Unix system, comprising: the configuration of Bash shell environment; basic data processing commands; issues of data processing automation by means of batch programs (scripts) in the Bash shell environment. They understand principles of computer cluster structure, configuration and management to support research in the field of materials science. Students know procedures to configure password-free communication with the use of SSH protocol and to implement an IT environment for parallel computations.	IM2A_W04 IM2A_W15	5 4
IM2A_SIECI_3	Students can build and configure a local computer network in accordance with the provided specification and can manage resources of a Windows server, in accordance with the provided specification. On a basic level they can manage basic resources of a server operating under the Unix system. They can design and write a batch program in the Bash shell environment of the Unix system in accordance with the specified objective.	IM2A_U02 IM2A_U06	5 5
IM2A_SIECI_4	Students can implement a password-free communication (SSH) between Unix servers in a computer cluster and configure the environment for parallel computations with the use of protocol (MPI).	IM2A_U06	5
IM2A_SIECI_5	Students are aware of responsibility for own work and readiness to submit to team work rules and to bear responsibility for tasks implemented together. They understand the need to formulate and to provide information on computer networks applications in the area of materials engineering.	IM2A_K03 IM2A_K06	3 3

3. Module description	
Description	The module Computer networks and their use in materials engineering shall enable that students are knowledgeable about issues of organisation, design, configuration of local computer networks; management of local networks and server resources; organisation of computer clusters for applications in materials modelling. Owing to that students shall achieve a better understanding of problems in the field of: computer operation in a computer network; rules and procedures for data protection on servers; organisation and management of computer clusters The understanding of principles and procedures for server management and network organisation shall result in deepening the skill of computer network use for information processing and in carrying out advanced parallel computations in the area of engineering materials computer modelling.
Prerequisites	Passive command of English language. Proficiency in a PC operation in the basic scope and a general knowledge of a PC structure. Knowledge of a binary number system.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_SIECI_w_1	Practical test	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_SIECI_1, IM2A_SIECI_2, IM2A_SIECI_3, IM2A_SIECI_4, IM2A_SIECI_5
IM2A_SIECI_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_SIECI_1, IM2A_SIECI_2, IM2A_SIECI_3, IM2A_SIECI_4, IM2A_SIECI_5
IM2A_SIECI_w_4	Sprawozdanie	Assessment of the skill to understand mechanisms of a computer network operation in materials engineering laboratory applications by correct formulation of conclusions.	IM2A_SIECI_1, IM2A_SIECI_2, IM2A_SIECI_3, IM2A_SIECI_4, IM2A_SIECI_5

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_ SIECI _fs_3	laboratory classes	Application of the acquired theoretical knowledge to practical implementation of tasks related to configuration and management of servers, local networks and computer clusters. Exercises are performed by students individually/in teams with the use	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	30	IM2A_SIECI_w_1, IM2A_SIECI_w_3, IM2A_SIECI_w_4

		of teaching laboratories equipment.				
IM2A_SIECI_fs_1	lecture	The lecture shall enable understanding issues related to computer networks operation and rules and procedures for a server and a local network management, enabling an active use of computer networks in a materials engineering laboratory. The lecture is delivered with the use of multimedia and demonstrations.	15	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	20	IM2A_SIECI_w_1

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Dental materials

Module code: IM2A_MS

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MS_1	Learning a tooth structure and material constants of its structures.	IM2A_W09	4
IM2A_MS_2	Learning physio-chemical properties and the way of handling materials used for prevention and reconstruction of teeth, manufacturing those dental crowns and removable dentures and dental implants; understanding the way of connecting dental materials with tooth tissues.	IM2A_W07 IM2A_W08	4 4
IM2A_MS_3	Students can critically analyse the dental materials biocompatibility.	IM2A_U14	3
IM2A_MS_4	The skill of choosing materials for production of dental crowns, removable dentures and dental implants	IM2A_K05 IM2A_U16	1 4
IM2A_MS_5	Students have a critical assessment of dental materials impact on human health.	IM2A_K02	2

3. Module description

Description	The module Dental materials shall enable that students are knowledgeable about physio-chemical properties of dental materials and ways of their preparation to dental applications. Owing to that students shall achieve understanding of correlations between those materials properties and their biocompatibility and also shall acquire the skill of materials selection for individual dental applications. The acquisition of this knowledge and skills shall result in preparing the student to design new materials for dental applications.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and rudiments of the materials science.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_MS_w_1	Written examination	Verification of acquired knowledge based on the lectures content, recommended literature and attended classes.	IM2A_MS_1, IM2A_MS_2, IM2A_MS_3, IM2A_MS_4, IM2A_MS_5
IM2A_MS_w_2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_MS_3, IM2A_MS_4
IM2A_MS_w_3	Report	Assessment of the skill to examine and characterise dental materials through correct formulation of conclusions.	IM2A_MS_3, IM2A_MS_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_MS_fs_1	lecture	The lecture shall enable learning dental materials and their properties as well as the preparation and processing methods. It shall enable understanding the biocompatibility issues and materials selection for individual applications in stomatology. The lecture is delivered with the use of multimedia and demonstrations	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_MS_w_1
IM2A_MS_fs_3	laboratory classes	The application of acquired theoretical knowledge to experimental learning of dental materials properties and of mechanisms enabling shaping their properties. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results and drawing conclusions.	5	IM2A_MS_w_2, IM2A_MS_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Dental materials

Module code: IM2A_ZMiSF

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ZMiSF_1	Student posiada rozszerzoną i pogłębioną wiedzę niezbędną do zrozumienia zjawisk fizycznych i właściwości istotnych z punktu widzenia najnowszych trendów rozwojowych i osiągnięć w zakresie zaawansowanych inżynierskich materiałów funkcyjnych. Ponadto posiada wiedzę z zakresu planowania eksperymentu naukowego i opracowania uzyskanych danych doświadczalnych.	IM2A_W01 IM2A_W05 IM2A_W07	5 4 5
IM2A_ZMiSF_2	Student potrafi zapisać konkretny problem w postaci równań matematycznych, analizować równania opisujące właściwości zaawansowanych materiałów funkcyjnych wraz z dyskusją założeń leżących u ich podstaw. Potrafi planować i przeprowadzać eksperymenty oraz opracować i zinterpretować uzyskane wyniki.	IM2A_U07 IM2A_U09 IM2A_U19	3 3 3
IM2A_ZMiSF_3	Student ma świadomość oraz zna możliwości dalszego dokształcania się. Widzi konieczność wszechstronnej, naukowej analizy problemów z zakresu inżynierii zaawansowanych materiałów funkcyjnych. Potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy.	IM2A_K01 IM2A_K04 IM2A_K05	2 2 2

3. Module description

Description	Moduł Zaawansowane materiały i struktury funkcyjne ma umożliwić studentom zapoznanie z teoretycznymi i praktycznymi zagadnieniami w zakresie najnowszych trendów rozwojowych i osiągnięć inżynierii materiałowej. Ma umożliwić orientowanie się w zjawiskach fizycznych i właściwościach zaawansowanych materiałów funkcyjnych. Student/studentka powinien znać i rozumieć różnice pomiędzy trzema zasadniczymi kategoriami zaawansowanych materiałów funkcyjnych tj.: materiałami sprytnymi (smart materials), inteligentnymi (intelligent materials) i mądrymi (wise materials). Dzięki temu studenci powinni uzyskać kompetencje niezbędne przy właściwym doborze materiałów i struktur do konkretnych zastosowań praktycznych. Ponadto student/studentka powinna uzyskać umiejętność analizowania i oceny parametrów materiałowych zebranych w katalogach i tablicach właściwości fizycznych.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów: fizyka ciała stałego, chemia materiałów oraz podstawy fizyczne materiałów funkcyjnych.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_ZMiSF_w_1	Oral examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz ćwiczenia.	IM2A_ZMiSF_1, IM2A_ZMiSF_2, IM2A_ZMiSF_3
IM2A_ZMiSF_w_2	preliminary test	Ocena opanowania podstawowych wiadomości niezbędnych do indywidualnego wykonania ćwiczenia praktycznego.	IM2A_ZMiSF_1, IM2A_ZMiSF_2
IM2A_ZMiSF_w_3	Report	Ocena umiejętności planowania i przeprowadzania eksperymentów oraz opracowania i interpretacji uzyskanych danych eksperymentalnych. Ocena umiejętności w zakresie rozumienia mechanizmów zjawisk fizycznych i ich powiązania z właściwościami zaawansowanych materiałów funkcyjnych poprzez poprawne formułowanie wniosków dotyczących przydatności materiału w konkretnych zastosowaniach.	IM2A_ZMiSF_2, IM2A_ZMiSF_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_ZMiSF_fs_1	lecture	Wykład ma umożliwić studentowi/studentce zapoznanie się z teoretycznymi i praktycznymi zagadnieniami w zakresie najnowszych trendów rozwojowych i osiągnięć inżynierii materiałowej. Ma umożliwić orientowanie się w zaawansowanych zjawiskach fizycznych i właściwościach materiałów. Student/ studentka powinien poznać i zrozumieć różnice pomiędzy trzema zasadniczymi kategoriami zaawansowanych materiałów funkcyjnych tj.: materiałami sprytnymi (smart materials), inteligentnymi (intelligent materials) i mądrymi (wise materials). Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	20	
IM2A_ZMiSF_fs_2	laboratory classes	Zastosowanie poznanych wiadomości w praktycznym wykonaniu ćwiczeń. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	15	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	15	IM2A_ZMiSF_w_2, IM2A_ZMiSF_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Diploma laboratory 1

Module code: IM2A_PD1

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PD1_1	Mastering the skill to perform an experiment for M.Sc. diploma theses on materials engineering.	IM2A_K04 IM2A_U02 IM2A_W13	4 2 3
IM2A_PD1_2	The skill to analyse and process results of studies and to formulate final conclusions.	IM2A_K05 IM2A_U03 IM2A_U07 IM2A_W05	1 5 2 3

3. Module description

Description	The module Diploma laboratory 1 shall enable students finishing activities related to the diploma thesis developing (carrying out studies, analysis and processing of study results, formulation of final conclusions). Owing to that students will be capable of independent planning and carrying out scientific research on the level of M.Sc. diploma theses.
Prerequisites	It is required to achieve the effects of eduction of basic and field of study modules related to the topic of diploma thesis under development.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PD1_w_1	Assessment of diploma thesis development progress	Determination of diploma thesis development progress based on the previously prepared schedule.	IM2A_PD1_1, IM2A_PD1_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PD1_fs_1	laboratory classes	Experimental work with the use of techniques necessary for the thesis development	60	Analysis of results, formulation of conclusions, and edition of the thesis	60	IM2A_PD1_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Diploma laboratory 2

Module code: IM2A_PD2

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PD2_1	Mastering the skill to perform an experiment for M.Sc. diploma theses on materials engineering	IM2A_K04 IM2A_U02 IM2A_W13	4 2 3
IM2A_PD2_2	The skill to analyse and process results of studies and to formulate final conclusions	IM2A_K05 IM2A_U03 IM2A_U07 IM2A_W05	1 5 2 3

3. Module description

Description	The module Diploma laboratory 2 shall enable students finishing activities related to the diploma thesis developing (carrying out studies, analysis and processing of study results, formulation of final conclusions). Owing to that students will be capable of independent planning and carrying out scientific research on the level of M.Sc. diploma theses.
Prerequisites	It is required to achieve the effects of eduction of basic and field of study modules related to the topic of diploma thesis under development.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PD2_w_1	Assessment of diploma thesis development progress	Determination of diploma thesis development progress based on the previously prepared schedule	IM2A_PD2_1, IM2A_PD2_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PD2_fs_1	laboratory classes	Experimental work with the use of techniques necessary for the thesis development	30	Analysis of results, formulation of conclusions, and edition of the thesis	30	IM2A_PD2_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Engineering materials

Module code: IM2A_MI

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MI_1	Students have an expanded knowledge in the field of structure and basic properties as well as of advanced groups of engineering materials useful to choose a material at manufacturing of technical products.	IM2A_W07 IM2A_W08 IM2A_W10 IM2A_W12	4 2 2 3
IM2A_MI_2	Students have the skill to compare materials mechanical, technological and operational properties and also to choose engineering materials for technical applications; they can assess economic conditions of various engineering materials use.	IM2A_K05 IM2A_U11 IM2A_U13 IM2A_U18 IM2A_U19 IM2A_W17	1 2 3 2 2 1
IM2A_MI_3	Students know development trends in the area of individual material groups.	IM2A_W07 IM2A_W18	4 2
IM2A_MI_4	Students show readiness to cooperate with designers and process engineers.	IM2A_U12	2

3. Module description

Description	The module Engineering materials shall enable that students are freely knowledgeable about basic and advanced groups of engineering materials in view of the structure, properties, the way of shaping and rules of selection for specific technical products. This will allow to deepen the skill of proper choice of structural materials for specific technical applications.

Prerequisites	It is required to achieve effects of level I modules education in rudiments of materials science or materials science.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_MI_w_1	Credits in the form of a test	Verification of the knowledge based on the lectures content, recommended literature and an own work.	IM2A_MI_1, IM2A_MI_2, IM2A_MI_3, IM2A_MI_4
IM2A_MI_w_2	Test	Assessment of own work effects in the field of selected issues.	IM2A_MI_1, IM2A_MI_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_MI _fs_1	lecture	The lecture shall enable mastering the issues related to basic and advanced groups of engineering materials and their importance in the civilisation progress. The lecture is delivered with the use of multimedia, presentations and software from the field of "Materials engineering".	45	Reading of the recommended literature. Deepening the knowledge of selected issues, preparation to get credits.	60	IM2A_MI_w_1, IM2A_MI_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Engineering materials

Module code: IM2A_MI_MF

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MI_1	Ma poszerzoną wiedzę w zakresie struktury i właściwości podstawowych oraz zaawansowanych grup materiałów inżynierskich przydatną do doboru tworzywa przy wytwarzaniu produktów technicznych. Zna trendy rozwojowe w obszarze poszczególnych grup materiałów.	IM2A_W06 IM2A_W07	4 3
IM2A_MI_2	Wykazuje gotowość współpracy z konstruktorami i technologami.	IM2A_K02 IM2A_K03	2 2

3. Module description

Description	Moduł Materiały inżynierskie ma umożliwić studentowi/studentce swobodne orientowanie się w podstawowych oraz zaawansowanych grupach materiałów inżynierskich pod kątem struktury, właściwości, sposobu kształtowania i zasad doboru na konkretne produkty techniczne. Pozwoli to na pogłębienie umiejętności właściwego doboru tworzyw konstrukcyjnych do określonych zastosowań technicznych.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów I stopnia kształcenia podstaw nauki o materiałach lub materiałoznawstwa .

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_MI_w_1	Credits in the form of a test	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz prace własne.	IM2A_MI_1
IM2A_MI_w_2	Sprawdzian	Ocena efektów pracy własnej w zakresie wybranych zagadnień.	IM2A_MI_1, IM2A_MI_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_MI _fs_1	lecture	Wykład ma umożliwić opanowanie zagadnień dotyczących podstawowych oraz zaawansowanych grup materiałów inżynierskich i ich znaczenia w postępie cywilizacyjnym. Wykład prowadzony jest z wykorzystaniem środków multimedialnych, prezentacji i programów w zakresie „Inżynierii materiałowej”.	30	Czytanie zalecanej literatury. Zgłębianie wiedzy wybranych zagadnień, przygotowanie do zaliczenia.	70	IM2A_MI_w_1, IM2A_MI_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Engineering materials designing and manufacturing

Module code: IM2A_FMM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_FMM_1	Zrozumienie zależności pomiędzy strukturą a właściwościami funkcjonalnych materiałów magnetycznych, zrozumienie zjawisk i procesów wpływających na właściwości tych materiałów.	IM2A_W01	5
IM2A_FMM_2	Poznanie zjawisk, procesów, sposobów kształtowania funkcjonalnych materiałów magnetycznych, mechanizmów odpowiedzialnych za zmianę właściwości fizycznych oraz metod badawczych pozwalających wyznaczać właściwości fizyczne funkcjonalnych materiałów magnetycznych.	IM2A_W01 IM2A_W05	5 4
IM2A_FMM_3	Umiejętność zdefiniowania i rozróżniania szkieł metalicznych, nanokompozytów i nanomateriałów magnetycznych, analizy ich właściwości oraz doboru metod ich wytwarzania, kształtowania struktury i właściwości tych materiałów do zastosowań technicznych. Umiejętność planowania eksperymentów charakteryzujących właściwości funkcjonalnych materiałów magnetycznych i opracowania wyników badań.	IM2A_U01 IM2A_U03 IM2A_U07 IM2A_U17	5 4 3 4
IM2A_FMM_4	Rozwój świadomości potrzeby wpływania na strukturę w celu zmiany właściwości funkcjonalnych materiałów magnetycznych.	IM2A_K01 IM2A_K04	5 5

3. Module description

Description	Moduł Funkcjonalne materiały magnetyczne ma umożliwić studentowi/studentce orientowanie się w strukturze funkcjonalnych materiałów magnetycznych oraz sposobach, zjawiskach, procesach umożliwiających zmianę właściwości takich materiałów. Dzięki temu student/studentka powinna uzyskać lepsze zrozumienie korelacji pomiędzy strukturą tych materiałów oraz mechanizmami wpływającymi na ich właściwości. Zrozumienie zależności i korelacji pomiędzy właściwościami funkcjonalnych materiałów magnetycznych, a ich strukturą ma doprowadzić do pogłębienia umiejętności kształtowania właściwości do zastosowań technicznych.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, krystalografii, metod badań materiałów oraz termodynamiki.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_FMM_w_1	Written examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia.	IM2A_FMM_1, IM2A_FMM_3, IM2A_FMM_4
IM2A_FMM_w_2	Report	Ocena umiejętności w zakresie rozumienia mechanizmów kształtowania struktury i powiązania z właściwościami funkcjonalnych materiałów magnetycznych poprzez poprawne formułowanie wniosków.	IM2A_FMM_2, IM2A_FMM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_FMM_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień dotyczących struktury funkcjonalnych materiałów mag-netycznych, zjawisk, procesów oraz mechanizmów umożliwiających wpły-wanie na kształtowanie ich właściwości. Wykład prowadzony jest z wyko-rzystaniem środków multimedialnych, demonstracji.	30	Praca ze wskazaną literaturą obejmująca samodzielne przy-swojenie wiedzy w odniesieniu do podstawowych zagadnień.	35	IM2A_FMM_w_1
IM2A_FMM_fs_3	laboratory classes	Zastosowanie poznanych wiadomości teoretycznej wiedzy w praktycznym poznaniu funkcjonalnych materiałów magnetycznych oraz mechanizmów umożliwiających kształtowanie ich właściwości. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni naukowych.	30	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	25	IM2A_FMM_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Engineering materials designing and manufacturing

Module code: IM2A_PIWMI

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PIWMI_1	Students have knowledge about criteria for materials selection for technical applications as well as thermodynamic, kinetic and structural aspects of engineering materials manufacturing and processing.	IM2A_W11	5
IM2A_PIWMI_2	Students have detailed knowledge about materials quality control and their manufacturing methods as well as know economic and ecological aspects of material technologies designing.	IM2A_W07	5
IM2A_PIWMI_3	Students have skills of designing engineering materials and technological processes of materials manufacturing, processing and recycling.	IM2A_K05 IM2A_U01 IM2A_U02 IM2A_U03 IM2A_U04 IM2A_U08 IM2A_U19	1 1 3 5 2 2 5
IM2A_PIWMI_4	Students show readiness to cooperate with designers and process engineers.	IM2A_K01 IM2A_K03	1 1

3. Module description

Description	The module Engineering materials designing and manufacturing shall enable that students acquire knowledge about all aspects of engineering materials manufacturing and processing and about those materials quality control methods and their manufacturing methods. Owing to that students shall acquire the skill of proper designing structural materials structure, taking into account obtaining products of required properties.
Prerequisites	

	It is required to achieve effects of education of the modules: physics, chemistry, thermodynamics, rudiments of the materials science as well as materials technology and processing.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PIWMI_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PIWMI_1, IM2A_PIWMI_2, IM2A_PIWMI_3, IM2A_PIWMI_4
IM2A_PIWMI_w_2	Test	Verification of theoretical basics knowledge preparing students to perform the exercise on their own.	IM2A_PIWMI_3
IM2A_PIWMI_w_3	Report	The assessment of practical exercise performance and of correctness of the obtained results description and of conclusions formulation.	IM2A_PIWMI_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PIWMI_fs_1	lecture	The lecture shall enable understanding issues related to all aspects of engineering materials designing and manufacturing. The lecture is delivered with the use of multimedia.	30	The reading of recommended literature, preparation to the examination.	10	IM2A_PIWMI_w_1
IM2A_PIWMI_fs_3	laboratory classes	The application of learned theoretical knowledge to design specific structural materials and technological processes. Exercises are performed individually by students in the form of preparing a specific project.	30	Preparation of theoretical basics and issues related to the topic of performed project. Preparation of the developed project presentation.	30	IM2A_PIWMI_w_2, IM2A_PIWMI_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Engineering materials structure and properties forming

Module code: IM2A_KSIWM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_KSIWM_1	Students have knowledge about the internal and external factors' influence on materials structure and properties useful to give those materials specific functional properties.	IM2A_W06	5
IM2A_KSIWM_2	Students have detailed knowledge about certain integrated technological processes for materials treatment	IM2A_W11	5
IM2A_KSIWM_3	Students can shape materials structure and properties by choosing a relevant technological process, using for that also computer technique applications.	IM2A_U02 IM2A_U11	2 5
IM2A_KSIWM_4	Students are aware of the importance and understand the impact of materials internal structure forming technology on the possibility to obtain products of specified or new functional properties.	IM2A_K02 IM2A_K05	1 1

3. Module description

Description	The module Engineering materials structure and properties forming shall enable that students are knowledgeable about ways to influence materials functional properties by structure changes caused by means of appropriate technological treatments. Owing to that students shall achieve a better understanding of relationships between structural materials properties and their internal structure. The understanding of those issues shall result in acquiring the skill to choose the right technological process to obtain a specific structure and properties of materials.
Prerequisites	It is required to achieve effects of education in rudiments of materials science, materials technology and processing, engineering materials and materials testing methods modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_KSIWM_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_KSIWM_1, IM2A_KSIWM_2, IM2A_KSIWM_3, IM2A_KSIWM_4
IM2A_KSIWM_w_2	Test	Assessment of mastering the basic general knowledge necessary for performance of a practical exercise.	IM2A_KSIWM_1, IM2A_KSIWM_2
IM2A_KSIWM_w_3	Report	The assessment of practical exercise performance and of correctness of the obtained results description and of conclusions formulation.	IM2A_KSIWM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_KSIWM_fs_1	lecture	The lecture shall enable understanding issues related to the influence of various technological treatments on the structure and functional properties of structural materials. The lecture is delivered with the use of multimedia.	15	The reading of recommended literature, preparation to the examination.	45	IM2A_KSIWM_w_1
IM2A_KSIWM_fs_2	laboratory classes	Application of the acquired theoretical knowledge in practical use of possibilities to form materials structure and properties through various technological treatments. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation to tests, reading the laboratory instructions, preparation of reports.	10	IM2A_KSIWM_w_2, IM2A_KSIWM_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Foreign language

Module code: IM2A_JO

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_JO_1	Students understand the meaning of main topics of the message comprised by clear standard texts on general subjects and in short simple specialised texts on materials engineering	IM2A_U03	2
IM2A_JO_2	Students understand the meaning of main topics of a simple oral message on general subjects and specialised subjects on materials engineering	IM2A_U03	2
IM2A_JO_3	Students formulate simple written statements on general subjects and specialised subjects on materials engineering	IM2A_U03 IM2A_U06	2 3
IM2A_JO_4	Students formulate speeches on general subjects and specialised subjects on materials engineering, trying to use basic rules of speech organisation	IM2A_U04 IM2A_U06	3 3
IM2A_JO_5	Students communicate in simple communication situations on general topics and on specialised ones on materials engineering	IM2A_U03 IM2A_U06	2 3
IM2A_JO_6	Students understand the need for further learning, perform self-assessment, are capable of supplementing and improving the acquired knowledge and skills	IM2A_K01 IM2A_U06	2 3

3. Module description

Description	The module is aimed at developing language communication competence in the field of language activities (reading, listening, speaking, writing, interacting) taking into account necessary language strategies. The module contains elements of education in the field of specialised language in the subject area and also develops the skill of independent learning, acquiring the knowledge as well as of team work and effective communication with the surroundings.
Prerequisites	Knowledge of English on B1 level.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_JO_w_1	Credits in a written and oral form	Exhaustive written and (or) oral checking of the knowledge and skills acquired during classes and through own work within the range of marks 2-5	IM2A_JO_1, IM2A_JO_2, IM2A_JO_3, IM2A_JO_4, IM2A_JO_5, IM2A_JO_6

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_JO_fs_1	practical classes	Subject classes using a communicative teaching method, with elements of discussion, with written or oral feedback, with the involvement of student's own work. Classes are delivered using a motivating method (including projects, webquest, case study) with the application of ICT	30	Work with a handbook, dictionary, exercises, supplementing literature, internet sources. Acquiring and consolidating the knowledge and skills gained during classes. Preparation of oral and written forms.	30	IM2A_JO_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Humanist module

Module code: IM2A_MH

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MH_1	It has a deeper knowledge of selected scientific methods and know the discipline unrelated to the field of study	IM2A_W19	5
IM2A_MH_2	It has the ability deeper to analyze problems in the field of disciplines unrelated to the field of study	IM2A_U21	5
IM2A_MH_3	He understands the need for an interdisciplinary approach to problem solving, to integrate knowledge from different disciplines and importance of self-study.	IM2A_K07	5

3. Module description

Description	The student selects the module (s) of the University-wide for the specific field of study. The aim of the module is to broaden the knowledge, skills and social competence of the students in the discipline unrelated to the field of study .
Prerequisites	The Faculty Council determines for students of a given field of study number of modules (according to the program of study) and determines the semester of training .

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_MH_w_1	credit	verification on the basis of an essay or oral verification (according to the syllabus)	IM2A_MH_1, IM2A_MH_2, IM2A_MH_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_MH_fs_1	lecture	Lecture enriched by presentation. Focused on the ideas which are conceptually difficult and pointing out references. Illustration of the content by examples.	30	Studying the topic of the lecture (books , scripts , web sites , etc). Preparing to exam (specified in detail in the syllabus implemented module).	45	IM2A_MH_w_1

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Implants and artificial organs

Module code: IM2A_ISN

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ISN _1	DUnderstanding physio-chemical and mechanical phenomena necessary for the operation and creation of new artificial organs and implants, learning the classification and principles of implants and artificial organs operation with respect to application needs in human and animal organisms. Understanding the methodology for designing and principles of implants and artificial organs application in medicine and veterinary medicine	IM2A_W02 IM2A_W06 IM2A_W07 IM2A_W08	4 4 4 5
IM2A_ISN _2	The skill of designing implants and artificial organs properties for medical applications	IM2A_U16 IM2A_U17 IM2A_U19	3 3 3
IM2A_ISN _3	Development of the awareness of the need to use and to choose appropriately implants and artificial organs in medicine	IM2A_K02 IM2A_K04 IM2A_K06	3 3 3

3. Module description

Description	The module Implants and artificial organs shall enable that students are knowledgeable about physio-chemical and mechanical aspects related to implants and artificial organs application in medicine and veterinary medicine. Owing to that students shall achieve understanding of correlations between the construction of implants and artificial organs and possibilities of their shaping and specific conditions of their operation together with limitations. The understanding of those relationships shall result in deepening the knowledge of rules for implants and artificial organs designing for specific applications in medicine and veterinary medicine.
Prerequisites	

	Achievement of effects of education in the modules: introduction to biomaterials, ceramic biomaterials, metallic biomaterials, polymers for medicine, materials surface engineering, materials mechanics and strength, selected issues from biomaterials toxicology, materials degradation in a biological environment.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_ ISN_w _1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_ISN _1, IM2A_ISN _2
IM2A_ ISN_w _2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_ISN _1, IM2A_ISN _2, IM2A_ISN _3
IM2A_ ISN_w _3	Report	The assessment of the skill of designing simple implants and artificial organs for medical and veterinary applications	IM2A_ISN _3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_ ISN_fs _1	lecture	The lecture shall enable that students understand issues related to physio-chemical and mechanical properties as well as to construction of implants and artificial organs used in medicine and veterinary medicine. The lecture is delivered with the use of multimedia	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	35	IM2A_ ISN_w_1
IM2A_ ISN_fs _2	laboratory classes	The application of the acquired theoretical knowledge in practical learning the operation of implants and artificial organs used in medicine and veterinary medicine as well as in designing new ones. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation to classes through independent studying of recommended issues	15	IM2A_ ISN_w_2, IM2A_ ISN_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Implants and artificial organs

Module code: IM2A_PMF

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PMF_1	Ma poszerzoną i pogłębioną wiedzę z zakresu zjawisk fizycznych i procesów chemicznych zachodzących podczas wytwarzania polimerów i tworzyw sztucznych stosowanych w technice i medycynie, wykazuje znajomość trendów rozwojowych i najnowszych osiągnięć w zakresie projektowania i kształtowania właściwości materiałów polimerowych.	IM2A_W05 IM2A_W06 IM2A_W11	3 1 5
IM2A_PMF_2	Potrafi wskazać wpływ środowiska reakcyjnego na właściwości użytkowe uzyskiwanych materiałów polimerowych,; wykazuje zrozumienie głównych kierunków planowanej modyfikacji łańcuchów polimerowych;	IM2A_U03 IM2A_U04 IM2A_U07	3 1 2
IM2A_PMF_3	Ma świadomość konsekwencji oddziaływania na środowisko użytkowanych materiałów polimerowych; zrozumienie potrzeby zrównoważonego rozwoju ze świadomym wykorzystaniem materiałów polimerowych.	IM2A_K05	4

3. Module description

Description	Moduł Polimerowe materiały funkcjonalne ma umożliwić studentowi/studentce ugruntować wiedzę z zakresu procesów fizycznych i reakcji chemicznych zachodzących podczas wytwarzania zaawansowanych materiałów polimerowych oraz opartych na nich tworzyw sztucznych. Pozwoli ona na wskazanie głównych kierunków ich modyfikacji oraz określenie możliwości projektowania właściwości materiału na etapie planowania budowy makrocząsteczek. Moduł ma także za zadanie zwiększyć świadomość wpływu czynników środowiskowych na właściwości tworzywa sztucznego, a także interakcji zachodzących w drugą stronę.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, polimery, technologie i przetwórstwo materiałów - polimery.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PMF_w_1	Written examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz ćwiczenia.	IM2A_PMF_1, IM2A_PMF_2, IM2A_PMF_3
IM2A_PMF_w_2	Written test	Sprawdzenie wiedzy z zakresu badania i projektowania właściwości materiałów polimerowych.	IM2A_PMF_1, IM2A_PMF_2, IM2A_PMF_3
IM2A_PMF_w_3	Report	Ocena zdolności rozumienia metod otrzymywania i projektowania właściwości zaawansowanych materiałów polimerowych.	IM2A_PMF_1, IM2A_PMF_2, IM2A_PMF_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM1A_PMF_fs_2	laboratory classes	Analiza teorii podstawowych zagadnień dotyczących wiedzy z zakresu oddziaływań. Ćwiczenia prowadzone w oparciu o wystąpienia ustne i dyskusję przy wykorzystaniu środków multimedialnych i demonstracji.	30	Przygotowanie do ćwiczeń poprzez samodzielne studiowanie wskazanych zagadnień.	25	IM2A_PMF_w_2, IM2A_PMF_w_3
IM2A_PMF_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zagadnień dotyczących zjawisk fizycznych i reakcji chemicznych charakterystycznych dla użytkowych materiałów polimerowych. Pozwoli to na płynne poruszanie się w tematyce głównych kierunków ich recyklingu. Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	25	IM2A_PMF_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Intellectual property protection

Module code: IM2A_OWI

1. Number of the ECTS credits: 1

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_OWI_1	Increasing the knowledge about legislation in force in Poland on the intellectual property protection; understanding basic terms and principles from the field of intellectual property protection; knowledge of trademarks binding in the European Union; understanding and applying instruments of intellectual property protection; knowledge of national and international bodies granting the property rights.	IM2A_W17 IM2A_W18	5 3
IM2A_OWI_2	Students understand the chronology of patent procedure and rules to prepare documentation of invention and utility design applications.	IM2A_W17 IM2A_W18	5 3
IM2A_OWI_3	Students are capable of preparing patent documentation, can use basic legislation related to the intellectual property protection.	IM2A_K05 IM2A_U01 IM2A_U03 IM2A_U12	1 2 2 1
IM2A_OWI_4	Students are aware of the importance of observing the professional ethics.	IM2A_K02	2

3. Module description

Description	The module Intellectual property protection shall enable students learning the issues, regulations and legal acts related to the intellectual property, including the chronology of patent procedure and the rules of preparing documentation for invention and utility design applications. Learning the national and international bodies granting the property rights. Students will learn trademarks binding in the European Union and instruments of intellectual property protection.
Prerequisites	The knowledge of basics of management, marketing and of psychological aspects of the work environment.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A _OWI_w _1	Credits test	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_OWI_1, IM2A_OWI_2, IM2A_OWI_3, IM2A_OWI_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_OWI _fs _1	lecture	The lecture shall enable understanding the issues, regulations and legal acts related to the intellectual property, learning principles of work organisation and integrated management in undertaken technical activities and in various types of professional activities. The lecture is delivered with the use of multimedia.	15	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	20	IM2A _OWI_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Materials chemistry

Module code: IM2A_ChM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ChM_1	Familiarising students with theoretical and practical aspects of materials chemistry. Learning and understanding basic phenomena and processes related to mass and energy conversion in the chemical industry.	IM2A_W01 IM2A_W07 IM2A_W09 IM2A_W14	2 2 1 1
IM2A_ChM_2	Learning processes related to the industrial transport of reagents and energy carriers in industry. Familiarising students with materials preparation to a chemical process.	IM2A_W01 IM2A_W07	2 2
IM2A_ChM_3	Identification of methods for mixtures separation. Learning materials and substances used in selected production processes of chemical industry. The skill to analyse chemical processes affecting the course of chemistry and environment relationship.	IM2A_U01 IM2A_U10 IM2A_U14 IM2A_U15 IM2A_U16	1 5 1 1 1

3. Module description

Description	The module Materials chemistry shall enable students learning theoretical and practical issues of materials chemistry. It shall enable becoming knowledgeable about chemical phenomena used in processes of materials production and analysing changes in those processes course. Owing to that students shall acquire better understanding of chemical processes influence on materials properties. Moreover, students shall acquire the skill to analyse mechanisms affecting possibilities of chemical processes course changes. The understanding of relationships, correlations and the skill to analyse shall result in identification of proceeding processes and in modifying the learned processes by the use of chemical phenomena.
Prerequisites	It is required to achieve effects of education of chemistry, physics, mathematical-physical basics of materials science modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_ ChM _w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and classes	IM2A_ChM_1, IM2A_ChM_2, IM2A_ChM_3
IM2A_ ChM _w_2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_ChM_1, IM2A_ChM_2
IM2A_ ChM _w_3	Report	Assessment of the skill to understand mechanisms of chemical processes course and connecting with materials properties by a correct formulation of conclusions	IM2A_ChM_2, IM2A_ChM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_ ChM_fs_1	lecture	The lecture shall enable understanding basic issues related to chemical phenomena accompanying materials production processes and teaching students theoretical and practical issues of materials chemistry, understanding basic phenomena and processes related to mass and energy conversion in the chemical industry. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	30	IM2A_ ChM _w_1
IM2A_ ChM_fs_2	laboratory classes	The application of acquired theoretical knowledge in practical learning of mechanisms of chemical processes course and studying possibilities to shape materials properties. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results	30	IM2A_ ChM _w_2, IM2A_ ChM _w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Materials chemistry

Module code: IM2A_ChM_MF_RM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ChM_1	Student posiada rozszerzoną i pogłębioną wiedzę merytoryczną z zakresu chemii, dotyczącą otrzymywania materiałów inżynierskich oraz zjawisk i procesów mających wpływ na kształtowanie ich właściwości. Ponadto ma wiedzę merytoryczną z zakresu planowania eksperymentu naukowego i opracowania danych doświadczalnych. Posiada poszerzoną wiedzę z zakresu materiałów inżynierskich stosowanych w technice.	IM2A_W02 IM2A_W05 IM2A_W07	5 4 3
IM2A_ChM_2	Student potrafi planować i przeprowadzić eksperyment oraz zinterpretować otrzymane wyniki. Potrafi ocenić materiały w oparciu o ich właściwości chemiczne. Posiada umiejętność dokonywania właściwego doboru metod badania materiałów inżynierskich. Potrafi ocenić zagrożenie procesów chemicznych dla środowiska naturalnego.	IM2A_U03 IM2A_U10 IM2A_W14	2 4 3
IM2A_ChM_3	Student ma świadomość dalszego dokształcania się i śledzenia nowości w zakresie materiałów inżynierskich. Ma świadomość skutków działalności inżynierskiej na środowisko naturalne. Potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy.	IM2A_K01 IM2A_K02 IM2A_K05	3 4 3

3. Module description

Description	Moduł Chemia materiałów ma umożliwić studentowi/studentce zapoznanie z teoretycznymi i praktycznymi zagadnieniami chemii materiałów. Ma umożliwić orientowanie się w zjawiskach chemicznych stosowanych w procesach produkcji materiałów oraz analizowanie zmian przebiegu tych procesów. Dzięki temu student/studentka powinna uzyskać lepsze zrozumienie wpływu procesów chemicznych na właściwości materiałów. Ponadto student/studentka powinna uzyskać umiejętność analizowania mechanizmów wpływających na możliwości zmian przebiegu procesów chemicznych. Zrozumienie zależności, korelacji i umiejętność analizowania ma doprowadzić do identyfikacji przebiegających procesów oraz modyfikowania poznanych procesów poprzez wykorzystanie zjawisk chemicznych.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii, fizyki, mat.-fiz. podstaw nauki o materiałach.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_ChM_w_1	Written examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz ćwiczenia.	IM2A_ChM_1, IM2A_ChM_2, IM2A_ChM_3
IM2A_ChM_w_2	Test	Ocena opanowania podstawowych wiadomości niezbędnych do indywidualnego wykonania ćwiczenia praktycznego.	IM2A_ChM_1, IM2A_ChM_2
IM2A_ChM_w_3	Report	Ocena umiejętności w zakresie rozumienia mechanizmów przebiegu procesów chemicznych i powiązania z właściwościami materiałów poprzez poprawne formułowanie wniosków.	IM2A_ChM_2, IM2A_ChM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_ChM_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zagadnień dotyczących zjawisk chemicznych towarzyszących procesom produkcji materiałów oraz zapoznanie studentów z teoretycznymi i praktycznymi zagadnieniami chemii materiałów, zrozumienie podstawowych zjawisk i procesów związanych z przemianą masy i energii w przemyśle chemicznym. Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	35	IM2A_ChM_w_1
IM2A_ChM_fs_2	laboratory classes	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	45		25	IM2A_ChM_w_2, IM2A_ChM_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Materials degradation in a biological environment

Module code: IM2A_DMWŚB

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_DMWŚB_1	Acquiring new knowledge from the field of nomenclature and basic notions related to materials degradation in the human body environment	IM2A_W07 IM2A_W14	2 2
IM2A_DMWŚB_2	Understanding and describing a destructive action of biological environment on biomaterials and processes of materials degradation in vivo and in vitro	IM2A_W09 IM2A_W14	3 3
IM2A_DMWŚB_3	Recognising and describing the influence of time and of degradation way on selected physical and chemical properties of biomaterials	IM2A_U01 IM2A_U11 IM2A_U14	2 3 3
IM2A_DMWŚB_4	Development of the awareness of the need to affect the biomaterials structure to improve their functional properties	IM2A_K01	3

3. Module description

Description	The module Materials degradation in a biological environment shall enable that students learn basic terms and definitions related to materials degradation, such as: biodegradation, bioreactivity or resorption, and also understanding the nature of biologically active environment action on biomaterials. The module shall ensure that students are knowledgeable about types of materials subject to biodegradation in the human body environment and factors affecting physio-chemical properties of biomaterials. The module shall also enable that students are proficient in the field of in vitro and in vivo studies to assess materials degradability, of determination of basic degradation processes mechanisms, like: corrosion (metals), dissolution (ceramics) and hydrolysis (polymers) as well as of identification of degradation products.
Prerequisites	The knowledge of materials chemistry module, rudiments of the materials science, corrosion and corrosion protection as well as biomaterials

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_DMWŚB_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended laboratory classes	IM2A_DMWŚB_1, IM2A_DMWŚB_2, IM2A_DMWŚB_3, IM2A_DMWŚB_4
IM2A_DMWŚB_w_2	Written tests	Checking the knowledge acquired during laboratory classes to examine experimentally processes of materials degradation in a biologically active environment and to make decisions on the way to improve the biomaterials durability	IM2A_DMWŚB_1, IM2A_DMWŚB_2, IM2A_DMWŚB_3, IM2A_DMWŚB_4
IM2A_DMWŚB_w_3	Weekly reports	The assessment of mastering the skill of independent performance of a practical exercise and also of a team work, of measurement results and measurement error analysis as well as of formulating the conclusions properly	IM2A_DMWŚB_3, IM2A_DMWŚB_4
IM2A_DMWŚB_w_4	Interview	The assessment of understanding the reasons and mechanisms of course and studying materials degradation processes	IM2A_DMWŚB_1, IM2A_DMWŚB_2

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_DMWŚB_fs_1	lecture	The lecture shall enable the understanding of basic terms and definitions used in biomaterials degradation, to familiarise students with theoretical issues of biological environment action on biomaterials, with biomaterials degradation processes in vivo and in vitro and the role of free radicals in materials degradation and biodegradation. The lecture is delivered with the use of multimedia based on a selected set of handbooks	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures	10	IM2A_DMWŚB_w_1
IM2A_DMWŚB_fs_2	laboratory classes	The application of learned theoretical knowledge in practical learning of materials degradation in a biological environment. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results	5	IM2A_DMWŚB_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Materials science

Module code: IM2A_NOM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_NOM_1	Students have an extended knowledge about the structure and specific characteristics of amorphous and crystalline materials; single-crystals and polycrystals; mono- and polyphase materials; understanding relationships between the structure and properties of modern engineering materials.	IM2A_U17 IM2A_W01 IM2A_W02 IM2A_W07 IM2A_W12	2 2 2 2 3
IM2A_NOM_2	Detailed learning of phenomena, processes and mechanisms causing changes of functional properties of modern engineering materials.	IM2A_W01 IM2A_W02	2 1
IM2A_NOM_3	Extended skill to analyse engineering materials structure and properties as well as to choose methods for their shaping in view of specific applications.	IM2A_U11 IM2A_U18 IM2A_W07 IM2A_W17	2 2 2 2
IM2A_NOM_4	Further development of awareness of non-technical aspects of engineering materials used; developing a creative and logical thinking.	IM2A_K02 IM2A_K05	3 3

3. Module description

Description	The module Materials science shall enable that students are knowledgeable about engineering materials structure and about phenomena and processes enabling its shaping. Owing to that students shall achieve understanding of correlations between engineering materials structure and mechanisms affecting their properties.

	The understanding of relationships and correlations between engineering materials properties and their structure shall result in deepening the skill to shape the structure so as to obtain designed properties of materials for technical and medical applications.
Prerequisites	It is required to achieve effects of level I modules education in physics, chemistry, rudiments of materials science or materials science in the field of technical sciences.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_NOM_w_1	Credits on the basis of a test	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_NOM_1, IM2A_NOM_2, IM2A_NOM_3, IM2A_NOM_4
IM2A_NOM_w_2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_NOM_1, IM2A_NOM_2, IM2A_NOM_3
IM2A_NOM_w_3	Report	Assessment of the skill to understand structure shaping mechanisms and to connect them with engineering materials properties by a correct formulation of conclusions.	IM2A_NOM_1, IM2A_NOM_2, IM2A_NOM_3, IM2A_NOM_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_NOM_fs_1	lecture	The lecture shall enable a full understanding of issues related to the structure of engineering materials, phenomena, processes, and mechanisms enabling their properties shaping. The lecture is delivered with the use of multimedia, demonstrations and software from the field of materials science.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_NOM_w_1
IM2A_NOM_fs_2	practical classes	The application of acquired theoretical knowledge to practical learning of engineering materials structure and of mechanisms enabling shaping their properties. Exercises are performed by students individually with the use of teaching and scientific laboratories.	15	Based on individual contacts students expand the acquired knowledge, make up for gaps, supplement the knowledge from areas difficult to them.	35	IM2A_NOM_w_2, IM2A_NOM_w_3

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Materials structure testing methods

Module code: IM2A_MBSM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MBSM_1	Understanding phenomena used in methods for engineering materials structure and properties description, including methods using X-ray and microscopic techniques; learning the design and operation rules of specialised scientific-research instruments.	IM2A_W05 IM2A_W13	3 4
IM2A_MBSM_2	The skill to operate specialised scientific-research instruments, to plan experiments to analyse engineering materials structure and properties, to interpret results of research and measurement errors	IM2A_K05 IM2A_U02 IM2A_U03 IM2A_U07	1 4 2 4
IM2A_MBSM_3	Students are aware of individual research method limitations and see the need for a thorough scientific analysis of problems in the field of materials engineering.	IM2A_K04	5

3. Module description

Description	The module Materials structure testing methods shall enable that students expand their knowledge about phenomena and principles of operation and design of research instruments, which are applied in advanced measuring techniques and methods used to characterise the structure and basic properties of engineering materials. Owing to that students shall master operation of scientific-research instruments and acquire the skill to interpret measurement results. The understanding of phenomena and principles of operation shall result in a skilful application of appropriate testing technique to assess materials structure and properties.
Prerequisites	Basic knowledge from the field of physics and chemistry modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_MBSM_w_1	Oral examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_MBSM_1, IM2A_MBSM_2, IM2A_MBSM_3
IM2A_MBSM_w_2	Written test	Checking the knowledge of measurement results interpretation, of phenomena and operating principle of the learned research instruments.	IM2A_MBSM_1, IM2A_MBSM_2, IM2A_MBSM_3
IM2A_MBSM_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_MBSM_1, IM2A_MBSM_2, IM2A_MBSM_3
IM2A_MBSM_w_4	Report	Assessment of the skill to analyse engineering materials structure and properties.	IM2A_MBSM_1, IM2A_MBSM_2, IM2A_MBSM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_MBSM_fs_1	lecture	The lecture shall enable understanding phenomena and principles of instruments used in methods for characterising engineering materials structure and properties. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	30	IM2A_MBSM_w_1
IM2A_MBSM_fs_2	laboratory classes	Application of the acquired theoretical knowledge to learn the skill of research instruments operation, to interpret results and to evaluate measurement errors. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	10	IM2A_MBSM_w_2, IM2A_MBSM_w_3, IM2A_MBSM_w_4

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1

Module code: IM2A_WM1_ZŚ

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_ZŚ_1	Posiada pogłębioną wiedzę na temat wybranych metod ochrony środowiska w aspekcie zagrożeń oraz o elementach zarządzania środowiskiem naturalnym.	IM2A_W16 IM2A_W18	3 3
IM2A_WM1_ZŚ_2	Posiada pogłębioną umiejętność stawiania i analizowania problemów na podstawie pozyskanych treści z zakresu tematyki związanej z zagrożeniami globalnymi, monitoringiem stanu środowiska oraz metodami rekultywacji.	IM2A_U01 IM2A_U12 IM2A_U13	3 3 3
IM2A_WM1_ZŚ_3	Rozumie potrzebę interdyscyplinarnego podejścia do rozwiązywanych problemów, integrowania wiedzy z różnych dyscyplin oraz praktykowania samokształcenia służącego pogłębianiu zdobytej wiedzy w zakresie zarządzania środowiskiem.	IM2A_K01 IM2A_K02 IM2A_K05	3 3 3

3. Module description

Description	Moduł Zarządzanie środowiskiem ma umożliwić studentowi/studentce zapoznanie się z podstawowymi zagadnieniami dotyczącymi strategii ochrony i zarządzania środowiskiem oraz zrównoważonego rozwoju. Moduł ma zapewnić studentowi/studentce poznanie zagrożeń globalnych oraz zrozumieć znaczenie ważności monitoringu stanu środowiska i rekultywacji. Realizacja powyższych celów będzie wymagała poznania zagadnień z zakresu pierwszego poziomu kształcenia.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii oraz recyklingu materiałów.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_WM1_ZŚ_w_1	lecture	Weryfikacja wiedzy w oparciu o treść wykładów oraz wskazaną literaturę.	IM2A_WM1_ZŚ_1, IM2A_WM1_ZŚ_2, IM2A_WM1_ZŚ_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_WM1_ZŚ _fs_1	lecture	Niniejszy wykład monograficzny ma umożliwić zrozumienie zagadnień dotyczących zarządzania środowiskiem. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Czytanie zalecanej literatury, przygotowanie do zaliczenia wykładu.	35	IM2A_WM1_ZŚ_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. Advanced numerical methods in materials modelling

Module code: IM2A_WM1_MMM

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_MMM_1	Knowledge of numerical methods used in materials modelling based on a classical molecular dynamics.	IM2A_W01	3
IM2A_WM1_MMM_2	Knowledge of selected numerical methods used to analyse simulation results.	IM2A_W02	2
IM2A_WM1_MMM_3	The skill to use computational capabilities of LAMMPS software and AtomEye software to visualise simulation results.	IM2A_U01	3

3. Module description

Description	The module Advanced numerical methods in materials modelling shall enable students learning issues of using a classical molecular dynamics method in simulations of physical phenomena and processes. Owing to learning specialised numerical methods used in LAMMPS and AtomEye software students shall understand benefits and limitations of a classical molecular dynamics method in testing properties and designing new materials. The accomplishment of the above objective will require learning a number of issues from the field of numerical methods used in computer simulations by the molecular mechanics method, such as: Verlet algorithms, Berendesen algorithm for temperature and pressure control of the simulated physical system, slip vector method or computation of internal stresses field used during the analysis of simulation results.
Prerequisites	The knowledge of issues from the field of mathematics, physics, programming languages and numerical methods is required.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM1	Written test	Verification of knowledge based on the lectures content and recommended literature.	

_MMM_w_1			IM2A_WM1_MMM_1, IM2A_WM1_MMM_2, IM2A_WM1_MMM_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM1_MMM_fs_1	lecture	The lecture shall enable understanding a classical molecular dynamics method. The lecture is delivered with the use of multimedia based on a recommended set of handbooks.	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures.	35	IM2A_WM1_MMM_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. Intelligent materials

Module code: IM2A_WM1_SAMO

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_SAMO_1	Extending the knowledge about diverse modern intelligent materials, i.e. capable of reacting to external stimuli through a significant change of their properties for the required and effective response to those stimuli.	IM2A_W07	5
IM2A_WM1_SAMO_2	The skill to determine phenomena occurring in intelligent materials, with particular emphasis on their existing or potential application in practice.	IM2A_K05 IM2A_U01 IM2A_U05	1 5 5
IM2A_WM1_SAMO_3	Development of the awareness of the need to affect the structure to change materials properties.	IM2A_K01 IM2A_K02	5 5

3. Module description

Description	The module Intelligent materials shall extend students knowledge about particular properties of materials reacting to external stimuli. It will allow becoming knowledgeable about types of intelligent materials, learning mechanisms causing appropriate material reactions and also their applications. Owing to that students shall acquire broader knowledge about modern materials.
Prerequisites	It is required to achieve effects of education of physics, chemistry, materials science, and biomaterials modules.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM1_SAMO_w_1	Test	Assessment of mastering basic knowledge from the field of intelligent materials.	

			IM2A_WM1_SAMO_1, IM2A_WM1_SAMO_2, IM2A_WM1_SAMO_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM1_SAMO_fs_1	lecture	The lecture shall enable understanding issues related to the structure of intelligent materials, phenomena, and mechanisms enabling their properties shaping.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_WM1_SAMO_w

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. Magnetic nanomaterials

Module code: IM2A_WM1_NMM

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_NMM_1	Understanding relationships between the structure and properties of magnetic nanomaterials, understanding phenomena of processes resulting in those materials properties changes.	IM2A_W12	5
IM2A_WM1_NMM_2	Learning phenomena, processes, manufacturing methods and mechanisms responsible for changing physical properties of magnetic nanomaterials.	IM2A_W11	3
IM2A_WM1_NMM_3	The skill to analyse the structure and properties of magnetic nanomaterials and to select manufacturing methods of magnetic nanomaterials for technical applications.	IM2A_K05 IM2A_U18	1 5
IM2A_WM1_NMM_4	Development of the awareness of the need to produce and to affect the structure to change magnetic nanomaterials properties.	IM2A_K01 IM2A_K04	5 5

3. Module description

Description	The module Magnetic nanomaterials shall enable that students are knowledgeable about magnetic nanomaterials structure and about methods, phenomena, and processes enabling those materials manufacturing and properties changing. Owing to that students shall achieve a better understanding of correlations between manufacturing methods, magnetic nanomaterials structure and mechanisms affecting their properties. The understanding of relationships and correlations between those materials properties and their structure shall result in honing the skill to form materials of expected physical properties for applications in technology.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_WM1_NMM_w_1	Written credits	Verification of knowledge based on the lectures content, recommended literature.	IM2A_WM1_NMM_1, IM2A_WM1_NMM_2, IM2A_WM1_NMM_3, IM2A_WM1_NMM_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_WM1_NMM_fs_1	lecture	The lecture shall enable understanding issues related to the structure of magnetic nanomaterials, phenomena, processes, and mechanisms enabling affecting their properties shaping. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_WM1_NMM_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. Nuclear techniques in materials testing

Module code: IM2A_WM1_TJB

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_TJB_1	Understanding the role and importance of nuclear spectroscopic techniques in materials testing.	IM2A_W13	5
IM2A_WM1_TJB_2	Knowledge of basic terms and definitions used in the description of nuclear spectroscopic methods. Understanding the terms used to describe phenomena being the basis of nuclear spectroscopic methods used in materials science with special emphasis on issues related to materials.	IM2A_W13	5
IM2A_WM1_TJB_3	Knowledge of basic instruments and principles of Moessbauer spectra and positron lifetime spectra measurement and the basis of numerical analysis of experimentally obtained data.	IM2A_W05	5
IM2A_WM1_TJB_4	The skill to analyse and interpret parameters obtained in the process of numerical processing of spectra and their application to describe selected properties of materials.	IM2A_U07	5
IM2A_WM1_TJB_5	The skill to describe and characterise nuclear spectroscopic methods using an understandable language, a free talk about obtained results and their interpretation.	IM2A_U01 IM2A_U04	5 5
IM2A_WM1_TJB_6	Development of the awareness of the importance of nuclear spectroscopic methods with particular emphasis on positron lifetime spectra and Moessbauer effect spectra in modern materials science and materials.	IM2A_K05 IM2A_K06	5 1

3. Module description

Description	The module Nuclear techniques in materials testing shall enable students learning those nuclear physics issues, which constitute the basis for nuclear techniques applications in materials testing and also which are necessary to understand the way of analysis of obtained experimental results and nuclear research methods used in the materials science. Owing to that students shall understand the importance of nuclear techniques not only in the description of materials physio-chemical properties, but also in designing new engineering materials for technical and medical applications. The accomplishment of

	the above objectives will require learning a number of issues from the field of physics, solid state physics, chemistry, mathematics, numerical methods, and also of mathematical statistics.
Prerequisites	The knowledge of physics, chemistry, mathematics, numerical methods, and also of mathematical statistic obtained in the basic module of materials science is required.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM1_TJB_w_1	Credits test	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_WM1_TJB_1, IM2A_WM1_TJB_2, IM2A_WM1_TJB_3, IM2A_WM1_TJB_4, IM2A_WM1_TJB_5, IM2A_WM1_TJB_6

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM1_TJB_fs_1	lecture	The lecture shall enable understanding of basic terms and definitions used in the description of nuclear spectroscopic methods. Understanding the terms used to describe phenomena being the basis of nuclear spectroscopic methods used in materials science with special emphasis on issues related to materials. The lecture is aimed at teaching nuclear physics issues, which constitute the basis for nuclear techniques applications in materials testing and also which are necessary to understand the way of analysis of obtained experimental results and nuclear research methods used in the materials science. The lecture is delivered with the use of multimedia based on a selected set of handbooks.	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures.	35	IM2A_WM1_TJB_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. Shape memory alloys in medicine

Module code: IM2A_WM1_SMAM

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_SMAM_1	Understanding of the nature of reversible martensitic transformation and phenomena classified as the shape memory effect occurring in metals, their alloys and polymers; learning the group of materials featuring shape memory effects.	IM2A_W06 IM2A_W07 IM2A_W10	2 2 5
IM2A_WM1_SMAM_2	Understanding ethical, economic and ecological aspects of materials designing for applications in medicine.	IM2A_K05 IM2A_W18	1 5

3. Module description

Description	The module Shape memory alloys in medicine shall enable students learning the nature of phenomena classified as the shape memory effect and factors having a decisive influence on martensitic transformation reversibility and on the shape memory effect inducing in engineering materials. This knowledge is necessary to obtain the skill to design alloys for specific applications, including medical applications.
Prerequisites	Achieving effects of education in materials science and engineering materials modules.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM1_SMAM_w_1	Test	Verification of knowledge based on the lectures content and recommended literature.	IM2A_WM1_SMAM_1, IM2A_WM1_SMAM_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM1_SMAM _fs_1	lecture	The lecture shall enable understanding of issues related to the nature of factors conditioning the occurrence of shape memory effects as well as basics enabling designing of engineering materials featuring the shape memory effect. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	30	IM2A_WM1_SMAM_w

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 1. The influence of defects on functional materials properties

Module code: IM2A_ WM1_DEF

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM1_DEF_1	Learning classification principles of defects occurring in various type materials	IM2A_W01	3
IM2A_WM1_DEF_2	Understanding defects properties and their influence on physical properties of crystals (materials) and courses of typical physical processes; distinguishing structurally sensitive crystal properties, i.e. semiconductors resistivity, ion crystals conductivity or diffusion properties, which are dominated by defects, from less sensitive properties like the melting point or modulus of elasticity.	IM2A_W02 IM2A_W06 IM2A_W07 IM2A_W12 IM2A_W13	3 3 3 4 4
IM2A_WM1_DEF_3	Using X-ray single-crystal testing methods (topography, Laue, precision measurement of lattice parameters) for defects identification.	IM2A_U01 IM2A_U13 IM2A_U19	4 4 4
IM2A_WM1_DEF_4	The skill to complete the information, to value and to present it.	IM2A_K05 IM2A_K06	1 4

3. Module description

Description	The module The influence of defects on functional materials properties shall enable students, who are preparing to develop an M.Sc. thesis, understanding the role played by defects in materials featuring special properties.
Prerequisites	Physics, chemistry and elements of solid state physics on level I engineering studies.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_WM1_DEF_w_1	Lecture credits	Verification of knowledge based on the lectures content, recommended literature.	IM2A_WM1_DEF_1, IM2A_WM1_DEF_2, IM2A_WM1_DEF_3, IM2A_WM1_DEF_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_WM1_DEF_fs_1	lecture	A monographic lecture illustrated by results of own work for a narrow group specialising in materials of functional properties. The lecture is delivered with the use of multimedia.	30	Work with the recommended literature.	35	IM2A_WM1_DEF_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2

Module code: IM2A_WM2_MLTK

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_MLTK_1	Posiada rozszerzoną i pogłębioną wiedzę z zakresu podstaw koncepcyjnych, fizyki i mechaniki kwantowej podstawowych materiałów funkcjonalnych stosowanych w lotnictwie i kosmonautyce, ich struktury, defektów i klasyfikacji.	IM2A_W01	4
IM2A_WM2_MLTK_2	Posiada rozszerzoną i pogłębioną wiedzę z zakresu zjawisk, procesów, sposobów otrzymywania i badania nanomateriałów funkcjonalnych stosowanych w lotnictwie i kosmonautyce, oraz ich typów i roli defektów w kształtowaniu właściwości jak i poznanie ich zastosowań jak i poznanie perspektyw rozwoju funkcjonalności nanocząstek.	IM2A_W06	3

3. Module description

Description	Moduł Materiały funkcjonalne stosowane w lotnictwie i kosmonautyce, ma umożliwić studentowi/studentce orientowanie się w klasyfikacji, strukturze, defektach i właściwościach tych materiałów oraz w metodach ich otrzymywania, badania i w zastosowaniach odpowiadających nowoczesnym wymaganiom techniczny lotnictwa i kosmonautyki Dzięki temu Student/studentka będzie mógł/a dobrać, materiał i metodę jego uzyskania w zależności od parametrów eksploatacyjnych konkretnych elementów urządzeń jak i uzyskać lepsze zrozumienie korelacji pomiędzy metodami otrzymywania materiałów funkcjonalnych stosowanych w lotnictwie i kosmonautyce, ich strukturą oraz właściwościami jak i mechanizmami kształtującymi te właściwości. To pozwoli na pogłębienia umiejętności kształtowania struktury i właściwości materiałów do zastosowań w lotnictwie i kosmonautyce.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, krystalografii, metod badań materiałów .

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM2_MLTK_w_1	oral exam	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia.	IM2A_WM2_MLTK_1, IM2A_WM2_MLTK_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM2_MLTK_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień dotyczących klasyfikacji, struktury, właściwości, metod otrzymywania i zastosowań oraz badań materiały funkcjonalne stosowane w lotnictwie i kosmonautyce. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne opanowanie wiedzy w zakresie zagadnień wykładu	35	IM2A_WM2_MLTK_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2

Module code: IM2A_WM2_RMK

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_RMK_1	Zaznajomienie się z rodzajami kompozytów, ich właściwościami oraz zastosowaniem. Poznanie zasad i kryteriów klasyfikacji materiałów kompozytowych ze względu na ich budowę oraz rodzaj materiałów zbrojenia i osnowy. Poznanie technik wytwarzania oraz recyklingu kompozytów. Zaznajomienie się z problematyką związaną z powstawaniem odpadów oraz poznanie metod ich wykorzystania poprzez recykling (materiałowy, surowcowy i energetyczny).	IM2A_W06 IM2A_W07	4 4
IM2A_WM2_RMK_2	Potrafi zaproponować i przygotować teoretyczne podstawy metody recyklingu materiałów kompozytowych. Zna trendy rozwojowe w obszarze technologii recyklingu materiałów kompozytowych.	IM2A_U01 IM2A_U05 IM2A_U11	4 4 4
IM2A_WM2_RMK_3	Ma świadomość roli recyklingu odpadów we współczesnej gospodarce. Potrafi myśleć i działać w sposób umożliwiający zrozumienie i projektowanie instalacji recyklingu materiałów kompozytowych. Ma świadomość potrzeby informowania o zagrożeniach związanych z odpadami i sposobach ich zagospodarowania w celu poprawy świadomości ekologicznej społeczeństwa.	IM2A_K02 IM2A_K05 IM2A_K06	4 4 4

3. Module description

Description	Moduł Recykling materiałów kompozytowych ma umożliwić studentom zdobycie podstawowej wiedzy na temat materiałów kompozytowych oraz metod ich wytwarzania i recyklingu. Studenci poznają kryteria klasyfikacji materiałów kompozytowych oraz ich właściwości, jak również nabywają umiejętności samodzielnego zdobywania wiedzy na temat budowy, zastosowań i recyklingu kompozytów. Student zrozumie rolę, jaką w gospodarce odgrywają materiały kompozytowe oraz zaznajomi się z bieżącymi trendami badawczymi związanymi z ich recyklingiem. Student orientuje się w zagadnieniach związanych z recyklingiem surowcowym, materiałowym i energetycznym kompozytów oraz w problematyce ochrony środowiska związanej z gwałtownym rozwojem produkcji przemysłowej.

Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii, fizyki, podstaw nauki o materiałach, materiałów inżynierskich, recyklingu polimerów, recyklingu metali i stopów.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM2_RMK_w_1	lecture	Weryfikacja wiedzy w oparciu o treść wykładów i wskazaną literaturę.	IM2A_WM2_RMK_1, IM2A_WM2_RMK_2, IM2A_WM2_RMK_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM2_RMK _fs_1	lecture	Wykład monograficzny ma umożliwić zrozumienie zagadnień dotyczących budowy, właściwości i metod recyklingu materiałów kompozytowych. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	35	IM2A_WM2_RMK_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2. Analysis of experimental data obtained in selected spectroscopic studies of materials

Module code: IM2A_WM2_ADE

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_ADE_1	Acquiring knowledge about advanced methods of spectroscopic data analysis based on the procedure of model fitting to experimental points, in particular about the role of measurements statistics, selection of model start parameters or type of constraints and the way of obtained results verification.	IM2A_W03 IM2A_W05	5 2
IM2A_WM2_ADE_2	The skill of practical performance of fitting procedures in the case of selected experimental data	IM2A_K05 IM2A_U02 IM2A_U07	1 2 5
IM2A_WM2_ADE_3	Becoming aware of the need to use optimisation methods in scientific and technical research.	IM2A_K04	5

3. Module description

Description	The module Analysis of experimental data obtained in selected spectroscopic studies of materials shall provide students with knowledge about theoretical basics of fitting by means of the least-squares method. It shall show an example of optimising software application to analyse spectroscopic data with particular emphasis on positron lifetime spectra and Moessbauer spectra.
Prerequisites	It is required to achieve effects of eduction in modules of mathematics, IT, programming languages, numerical methods and algorithms, advanced methods for measurements numerical analysis and nuclear techniques in biomaterials testing.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM2	Credits on the basis of a test	Verification of knowledge based on the lectures content and recommended literature	

_ADE_w_1			IM2A_WM2_ADE_1, IM2A_WM2_ADE_2, IM2A_WM2_ADE_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM2_ADE_fs_1	lecture	The lecture shall familiarise with theoretical methods of optimisation (fitting) and demonstrate practical applications of those methods in the analysis of experimental data obtained from various type measurements, with special emphasis on measurements using nuclear methods. The lecture is delivered with the use of audiovisuals and existing computer programs (LT, MOSS)	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	35	IM2A_WM2_ADE_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2. Modification of biomaterials surface

Module code: IM2A_WM2_MPB

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_MPB_1	A deepened, supported with theory knowledge of phenomena and processes occurring on the metallic biomaterial - living organism interface and negative effects of those phenomena.	IM2A_W14	2
IM2A_WM2_MPB_2	Learning methods for surface modification of metallic materials intended for application in medicine to improve their biocompatibility.	IM2A_U11 IM2A_W06	1 2
IM2A_WM2_MPB_3	Development of the awareness of the need to modify the biomaterials surface.	IM2A_K02 IM2A_K05	2 1

3. Module description

Description	The module Modification of biomaterials surface shall enable that students are knowledgeable about possibilities to improve physio-chemical-mechanical properties of the surface of materials used in medicine through their surface modification and appropriate surface engineering techniques. Owing to that students should acquire knowledge related to correlations between tissues of a living organism and a biomedical material and about possibilities to reduce interaction effects - materials corrosion, negative interaction of corrosion products with the organism. The understanding of those relationships should result in deepening the skills of materials surface structure shaping to improve their biocompatibility.
Prerequisites	It is required to achieve effects of education of the modules: introduction to materials, physio-chemistry of biological processes, rudiments of the materials science, metallic biomaterials, polymers for medicine, ceramic biomaterials, materials surface engineering.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_WM2_MPB_w_1	Written test	Verification of the knowledge based on the lectures content, recommended literature and attended classes. Checking the acquired skills related to the biomaterials surface structure, the material-surrounding interface, methods for surface shaping and modifying to improve biocompatibility of implants, surgical instruments or artificial organs made of materials for medicine.	IM2A_WM2_MPB_1, IM2A_WM2_MPB_2, IM2A_WM2_MPB_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_WM2_MPB_fs_1	lecture	The lecture shall enable understanding the issues related to the surface structure and the need to modify it to improve the operational parameters and to extend the life of implants and surgical instruments made of materials used in medicine. Understanding physio-chemical effects and mechanisms enabling the manufacturing of biocompatible surface layers. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_WM2_MPB_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2. Nanocomposites

Module code: IM2A_WM2_NK

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_NK_1	Understanding conceptual basics of nanomaterials build with the involvement of 1D, 2D and 3D dimension type units (in particular carbon nanotubes) and the relationship between materials structural scale and their properties, their testing and application methods as well as the categorisation of reinforcing nanoparticles based on the increase in functionality and prospects for nanocomposites development.	IM2A_W07 IM2A_W11	2 1
IM2A_WM2_NK_2	Learning phenomena, processes, methods for nanocomposites obtaining and testing, their types and defects (in particular interphase boundaries) role in nanocomposites properties forming and learning their applications.	IM2A_W12 IM2A_W13	2 2
IM2A_WM2_NK_3	The skill to analyse nanocomposites structure, properties and methods for their obtaining as well as their type selection and obtaining methods depending on the required properties.	IM2A_U11 IM2A_U17	2 1
IM2A_WM2_NK_4	Development of the awareness of the need for development of nanomaterials and their technologies based on complex objects of sub-micrometric scale and understanding related technological, environmental and general-social issues.	IM2A_K02 IM2A_K04	1 1

3. Module description

Description	The module Nanocomposites shall enable that students are knowledgeable about the conceptual basics, classification, structure, defects and properties of nanocomposites and about methods of their obtaining, testing and about applications corresponding with modern technical requirements. Students will be capable of performing a comparative analysis of nanocomposites testing methods, in particular methods based on atomic forces microscopy and scanning tunnelling microscopy. Owing to that students will be capable of selecting the material, the method of its obtaining depending on operational parameters of specific elements of equipment and also of obtaining a better understanding of correlations between nanocomposites obtaining methods, their structure and properties as well as mechanisms forming their properties. This will allow honing the skill to form nanocomposites structure and properties necessary for technical and medical applications.
Prerequisites	

	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods, nanomaterials and nanotechnologies .

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM2_NK_w_1	Oral test	Verification of knowledge based on the lectures content, recommended literature.	IM2A_WM2_NK_1, IM2A_WM2_NK_2, IM2A_WM2_NK_3, IM2A_WM2_NK_4
IM2A_WM2_NK_w_2	Written test	Checking the acquired skills of nanocomposites classification, obtaining methods and forming the structure as well as mechanisms responsible for their properties changing, selected for specific technical and medical applications.	IM2A_WM2_NK_1, IM2A_WM2_NK_2, IM2A_WM2_NK_3, IM2A_WM2_NK_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM2_NK_fs_1	lecture	The lecture shall enable understanding issues related to the classification, structure, properties, methods of obtaining and applications as well as nanocomposites testing. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge in the field of issues raised during the lecture.	30	IM2A_WM2_NK_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2. Nanomaterials in medicine

Module code: IM2A_WM2_NWM

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_NWM_1	Understanding conceptual basics of nanomaterials application in medicine and characteristics of their structure and properties; understanding relationships between the structural scale of nanomaterials and their properties, being knowledgeable about current development trends of nanomaterials for applications in medicine.	IM2A_W05 IM2A_W11 IM2A_W16 IM2A_W17	2 2 2 2
IM2A_WM2_NWM_2	The skill to evaluate basic features and possibilities of nanomaterials application in medicine.	IM2A_U14	3
IM2A_WM2_NWM_3	Development of the awareness of nanomaterials application consequences in medicine.	IM2A_K02	1

3. Module description

Description	The module Nanomaterials in medicine shall enable that students are knowledgeable about the classification, structure, defects and properties of nanomaterials used in medicine and about methods of their obtaining, testing and in applications corresponding with modern medicine requirements. Owing to that students will be capable of selecting the material, the method of its obtaining depending on biometric and operational parameters of specific elements of equipment and also to obtain a better understanding of correlations between bionanomaterials obtaining methods, their structure and properties as well as mechanisms forming their properties. In addition, the module will enable students familiarising with a wide range of nanomaterials medical applications and with principles of their operation. This will allow in turn honing the skill to form nanomaterials structure and properties necessary for diverse medical applications.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods .

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_WM2_NWM_w_1	Written test/conversation	Verification of knowledge based on the lectures content and recommended literature.	IM2A_WM2_NWM_1, IM2A_WM2_NWM_2, IM2A_WM2_NWM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_WM2_NWM_fs_1	lecture	The lecture shall enable understanding issues related to the classification, structure, properties, methods of obtaining and applications as well as testing nanomaterials used in medicine. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge in the field of issues raised during the lecture.	30	IM2A_WM2_NWM_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Monographic lecture 2. Scanning probe microscopy

Module code: IM2A_WM2_MBO

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WM2_MBO_1	Knowledge of selected methods and of the structure of scanning probe microscopy equipment.	IM2A_W13	5
IM2A_WM2_MBO_2	Understanding the importance and possibilities of scanning probe microscopy methods and techniques in studies of materials surface, including biological materials.	IM2A_W13	5

3. Module description

Description	The module Scanning probe microscopy shall enable that students are knowledgeable about issues of scanning probe microscopy methods and techniques use in materials surface studying. To this end it will be necessary to learn a number of microscopic methods, such as: tunnelling (STM), atomic forces (AFM), magnetic forces (MFM), electrostatic forces (EFM), and Raman microscopy.
Prerequisites	It is required to know basic issues from the field of classical and quantum mechanics and the theory of electricity and magnetism.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WM2_MBO_w_1	Credits	Verification of knowledge based on the lectures content and recommended literature.	IM2A_WM2_MBO_1, IM2A_WM2_MBO_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WM2_MBO_fs_1	lecture	The lecture shall enable understanding the scanning probe microscopy methods and techniques. The lecture is delivered with the use of multimedia based on a recommended set of handbooks.	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures.	35	IM2A_WM2_MBO_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: M.Sc. seminar 1

Module code: IM2A_SM1

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_SM1_1	Students are capable of preparing a detailed documentation related to the project or research task implementation; they can prepare a study containing discussion of obtained results.	IM2A_U03	5
IM2A_SM1_2	Improved skills to gather and analyse the information based on the global scientific literature on the problem to be resolved within the thesis under development on materials engineering, to formulate the objective and to suggest ways for its accomplishment.	IM2A_U01	4
IM2A_SM1_3	The skill to plan and carry out research tasks related to the M.Sc. thesis under development.	IM2A_K05 IM2A_W05	1 4
IM2A_SM1_4	The skill to use techniques for presentation of effects obtained at individual stages of the M.Sc. thesis under development.	IM2A_U05	3

3. Module description

Description	The module M.Sc. seminar 1 shall enable that students are knowledgeable about the subject matter under implementation, in the materials engineering field, within M.Sc. theses under development. Owing to that students will acquire the skill of independent resolution of materials engineering issues at individual stages of the M.Sc. thesis under development.
Prerequisites	It is required to achieve the effects of eduction of modules related to the topic of the M.Sc. thesis under development

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_SM1_w_1	Assessment of presented papers and carried out discussion	Assessment of mastering the skill to present the literature information in the form of papers, to formulate the thesis objective, to use necessary research techniques and to present current	IM2A_SM1_1, IM2A_SM1_2, IM2A_SM1_3, IM2A_SM1_4

		results of the work.	

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_SM1_fs_1	seminar	The seminar is carried out with the use of multimedia, enabling presentation of results obtained at individual stages of the work. A discussion is carried out after papers presentation.	30	Preparation for the seminar of multimedia presentations on individual stages of the carried out work.	60	IM2A_SM1_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: M.Sc. seminar 2

Module code: IM2A_SM2

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_SM2_1	Deepening the knowledge of materials engineering in the field of the M.Sc. thesis under development.	IM2A_W06 IM2A_W07	3 3
IM2A_SM2_2	The skill to use research techniques necessary to carry out research tasks.	IM2A_W13	4
IM2A_SM2_3	Independent preparation and presentation of papers related to the subject-matter of M.Sc. theses under development	IM2A_K05 IM2A_U04	1 2
IM2A_SM2_4	Acquiring the skill to discuss the field of diploma theses under development.	IM2A_U04	3

3. Module description

Description	The module M.Sc. seminar 2 shall enable that students are knowledgeable about the materials engineering issues within M.Sc. theses under development. Owing to that students will acquire the skill of independent resolution of materials engineering issues through the analysis of necessary world literature, of formulating the M.Sc. thesis objective, of presenting the obtained results and of formulating the final conclusions.
Prerequisites	It is required to achieve the effects of eduction of modules related to the topic of the M.Sc. thesis under development.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_SM2_w_1	Assessment of presented papers and carried out discussion	Assessment of mastering the skill to present the literature information in the form of papers, to formulate the thesis objective, to use necessary research techniques and to present current results of the work.	IM2A_SM2_1, IM2A_SM2_2, IM2A_SM2_3, IM2A_SM2_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_SM2_fs_1	seminar	The seminar is carried out with the use of multimedia, enabling presentation of results obtained at individual stages of the work and presentation of final conclusions. A discussion is carried out after papers presentation.	30	Preparation for the seminar of multimedia presentations on the developed M.Sc. thesis .	60	IM2A_SM2_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: M.Sc. thesis preparation

Module code: IM2A _PPM

1. Number of the ECTS credits: 16

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PPM_1	The skill to process results obtained from the research work on an M.Sc. level.	IM2A_U01 IM2A_U05	2 5
IM2A_PPM_2	The skill to draw conclusions based on results of the research work on an M.Sc. level.	IM2A_K05 IM2A_U04	5 2
IM2A_PPM_3	Developing the whole M.Sc. thesis, the skill to formulate an opinion and communicating it to the public.	IM2A_K05 IM2A_K06	5 5

3. Module description

Description	The module M.Sc. thesis preparation shall enable students learning the skill to prepare the final version of M.Sc. thesis.
Prerequisites	It is required to achieve the effects of eduction of basic and field of study modules related to the topic of M.Sc. thesis under development.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PPM_w_1	M.Sc. thesis	M.Sc. thesis presentation and assessment by the thesis supervisor and tutor.	IM2A_PPM_1, IM2A_PPM_2, IM2A_PPM_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PPM_fs_1	proseminar	Own work	0	Developing the M.Sc. thesis results and contents	405	IM2A_PPM_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Physico-chemical methods of waste treatment

Module code: IM2A_FMPO

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_FMPO_1	Student ma poszerzoną wiedzę w zakresie technik rozdziału, unieszkodliwiania i utylizacji odpadów. Rozumie ich podstawy teoretyczne, zna zalety i ograniczenia poszczególnych metod .	IM2A_W06	4
IM2A_FMPO_2	Student potrafi dokonać wyboru odpowiednich metod fizyko-chemicznych do przetwarzania danej grupy odpadów.	IM2A_U11	3
IM2A_FMPO_3	Student ma świadomość ważności procesów przetwarzania odpadów dla ochrony środowiska.	IM2A_K02	2

3. Module description

Description	Moduł Fizykochemiczne metody przetwarzania odpadów umożliwia studentowi zapoznanie się z podstawowymi zagadnieniami dotyczącymi metod rozdziału, unieszkodliwiania i utylizacji odpadów, takich jak separacja i segregacja, mineralizacja, utylizacja termiczna, filtracja, neutralizacja, procesy utleniania i redukcji, koagulacja, adsorpcja, flotacja, wymiana jonowa i procesy membranowe. Dzięki temu student będzie potrafił dobrać odpowiednią do rodzaju odpadów technikę ich przetwarzania.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii i fizyki.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_FMPO_w_1	Written tests	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia.	IM2A_FMPO_1, IM2A_FMPO_2, IM2A_FMPO_3
IM2A_FMPO_w_2	Test	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia.	IM2A_FMPO_1, IM2A_FMPO_2

IM2A_FMPO_w_3	Report	Ocena wykonania ćwiczenia praktycznego oraz poprawności opisania uzyskanych wyników i sformułowania wniosków.	IM2A_FMPO_1, IM2A_FMPO_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_FMPO_fs_1	lecture	Wykład ma umożliwić zrozumienie teoretycznych podstaw fizykochemicznych technik rozdziału, unieszkodliwiania i utylizacji odpadów. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	15	Praca ze wskazaną literaturą. Przygotowanie do egzaminu.	25	IM2A_FMPO_w_1
IM2A_FMPO_fs_2	laboratory classes	Zastosowanie posiadanej wiedzy teoretycznej do wykonania ćwiczeń praktycznych, mających na celu opanowanie podstawowych technik stosowanych do przetwarzania odpadów. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	30	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Opracowanie sprawozdań.	30	IM2A_FMPO_w_2, IM2A_FMPO_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Podstawy gospodarki odpadami

Module code: IM2A_FPMF

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PGO_1	Ma wiedzę w zakresie gospodarki odpadami, o produkcji i składzie odpadów oraz o ich unieszkodliwianiu, usuwaniu i recyklingu.	IM2A_W06 IM2A_W18	2 3
IM2A_PGO_2	Potrafi ocenić przydatność i możliwość wykorzystania istniejących i nowych technologii i technik przetwarzania materiałów pod kątem minimalizacji zagrożeń odpadami dla środowiska oraz możliwości zagospodarowania tych odpadów.	IM2A_U11	3
IM2A_PGO_3	Ma świadomość ważności i rozumie znaczenie recyklingu odpadów dla ochrony środowiska.	IM2A_K02	3

3. Module description

Description	Moduł Podstawy gospodarki odpadami ma umożliwić studentowi/studentce zapoznanie się z podstawowymi zagadnieniami dotyczącymi unieszkodliwiania i usuwania odpadów oraz ich recyklingu. Moduł ma zapewnić studentowi/studentce poznanie modelu współczesnej gospodarki odpadami oraz zrozumieć znaczenie ważności problemu recyklingu odpadów. Realizacja powyższych celów będzie wymagała poznania zagadnień z zakresu pierwszego poziomu kształcenia.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii oraz recyklingu materiałów.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PGO_w_1	Written test	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia laboratoryjne.	IM2A_PGO_1, IM2A_PGO_2, IM2A_PGO_3
IM2A_PGO_w	written test	Ocena opanowania podstawowych wiadomości ogólnych niezbędnych do wykonania	IM2A_PGO_1, IM2A_PGO_2,

_2		ćwiczenia praktycznego.	IM2A_PGO_3
IM2A_PGO_w_3	Report	Ocena wykonania ćwiczenia praktycznego oraz poprawności opisania uzyskanych wyników i sformułowania wniosków.	IM2A_PGO_1, IM2A_PGO_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PGO_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień dotyczących podstaw gospodarki odpadami. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Czytanie zalecanej literatury, przygotowanie do egzaminu.	30	IM2A_PGO_w_1
IM2A_PGO_fs_2	laboratory classes	Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	15	Przygotowanie do sprawdzianów, czytanie instrukcji laboratoryjnych, opracowanie sprawozdań.	15	IM2A_PGO_w_2, IM2A_PGO_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Production and quality management

Module code: IM2A_ZPiJ

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ZPiJ _1	Students have a broadened knowledge about management, including the quality management and running a business, know principles of individual entrepreneurship creation and development.	IM2A_W04 IM2A_W16	5 5
IM2A_ZPiJ_2	Students have preparation necessary to work in an industrial environment and know the safety rules.	IM2A_U12	5
IM2A_ZPiJ_3	Students know principles, ways and methods of running production and service activities, and also the organisation of production and service space. They can specify logistic parameters affecting the course of production processes and services. They know and understand HR management methods and instruments.	IM2A_U20	3
IM2A_ZPiJ_4	Students are aware of importance and understand non-technical aspects and effects of engineering activities, including their influence on a human organism and environment and related responsibility for the taken decisions.	IM2A_K02	3

3. Module description

Description	The module Production and quality management shall enable that students learn basic principles of production management and issues related to the quality management in an organisation, with special emphasis on an enterprise.
Prerequisites	The knowledge of basics of management, integrated management systems and psychological aspects of the work environment.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_ZPiJ_w _1	Test	Written test consisting of open and closed questions.	IM2A_ZPiJ _1, IM2A_ZPiJ_2, IM2A_ZPiJ_3, IM2A_ZPiJ_4

IM2A_ZPiJ_w _2	Credits paper	Development and presentation of a production and QM system based on an example of a selected enterprise.	IM2A_ZPiJ _1, IM2A_ZPiJ_2, IM2A_ZPiJ_3, IM2A_ZPiJ_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_ ZPiJ _fs _2	practical classes	Lectures with the analysis of case studies, using multimedia presentations.	15	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_ZPiJ_w_2
IM2A_ZPiJ_fs _1	lecture	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	15	Developing the credits paper based on a selected example; preparation to the presentation and discussion.	15	IM2A_ZPiJ_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Project management

Module code: IM2A_ZPrj

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_ZPrj_1	Students describe organisational roles and functions	IM2A_W04 IM2A_W16	5 5
IM2A_ZPrj_2	Students have the skill to manage and cooperate in projects introducing specific changes in the organisation.	IM2A_U12	5
IM2A_ZPrj_3	Students have skills of effective management of entrusted human, tangible, financial and information resources to perform tasks	IM2A_U20	3
IM2A_ZPrj_4	Students are prepared to organise and manage the work of teams (project, task etc.) and of organisations in the work environment and outside it.	IM2A_K02	3

3. Module description

Description	The overall objective of the module is to provide students with selected basic issues of project management and to form the skill of practical application of those methods and techniques in this field. In particular the subject area of the module covers developing students skills in the context of analysis and interpretation of basic project management aspects. A synthetic characteristic of the project management context (impact of organisational conditions on projects implementation success) contributes to acquiring the knowledge in the area of organisational role and functions description and to build students skill in the field of managing and cooperating in projects introducing specific changes in the organisation. Another detailed objective of the module consists of the analysis of personal project management problems (dilemmas related to building the project team identity), which consolidates students' knowledge and skills in the field of organising and managing the team (project, task etc.) work. A practical use of project tools and techniques in the context of planning and control (own project preparing) results in acquiring by students the skill to plan and manage the time in team projects and to effectively manage the entrusted human, tangible, financial and information resources to perform tasks. Through a team development of own projects students acquire also the skill of developing and effective use of interpersonal skills.
Prerequisites	Formal requirements - passing modules on the organisation science and basics of management, which is necessary to implement basic programme

	contents.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_ ZPrj _w _1	A credits work in student teams (project)	Under the care of a teacher students are preparing individual credits work (project), aimed at verification of the skill to apply practically project tools and techniques. The work subject covers selected issues discussed during lectures. An independence in problems formulating and solving, the knowledge of appropriate project tools and techniques as well as the skill to visualise the obtained results are required to obtain the credits.	IM2A_ZPrj_1, IM2A_ZPrj_2, IM2A_ZPrj_3, IM2A_ZPrj_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_ ZPrj _fs _1	lecture	Lectures with the analysis of case studies, using multimedia presentations	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	5	IM2A_ ZPrj _w_1
IM2A_ ZPrj _fs _2	practical classes	Analysis of the source literature; preparing and developing the credits work concept; presentation by students of the credits work in a selected enterprise; discussion, conclusions	15	Developing the credits work based on a selected example; preparation to the presentation and discussion	10	IM2A_ ZPrj _w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Selected issues from biomaterials toxicology

Module code: IM2A_ WZTB

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WZTB_1	Defining basic notions from the field of biomaterials toxicology.	IM2A_W14	3
IM2A_WZTB_2	Distinguishing and describing mechanisms of toxic action and of metabolic and morphological disorders caused by poisons. Recognising and describing infections, carcinogenic and allergic reaction of a living organism to an implant.	IM2A_K05 IM2A_U01 IM2A_U14	1 2 3
IM2A_WZTB_3	Improving skills of acquiring knew knowledge from the field of toxicological legal requirements for biomaterials binding in the European Union.	IM2A_K01	4

3. Module description

Description	The module Selected issues from biomaterials toxicology shall enable that students learn issues related to biomaterials toxicology, including terms and definitions such as: toxin (poison), toxicity, degrees of toxicity, types of intoxications, adsorption of toxic substances and biocorrosion. The module shall ensure that students are knowledgeable about toxic action mechanisms and dynamics, based on which students shall understand the importance of biomaterials toxicity and its adverse effects of impact on the organism. The accomplishment of the above objectives will require learning a number of issues from the scope of the first level of education.
Prerequisites	Required knowledge of chemistry, rudiments of the materials science, corrosion and corrosion protection as well as biomaterials.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WZTB	Written examination	Verification of the knowledge based on the lectures content, recommended literature and	

_w_1		attended auditorium classes.	IM2A_WZTB_1, IM2A_WZTB_2, IM2A_WZTB_3
IM2A_WZTB_w_2	Written tests	Checking the knowledge acquired during auditorium classes.	IM2A_WZTB_1, IM2A_WZTB_2, IM2A_WZTB_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WZTB_fs_1	lecture	The lecture shall enable understanding basic terms and definitions used in biomaterials toxicology, familiarising students with theoretical issues of toxic action mechanisms and distinguishing a carcinogenic and allergic reaction of a living organism to an implant. The lecture is delivered with the use of multimedia based on a selected set of handbooks.	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures.	10	IM2A_WZTB_w_1
IM2A_WZTB_fs_2	practical classes	Classes are conducted based on discussion and resolving issues with the use of multimedia.	15	Preparation to classes through independent studying of recommended issues.	5	IM2A_WZTB_w_2

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Selected issues from biomaterials toxicology

Module code: IM2A_PFMF

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PFMF_1	Student posiada rozszerzoną i pogłębioną wiedzę niezbędną do zrozumienia podstawowych zjawisk fizycznych i właściwości inżynierskich materiałów funkcyjnych wykorzystywanych w różnych dziedzinach techniki i medycyny. Ponadto ma podstawową wiedzę merytoryczną z zakresu planowania eksperymentu i opracowania danych doświadczalnych.	IM2A_W01 IM2A_W05 IM2A_W07	5 3 5
IM2A_PFMF_2	Student potrafi zapisać konkretny problem w postaci równań matematycznych, analizować równania opisujące właściwości materiałów wraz z dyskusją założeń leżących u ich podstaw. Umie prognozować właściwości materiałów inżynierskich z uwzględnieniem występowania w nich możliwych zjawisk fizycznych. Umie zaplanować i przeprowadzić eksperymenty, zinterpretować uzyskane wyniki i wyciągnąć wnioski. Potrafi gromadzić informacje z podanej literatury, baz danych i innych dostępnych źródeł; potrafi uzyskane informacje integrować, dokonywać ich interpretacji i krytycznej oceny, wyciągać wnioski oraz formułować i wyczerpująco uzasadniać opinie. Ponadto student potrafi przygotować opracowanie na temat realizacji eksperymentu zawierającego omówienie uzyskanych wyników oraz ocenę ich niepewności.	IM2A_U01 IM2A_U03 IM2A_U07 IM2A_U09 IM2A_U19	4 4 4 3 3
IM2A_PFMF_3	Student ma świadomość oraz zna możliwości dalszego dokształcania się. Widzi konieczność wszechstronnej, naukowej analizy problemów z zakresu inżynierii materiałów funkcyjnych. Potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy.	IM2A_K01 IM2A_K04 IM2A_K05	2 2 2

3. Module description

Description	Moduł Podstawy fizyczne materiałów funkcyjnych ma umożliwić studentowi/studentce zapoznanie z teoretycznymi i praktycznymi zagadnieniami wykorzystania materiałów. Ma umożliwić orientowanie się w zjawiskach fizycznych i właściwościach materiałów. Dzięki temu student/studentka powinna uzyskać kompetencje niezbędne przy właściwym doborze materiałów do konkretnych zastosowań praktycznych. Ponadto student/studentka powinna uzyskać umiejętność analizowania i oceny parametrów materiałowych zebranych w katalogach i tablicach właściwości fizycznych.

Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii oraz matematyczno-fizycznych. podstaw nauki o materiałach.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PFMF_w_1	Oral examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz ćwiczenia.	IM2A_PFMF_1, IM2A_PFMF_2, IM2A_PFMF_3
IM2A_PFMF_w_2	preliminary test	Ocena opanowania podstawowych wiadomości niezbędnych do indywidualnego wykonania ćwiczenia praktycznego.	IM2A_PFMF_1, IM2A_PFMF_2
IM2A_PFMF_w_3	Report	Ocena umiejętności rozumienia mechanizmów zjawisk fizycznych i ich powiązania z właściwościami materiałów poprzez poprawne formułowanie wniosków dotyczących przydatności materiału w konkretnych zastosowaniach.	IM2A_PFMF_2, IM2A_PFMF_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PFMF_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zjawisk fizycznych wykorzystywanych w praktyce oraz wzajemnych relacji pomiędzy strukturą materiału a jego właściwościami fizycznymi. Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	60	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	30	IM2A_PFMF_w_1
IM2A_PFMF_fs_2	laboratory classes	Zastosowanie poznanych wiadomości w praktycznym wykonaniu ćwiczeń. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	30	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	10	IM2A_PFMF_w_2, IM2A_PFMF_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Selected topics from recycled materials

Module code: IM2A_WZRM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_WZRM_1	Posiada wiedzę z zakresu terminologii, podstawowych pojęć i problemów z zakresu odpadów różnego pochodzenia oraz sposobów ich usuwania i zagospodarowywania. Rozumie i ma świadomość ważności prowadzenia procesów recyklingu i utylizacji odpadów. Rozumie potrzebę i konieczność informowania społeczeństwa o korzystnych i niekorzystnych aspektach recyklingu i utylizacji odpadów. Potrafi przekazać taką informację w sposób powszechnie zrozumiały i podkreślić jej najważniejsze kwestie.	IM2A_W18	3
IM2A_WZRM_2	Potrafi przygotować opracowanie naukowe na temat realizacji eksperymentu, zadania projektowego lub badawczego, zawierające omówienie uzyskanych wyników.	IM2A_U03	4
IM2A_WZRM_3	Potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy.	IM2A_K03 IM2A_K05	3 3

3. Module description

Description	Moduł Wybrane zagadnienia z recyklingu materiałów ma umożliwić studentowi/studentce nabyć umiejętności pracy w zespole, podejmowania strategicznych decyzji oraz zarządzania grupą. Ponadto ugruntować wiedzę z zakresu recyklingu materiałów, metod wytwarzania wybranych materiałów, charakterystyki surowców, produktu głównego i produktów ubocznych. W ramach modułu zostanie przedstawiona charakterystyka odpadów i ścieków z omówieniem możliwości ich utylizacji, magazynowania lub neutralizacji. Pozwoli to na wskazanie głównych kierunków recyklingu wybranego materiału.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, polimery, technologie i przetwórstwo materiałów - polimery.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_WZRM_w_1	Final test	Weryfikacja wiedzy w oparciu o treść wykładów oraz wskazaną literaturę.	IM2A_WZRM_1, IM2A_WZRM_2, IM2A_WZRM_3
IM2A_WZRM_w_2	Assessment of the project	Zaliczenie projektu na podstawie opracowywania poszczególnych jego części na zajęciach laboratoryjnych.	IM2A_WZRM_1, IM2A_WZRM_2, IM2A_WZRM_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_WZRM_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zagadnień dotyczących recyklingu materiałów powszechnie stosowanych w różnych dziedzinach przemysłu, metod wytwarzania wybranych materiałów, charakterystyki surowców, produktów oraz odpadów. Pozwoli to na płynne poruszanie się w tematyce głównych kierunków ich recyklingu. Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	15	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	20	IM2A_WZRM_w_1
IM2A_WZRM_fs_2	laboratory classes	Analiza zagadnień dotyczących recyklingu materiałów. Nauka pracy w zespole, podejmowania strategicznych decyzji oraz zarządzania grupą. Myślenie projektowe. Ćwiczenia prowadzone w oparciu o wystąpienia ustne i dyskusję w podgrupach jak również na forum grupy laboratoryjnej.	45	Przygotowanie do ćwiczeń poprzez samodzielne studiowanie wskazanych zagadnień.	15	IM2A_WZRM_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Social module

Module code: IM2A_MSP

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MSP_1	Posiada pogłębioną wiedzę na temat wybranych metod naukowych oraz zna zagadnienia charakterystyczne dla dyscypliny nauki niezwiązanej z kierunkiem studiów	IM2A_W19	5
IM2A_MSP_2	It has the ability deeper to analyze problems in the field of disciplines unrelated to the field of study	IM2A_U21	5
IM2A_MSP_3	He understands the need for an interdisciplinary approach to problem solving, to integrate knowledge from different disciplines and importance of self-study.	IM2A_K07	5

3. Module description

Description	The student selects the module (s) of the University-wide for the specific field of study. The aim of the module is to broaden the knowledge, skills and social competence of the students in the discipline unrelated to the field of study .
Prerequisites	The Faculty Council determines for students of a given field of study number of modules (according to the program of study) and determines the semester of training .

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_MSP_w_1	credit	verification on the basis of an essay or oral verification (according to the syllabus)	IM2A_MSP_1, IM2A_MSP_2, IM2A_MSP_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_MSP_fs_1	lecture	Lecture enriched by presentation. Focused on the ideas which are conceptually difficult and pointing out references. Illustration of the content by examples.	30	Studying the topic of the lecture (books , scripts , web sites , etc). Preparing to exam (specified in detail in the syllabus implemented module).	45	IM2A_MSP_w_1

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Solid state physics

Module code: IM2A_FCS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_FCS_1	Understanding the relationship between material properties and basic laws of nature. Acquiring basic knowledge about theoretical specification of material properties (specific heat, susceptibility etc.). Analysis of various type computational approximations. Acquiring the knowledge about materials electron structure, magnetism, dielectric and other properties.	IM2A_W01 IM2A_W03	5 2
IM2A_FCS_2	Acquiring the skill to resolve theoretical problems from the field of material properties computation. Acquiring the skill to apply specified computational methods and approximations. Analysis of various type approaches to theoretical determination of material properties	IM2A_U09 IM2A_U19	5 3
IM2A_FCS_3	Development of the skill of new knowledge acquisition, problem analysis, concluding based on mathematical equations, acquiring the skill to interpret ideas and concepts.	IM2A_K01 IM2A_K04 IM2A_K05	2 2 1

3. Module description

Description	The module Solid state physics shall enable that students learn a theoretical description of material properties and their relation to basic laws of nature. Listeners should master the scope of knowledge related to materials electron structure, thermal properties, magnetism and magnetic and dielectric properties, transport phenomena and others. A special emphasis will be placed on mastering certain computational techniques, the analysis of used approximations and of obtained results
Prerequisites	The knowledge of mathematics and physics on a university level and of chemistry on a grammar school level is required

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_FCS_w_1	Oral examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_FCS_1, IM2A_FCS_2, IM2A_FCS_3
IM2A_FCS_w_2	Written tests	Checking the acquired skills to resolve problems, compute material properties from basic laws of physics	IM2A_FCS_2, IM2A_FCS_3
IM2A_FCS_w_3	Interview	Assessment of understanding the material properties, their interpretation in the context of application in materials engineering	IM2A_FCS_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_FCS _fs_1	lecture	The lecture shall enable understanding basic material properties as resulting from the laws of physics. It illustrates general regularities in the structure of matter in a classical and quantum presentation. The whole is illustrated with multimedia presentations	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	35	IM2A_FCS_w_1
IM2A_FCS _fs_2	practical classes	Independent analysis of physical problems based on the use of various type computational methods.	30	Preparation to classes by self-studying of recommended issues from a handbook and/ or collection of problems	20	IM2A_FCS_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1

Module code: IM2A_PS1_MC

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_MC_1	Student posiada rozszerzoną i pogłębioną wiedzę obejmującą teoretyczne i praktyczne zagadnienia związane z zagadnieniami fizyki ciała stałego. Rozumie podstawowe zjawiska zachodzące w tych materiałach oraz umieć charakteryzować przejścia mające miejsca pomiędzy fazami.	IM2A_W01 IM2A_W07	4 2
IM2A_PS1_MC_2	Posiada wiedzę z zakresu planowania eksperymentu naukowego i opracowania danych doświadczalnych. Zakres wiedzy studenta obejmuje wiedzę w zakresie nowoczesnych trendów rozwojowych i osiągnięć w zakresie rozwoju nowych materiałów.	IM2A_W05 IM2A_W07	2 2
IM2A_PS1_MC_3	Dokonywać interpretacji wyników badań, wyciągać wnioski oraz formułować i wyczerpująco uzasadniać swoje opinie. Potrafi przygotować oraz wygłosić prezentację na zadany temat oraz w ramach prezentacji założonego problemu badawczego jak również będzie umiał poprowadzić dyskusję na podstawie realizowanego zagadnienia. Potrafi planować i przeprowadzać eksperymenty.	IM2A_U01 IM2A_U04 IM2A_U07	2 4 2

3. Module description

Description	Moduł Materiały ciekłokrystaliczne ma umożliwić studentowi/studentce zapoznanie z teoretycznymi i praktycznymi zagadnieniami dotyczacymi materiałów ciekłokrystalicznych. Student powinien znać podział ciekłych kryształów ze względu na czynnik determinujący ich uporządkowanie, wiedzieć jakie molekuły tworzą fazę ciekłokrystaliczną, czy też jakiego typu fazy mozna spotkać w tych materiałch. Dzięki temu student/studentka powinna uzyskać lepsze zrozumienie wpływu procesów chemicznych na właściwości materiałów. Student/studentka powinien/na przy tym orientować się w metodach badawczych oraz apraturze niezbędnej przy analizowaniu stanu cikłokrystalicznego, a także posiadać podstawową wiedzę związaną z budową oraz zasadą działania powszechnie stosowanych displei ciekłokrystalicznych.
Prerequisites	Student powienien posiadać podstawową wiedzę z zakresu fizyki ogólnej (podstawy termodynamiki, elektryczności i magnetyzmu, optyki) oraz fizyki atomowej i molekularnej (budowa atomu, wiązania cząsteczkowe, oddziaływania międzymolekularne).

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS1_MC_w_1	Passing a written test to assess	Zaliczenie przedmiotu odbędzie się w formie ustnej, a zagadnienia tematyczne obejmują swoimi zakresem omówione na wykładzie tematy; skala ocen: 2-5.	IM2A_PS1_MC_1, IM2A_PS1_MC_2
IM2A_PS1_MC_w_2	Reports from the laboratory classes	Samodzielne opracowanie wyników pomiarów i przeprowadzenie ich analizy oraz wykonanie pisemnego sprawozdania; ocena sprawozdania w skali 2-5; co najmniej dwa sprawozdania.	IM2A_PS1_MC_1, IM2A_PS1_MC_2, IM2A_PS1_MC_3
IM2A_PS1_MC_w_3	Activity classes	Weryfikacja odbędzie się w formie aktywności w trakcie wykładu i zajęć laboratoryjnych (udział w dyskusji, pytania odnośnie poruszanych zagadnień, odpowiedzi na pytania) – stanowi to także podstawę do podniesienia oceny maksymalnie o 1 punkt; skala ocen: 3-5, jako średnia z ocen cząstkowych.	IM2A_PS1_MC_2, IM2A_PS1_MC_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS1_MC_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zagadnień dotyczących fazy ciekłokrystalicznej oraz materiałów wykazujących tego typu własności. Studenci dowiedza się jakiego typu molekuły tworzą fazę ciekłokrystaliczną, poznają techniki eksperymentalne przydatne przy badaniu tych materiałów oraz zapoznają się z budową powszechnie stosowanych w optoelektronice displei ciekłorystalicznych. Wykład oparty na prezentacjach w PowerPoincie; treść do dyspozycji studentów w formacie pdf.	30	Praca z materiałami z wykładu i lekturami uzupełniającymi polegająca na samodzielnym przyswojeniu wiedzy przez studenta.	30	IM2A_PS1_MC_w_1
IM2A_PS1_MC_fs_2	laboratory classes	Zakres ćwiczeń obejmuje omówienie budowy urządzeń eksperymentalnych; przygotowanie próbek oraz samodzielne przeprowadzenie pomiarów. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	15	Scharakteryzowanie jakościowe i ilościowe badanych próbek, wykonanie sprawozdania zawierającego widma, obliczenia i wnioski.	15	IM2A_PS1_MC_w_2, IM2A_PS1_MC_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1

Module code: IM2A_PS1_OZE

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_OZE_1	Ma wiedzę z zakresu systematyki odnawialnych źródeł energii (OZE), metod pozyskiwania OZE, ich wykorzystania i wpływu technologii OZE na środowisko przyrodnicze.	IM2A_W18	2
IM2A_PS1_OZE_2	Ma podstawową wiedzę o projektowaniu, budowie i działaniu maszyn oraz urządzeń stosowanych w energetyce odnawialnej.	IM2A_U01	2
IM2A_PS1_OZE_3	Potrafi identyfikować źródła energii odnawialnych, dobierać technologie przetwarzania do rodzaju źródła energii odnawialnej oraz rozumie zagrożenia związane ze stosowaniem tych technologii.	IM2A_K02	4

3. Module description

Description	Moduł Odnawialne źródła energii ma umożliwić studentowi/studentce zapoznanie się z podstawowymi zagadnieniami dotyczącymi klasyfikacji odnawialnych źródeł energii i ich znaczeniem w bilansie energetycznym Polski, UE i świata. Moduł ma zapewnić studentowi/studentce poznanie możliwości wykorzystania odnawialnych źródeł energii, prognoz i kierunków rozwoju energetyki niekonwencjonalnej oraz wpływu wybranych technologii odnawialnych na środowisko przyrodnicze. Realizacja powyższych celów wymaga poznania zagadnień z zakresu pierwszego poziomu kształcenia.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów chemii, elektrochemii, fizyki oraz recyklingu materiałów.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS1_OZE_w_1	final test	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia laboratoryjne.	IM2A_PS1_OZE_1, IM2A_PS1_OZE_2, IM2A_PS1_OZE_3

IM2A_PS1 _OZE_w_2	written test	Sprawdzenie wiadomości nabytych podczas ćwiczeń laboratoryjnych do badania na drodze doświadczalnej procesów związanych z OZE oraz podejmowania decyzji o sposobie pozyskania i wykorzystania OZE.	IM2A_PS1_OZE_1, IM2A_PS1_OZE_2, IM2A_PS1_OZE_3
IM2A_PS1 _OZE_w_3	Report	Ocena opanowania umiejętności samodzielnego przeprowadzania ćwiczenia praktycznego jak i pracy w zespole, analizy wyników pomiarowych i niepewności pomiarowej oraz prawidłowego formułowania wniosków.	IM2A_PS1_OZE_3
IM2A_PS1 _OZE_w_4	conversation	Ocena rozumienia zalet i wad technologii OZE i ich wpływu na środowisko przyrodnicze.	IM2A_PS1_OZE_1, IM2A_PS1_OZE_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS1 _OZE_fs_1	lecture	Niniejszy wykład monograficzny ma umożliwić zrozumienie zagadnień dotyczących odnawialnych źródeł energii. Wykład prowadzony jest z wykorzystaniem nowoczesnych środków multimedialnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do zagadnień poruszanych na wykładach.	35	IM2A_PS1_OZE_w_1, IM2A_PS1_OZE_w_2, IM2A_PS1_OZE_w_4
IM2A_PS1 _OZE_fs_2	laboratory classes	Zastosowanie poznanych wiadomości teoretycznej wiedzy w praktycznym poznaniu i wykorzystaniu OZE. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	15	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	10	IM2A_PS1_OZE_w_2, IM2A_PS1_OZE_w_3, IM2A_PS1_OZE_w_4

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1. Phase transitions in amorphous and nanocrystalline materials

Module code: IM2A_ PS1_PFAN

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_PFAN_1	Understanding phenomena of phase transitions, interpreting relationships between the structure and phase transitions, analysing and explaining processes affecting phase transitions.	IM2A_W01 IM2A_W12	1 5
IM2A_PS1_PFAN_2	The skill to analyse phase transitions and to select methods for forming, in respect of phase transitions, materials for technical applications.	IM2A_K05 IM2A_U18	1 5
IM2A_PS1_PFAN_3	Development of the awareness of the need to model and form materials in respect of phase transitions.	IM2A_K04	3

3. Module description

Description	The module Phase transitions in amorphous and nanocrystalline materials shall enable students classifying phase transitions and understanding, interpreting and analysing phenomena related to phase transitions and their influence on properties of amorphous and nanocrystalline materials. Owing to that students will be capable of reconstructing, explaining, planning and using technologies utilising phase transitions in amorphous and nanocrystalline materials. They will have a possibility to adapt the existing and to design new technologies.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS1_PFAN_w_1	Written credits	Verification of the knowledge based on the lectures content, recommended literature and attended laboratory classes.	IM2A_PS1_PFAN_1, IM2A_PS1_PFAN_2,

			IM2A_PS1_PFAN_3
IM2A_PS1 _PFAN_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_PS1_PFAN_1, IM2A_PS1_PFAN_2, IM2A_PS1_PFAN_3
IM2A_PS1 _PFAN_w_4	Report	Assessment of the skill to understand phase transitions mechanisms and to connect them with engineering materials properties by a correct formulation of conclusions.	IM2A_PS1_PFAN_1, IM2A_PS1_PFAN_2, IM2A_PS1_PFAN_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS1 _PFAN_fs_1	lecture	The lecture shall enable understanding issues related to phase transitions: phenomena, processes, and mechanisms enabling affecting phase transitions. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_PS1_PFAN_w_1
IM2A_PS1 _PFAN_fs_3	laboratory classes	The application of learned theoretical knowledge in practical learning of phase transitions and their mechanisms. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	15	IM2A_PS1_PFAN_w_3 IM2A_PS1_PFAN_w_4

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1. Review of programming languages used in materials engineering

Module code: IM2A_PS1_PJP

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_PJP_1	Systematisation of knowledge about advanced computer programming. The skill to apply programming to computer simulations, advanced development of experiments and ab initio computations.	IM2A_W15	5
IM2A_PS1_PJP_2	The skill of practical use of programming languages consisting in understanding the code of scientific computer programs, their modification and creation of own computational codes.	IM2A_K05 IM2A_U02 IM2A_U06	1 2 5
IM2A_PS1_PJP_3	Becoming aware of the programming languages importance in developing programming tools supporting research in science and technology.	IM2A_K04 IM2A_K06	5 5

3. Module description

Description	The module Review of programming languages used in materials engineering shall enable students repeating, systematising and developing the knowledge about programming languages (Basic for EXCEL spreadsheets, Pascal on the Delphi platform, Fortran), which may be applied to process the experimental data, ab initio computations or computer simulations carried out within the 'Computer materials modelling' specialisation.
Prerequisites	It is required to achieve effects of education of the modules: mathematics, IT, programming languages, numerical methods and algorithms as well as object-oriented programming and computer simulations.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS1	Practical test	Checking the skill of scientific programs codes interpretation, their modification and	

_PJP_w_1		development of a new code.	IM2A_PS1_PJP_1, IM2A_PS1_PJP_2, IM2A_PS1_PJP_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS1_PJP_fs_1	lecture	The lecture shall summarise students knowledge so far about programming languages knowledge and teach new programming languages (Fortran), which have not been taught during the course so far. The lecture is delivered with the use of audiovisuals.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	25	IM2A_PS1_PJP_w_1
IM2A_PS1_PJP_fs_2	laboratory classes	Practical application of learned programming languages to read, modify and develop a new code of scientific computer programs. Exercises are performed by students in computer rooms and scientific laboratories.	15	Preparation to the classes. Preparation of a theoretical description of the planned exercise. Independent development and testing of computer programs. Conclusions formulation.	15	IM2A_PS1_PJP_w_1

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 1. Shape memory alloys

Module code: IM2A_PS1_SMA

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS1_SMA_1	Understanding of the nature of reversible martensitic transformation and phenomena classified as the shape memory effect occurring in metals, their alloys and polymers; learning the group of materials featuring shape memory effects.	IM2A_W06 IM2A_W07 IM2A_W10	2 2 5
IM2A_PS1_SMA_2	The skill to design material properties on account of shape memory effects occurrence.	IM2A_K05 IM2A_U03 IM2A_U15	1 1 5
IM2A_PS1_SMA_3	Understanding ethical, economic and ecological aspects of designing materials with shape memory effects for applications in medicine.	IM2A_K02 IM2A_W18	2 5

3. Module description

Description	The module Shape memory alloys shall enable students learning the nature of phenomena classified as the shape memory effect and factors having a decisive influence on martensitic transformation reversibility and on the shape memory effect inducing in alloys. This knowledge is necessary to obtain the skill to design alloys for specific applications, including medical applications.
Prerequisites	The achievement of effects of education in modules related to rudiments of materials science, materials science and modules related to engineering materials groups.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS1_SMA_w_1	Credits test	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_PS1_SMA_1, IM2A_PS1_SMA_2, IM2A_PS1_SMA_3
IM2A_PS1_SMA_w_2	Written test	Checking the knowledge of and the skill to interpret phenomena of shape memory effect and of reversible martensitic transformation.	IM2A_PS1_SMA_1, IM2A_PS1_SMA_2, IM2A_PS1_SMA_3
IM2A_PS1_SMA_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_PS1_SMA_1, IM2A_PS1_SMA_2, IM2A_PS1_SMA_3
IM2A_PS1_SMA_w_4	Report	Assessment of the skill to design properties of materials related to shape memory effects.	IM2A_PS1_SMA_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS1_SMA_fs_1	lecture	The lecture shall enable understanding of issues related to the nature of factors conditioning the occurrence of shape memory effects as well as basics enabling designing of engineering materials featuring the shape memory effect. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	25	IM2A_PS1_SMA_w_1
IM2A_PS1_SMA_fs_2	laboratory classes	Application of the acquired theoretical knowledge in practical designing of materials and shaping properties on account of the shape memory effect Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation to classes through independent studying of recommended issues.	20	IM2A_PS1_SMA_w_2, IM2A_PS1_SMA_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2

Module code: IM2A_PS2_RMP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_RMP_1	Ma poszerzoną i pogłębioną wiedzę merytoryczną w zakresie zjawisk fizycznych i procesów chemicznych zachodzących podczas przetwarzania polimerów i tworzyw sztucznych; umiejętność wskazania wpływu zastosowanego kierunku recyklingu na parametry uzyskiwanych recyklatów; posiada uporządkowaną wiedzę o charakterze interdyscyplinarnym z zakresu zaawansowanych technologii przetwarzania i charakteryzacji materiałów polimerowych, niezbędną do projektowania i modelowania nowoczesnych materiałów inżynierskich poddawanych procesom odzysku.	IM2A_W06 IM2A_W11	1 4
IM2A_PS2_RMP_2	Potrafi ocenić przydatność i możliwość wykorzystania istniejących i nowych technologii i technik wytwarzania i przetwarzania materiałów inżynierskich, potrafi ukształtować strukturę powierzchni materiałów w celu poprawy ich zdolności do powtórnego użycia; umie projektować polimerowe materiały inżynierskie oraz prognozować ich właściwości z uwzględnieniem występowania zjawisk w cykl życia produktu wykonanego z tego materiału.	IM2A_U11 IM2A_U19	4 2
IM2A_PS2_RMP_3	Potrafi myśleć i działać w sposób kreatywny wykazując świadomość konsekwencji oddziaływania na środowisko użytkowanych tworzyw sztucznych; potrafi działać w sposób przedsiębiorczy mając na uwadze potrzebę zrównoważonego rozwoju z wykorzystaniem odpadowych materiałów polimerowych.	IM2A_K02	4

3. Module description

Description	Moduł Recykling materiałów polimerowych ma umożliwić studentowi/studentce ugruntować wiedzę z zakresu procesów fizycznych i reakcji chemicznych zachodzących podczas wytwarzania polimerów oraz tworzyw sztucznych, jak również na etapie ich przetwórstwa. Pozwoli ona na wskazanie głównych kierunków ich recyklingu oraz określenie wpływu zastosowanej techniki na parametry uzyskiwanych recyklatów. Moduł ma także za zadnie zwiększyć świadomość wpływu czynników środowiskowych na właściwości tworzywa sztucznego, a także interakcji zachodzących w kierunku odwrotnym.
Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, polimery, technologie i przetwórstwo materiałów – polimery.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS2_RMP_w_1	written exam	Weryfikacja wiedzy teoretycznej w oparciu o treść wygłoszonych wykładów, wskazaną literaturę przedmiotu oraz praktyczne ćwiczenia laboratoryjne.	IM2A_PS2_RMP_1, IM2A_PS2_RMP_2, IM2A_PS2_RMP_3
IM2A_PS2_RMP_w_2	written test	Sprawdzenie wiedzy z zakresu wykonywanych ćwiczeń laboratoryjnych związanych z badaniem i oceną właściwości odpadowych materiałów polimerowych.	IM2A_PS2_RMP_1, IM2A_PS2_RMP_2, IM2A_PS2_RMP_3
IM2A_PS2_RMP_w_3	report	Sprawdzenie wiedzy z zakresu wykonanych praktycznych ćwiczeń związanych z wykorzystaniem odpadowych materiałów polimerowych.	IM2A_PS2_RMP_1, IM2A_PS2_RMP_2, IM2A_PS2_RMP_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS2_RMP_fs_1	lecture	Wykład ma umożliwić zrozumienie podstawowych zagadnień dotyczących zjawisk fizycznych i reakcji chemicznych zachodzących charakterystycznych dla użytkowych materiałów polimerowych. Pozwoli to na płynne poruszanie się w tematyce głównych kierunków ich recyklingu. Wykład prowadzony jest z wykorzystaniem środków multimedialnych i demonstracji.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	30	IM2A_PS2_RMP_w_1
IM2A_PS2_RMP_fs_2	laboratory classes		30		30	IM2A_PS2_RMP_w_2, IM2A_PS2_RMP_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Basics of ab initio methods of computer materials modelling

Module code: IM2A_PS2_PMA

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_PMA_1	Knowledge about quantum basics of modern ab inito methods of engineering materials theoretical modelling. Knowledge and understanding of principles of approximations selection for an exchange-correlation potential and modelling methods for a crystalline potential and one-electron wave functions used in modern quantum methods of ab initio computations. Knowledge and understanding of differences between full-electron and pseudo-potential methods of quantum modelling of ordered materials properties.	IM2A_W01	5
IM2A_PS2_PMA_2	Knowledge on an extended level of at least two dedicated software packages used for quantum computations of microscopic and macroscopic properties of engineering materials. Knowledge about ab initio modelling methods of atomically disordered materials.	IM2A_W01	5
IM2A_PS2_PMA_3	The skill of understandable presentation of theoretical basics of modern quantum methods of ab initio computations used in materials modelling. The skill of understandable discussion of limitations of learned methods and of explaining issues related to approximations used in those methods.	IM2A_U02 IM2A_U07 IM2A_U09	2 5 5
IM2A_PS2_PMA_4	The skill to select a proper method of ab initio computations to perform modelling to achieve a specified objective of engineering materials testing, practical implementation of those computations and an in-depth analysis of computation results. The skill to implement ab initio modelling for atomically disordered materials.	IM2A_U07	5
IM2A_PS2_PMA_5	Development of responsibility for a reliable implementation of a computational project. Deepening the skill of team work and understanding the necessity of systematic work on projects, which are long-term in nature. Preparation for an active participation in team implementation of the project.	IM2A_K03	3

3. Module description

Description	The module Basics of ab initio methods of computer materials modelling shall enable students learning modern quantum methods used in theoretical modelling of atomically ordered and disordered materials. Owing to that students will be prepared to use the software, available in research laboratories,

	for electron structure computations and thermodynamic modelling of new materials as well as to use the results to determine physical and chemical properties of materials studied and designed.
Prerequisites	It is required to achieve effects of education of the modules: solid state physics, chemistry, crystallography, materials testing methods and the IM2A_KMSM, IM2A_SIECI module.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS2_PMA_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PS2_PMA_1, IM2A_PS2_PMA_2, IM2A_PS2_PMA_3, IM2A_PS2_PMA_4, IM2A_PS2_PMA_5
IM2A_PS2_PMA_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of quantum computations of engineering materials.	IM2A_PS2_PMA_1, IM2A_PS2_PMA_2, IM2A_PS2_PMA_3, IM2A_PS2_PMA_4, IM2A_PS2_PMA_5
IM2A_PS2_PMA_w_4	Report	Assessment of the skill to understand results of computations and to connect them with engineering materials properties by a correct formulation of conclusions.	IM2A_PS2_PMA_1, IM2A_PS2_PMA_2, IM2A_PS2_PMA_3, IM2A_PS2_PMA_4, IM2A_PS2_PMA_5

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS2_PMA_fs_1	lecture	The lecture shall enable learning the quantum basics, used approximations and the applications scope as well as limitations of modern ab inito methods used for materials modelling. The lecture is delivered with the use of multimedia and demonstrations using WIEN2k and VASP packages.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	25	IM2A_PS2_PMA_w_1
IM2A_PS2_PMA_fs_3	laboratory classes	Application of the acquired theoretical knowledge to practical computations of engineering materials structure and microscopic and macroscopic properties.	30	Preparation of theoretical basics and issues related to the topic of performed exercise as well as preparation of the necessary data. Independent/team preparation of the	40	IM2A_PS2_PMA_w_3, IM2A_PS2_PMA_w_4

		Exercises are performed by students individually/in teams with the use of teaching and research laboratories equipment.		theoretical introduction and presentation of exercise results.		

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Ceramic and polymer materials in medicine

Module code: IM2A_ PS2_MCP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_MCP_1	Learning basic features of ceramic and polymer materials used in medicine and the skill to recall them at the material type identification. Acquiring basic knowledge about those materials structure, properties and manufacturing methods.	IM2A_W06 IM2A_W07	3 5
IM2A_PS2_MCP_2	Mastering the skill to assess and examine a real structure and selected practical properties of ceramic and polymer materials used in medicine.	IM2A_K05 IM2A_U11 IM2A_U19	1 2 3
IM2A_PS2_MCP_3	Developing the awareness of the need for development of technology for ceramic and polymer materials used in medicine.	IM2A_K02 IM2A_W18	1 5

3. Module description

Description	The module Ceramic and polymer materials in medicine shall enable students achieving competence in the field of physical and practical properties of ceramic and polymer materials and in choosing ceramic and polymer materials for medical applications as well as acquiring skills to assess and examine a real structure and selected practical properties of ceramic and polymer materials.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, thermodynamics, crystallography, biomaterials, polymers as well as materials testing methods, materials technology and processing.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS2	Oral examination	Verification of the knowledge based on the lectures content, recommended literature as well	

_MCP_w_1		as attended classes and consultations.	IM2A_PS2_MCP_1, IM2A_PS2_MCP_2, IM2A_PS2_MCP_3
IM2A_PS2 _MCP_w_2	Written test	Checking the acquired skill to associate the metallic biomaterials structure, properties, and interaction with the tissue, adverse effects of such interactions and with application possibilities.	IM2A_PS2_MCP_1, IM2A_PS2_MCP_2, IM2A_PS2_MCP_3
IM2A_PS2 _MCP_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_PS2_MCP_1, IM2A_PS2_MCP_3
IM2A_PS2 _MCP_w_4	Report	Assessment of the skill to perceive and understand the specific nature of metallic biomaterials properties as well as possibilities of their application by a correct formulation of conclusions.	IM2A_PS2_MCP_1, IM2A_PS2_MCP_2, IM2A_PS2_MCP_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS2 _MCP_fs_1	lecture	The lecture shall enable understanding issues related to systematisation of metallic materials into appropriate groups, shaping properties through forced changes of structure from their application point of view. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	30	IM2A_PS2_MCP_w_1
IM2A_PS2 _MCP_fs_2	laboratory classes	Application of the acquired theoretical knowledge to practical learning of relationships: structure - practical properties - potential application possibilities of metallic materials. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results and formulation of proper conclusions.	30	IM2A_PS2_MCP_w_2, IM2A_PS2_MCP_w_3, IM2A_PS2_MCP_w_4

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Metallic glasses and nanomaterials

Module code: IM2A_PS2_SMN

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_SMN_1	Understanding relationships between the structure and properties of metallic glasses and nanomaterials, understanding phenomena and processes affecting those materials properties.	IM2A_W12	5
IM2A_PS2_SMN_2	Learning phenomena, processes, and methods for metallic glasses and nanomaterials forming as well as mechanisms responsible for physical properties changing.	IM2A_W12	5
IM2A_PS2_SMN_3	The skill to analyse properties of metallic glasses and nanomaterials and to choose methods for those materials structure and properties forming for technical applications.	IM2A_K05 IM2A_U18	1 5
IM2A_PS2_SMN_4	Development of the awareness of the need to affect the structure to change properties of metallic glasses and nanomaterials.	IM2A_K01 IM2A_K04	5 5

3. Module description

Description	The module Metallic glasses and nanomaterials shall enable that students are knowledgeable about the structure of metallic glasses and nanomaterials as well as about methods, phenomena, and processes enabling changes of such materials properties. Owing to that students shall achieve a better understanding of correlations between those materials structure and mechanisms affecting their properties. The understanding of relationships and correlations between properties of metallic glasses and nanomaterials and their structure shall results in honing the skill to shape the properties for technical applications.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS2_SMN_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PS2_SMN_1, IM2A_PS2_SMN_2, IM2A_PS2_SMN_3, IM2A_PS2_SMN_4
IM2A_PS2_SMN_w_2	Report	Assessment of the skill to understand structure shaping mechanisms and to connect them with properties of metallic glasses and nanomaterials by a correct formulation of conclusions.	IM2A_PS2_SMN_3, IM2A_PS2_SMN_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS2_SMN_fs_1	lecture	The lecture shall enable understanding issues related to the structure of metallic glasses and nanomaterials as well as phenomena, processes and mechanisms enabling affecting their properties shaping. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	35	IM2A_PS2_SMN_w_1
IM2A_PS2_SMN_fs_3	laboratory classes	The application of acquired theoretical knowledge to experimental learning of metallic glasses and nanomaterials and of mechanisms enabling shaping their properties. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	25	IM2A_PS2_SMN_w_2

1.	**Field of study**	**Materials Science and Engineering**
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Modern microscopic and spectral methods

Module code: IM2A_ PS2_MIKRS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_MIKRS_1	Understanding physical and geometrical properties of electron scattering on atoms, learning the principle of electron microscopes operation, acquiring the notion of theoretical and practical resolution, understanding the notion of reciprocal lattice.	IM2A_U01 IM2A_W13	5 5
IM2A_PS2_MIKRS_2	Learning various diffraction types in electron microscopy and their use in the analysis of crystals structure.	IM2A_W05 IM2A_W13	5 5
IM2A_PS2_MIKRS_3	Understanding the origination of contrast in electron microscopy, the difference between a diffraction and phase contrast as well as principles of high-resolution image origination. Learning examples of materials testing capacities.	IM2A_U01 IM2A_U07	5 5
IM2A_PS2_MIKRS_4	Learning basics of spectrometry in electron microscopy and of chemical composition determination.	IM2A_W13	5

3. Module description

Description	The module Modern microscopic and spectral methods shall enable that students are knowledgeable about microscopic methods for materials structure examination and also their possibilities and limitations. Students shall learn the theory of microscopic and diffraction images origination as well as of spectral methods for chemical composition determination. Owing to that students shall achieve skills of microscopic images interpretation and hence acquiring information about the structure, defects, phase and chemical composition of materials The understanding of relationships and correlations between engineering materials properties and their structure shall result in deepening the skill to shape the structure and properties of engineering materials for technical and medical applications.
Prerequisites	It is required to achieve effects of education of physics, chemistry, crystallography, and materials science modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS2_MIKRS_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PS2_MIKRS_1, IM2A_PS2_MIKRS_2, IM2A_PS2_MIKRS_3, IM2A_PS2_MIKRS_4
IM2A_PS2_MIKRS_w_2	Written test	Checking the acquired skills to use electron microscopy methods.	IM2A_PS2_MIKRS_1, IM2A_PS2_MIKRS_2, IM2A_PS2_MIKRS_3, IM2A_PS2_MIKRS_4
IM2A_PS2_MIKRS_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_PS2_MIKRS_1, IM2A_PS2_MIKRS_2
IM2A_PS2_MIKRS_w_4	Report	Assessment of the skill to understand mechanisms of microscope images origination and to interpret them by a correct formulation of conclusions.	IM2A_PS2_MIKRS_3, IM2A_PS2_MIKRS_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS2_MIKRS_fs_1	lecture	The lecture shall enable understanding the issues related to electron microscopy in engineering materials testing. The lecture is delivered with the use of multimedia, demonstrations and the „Materials science” software.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	30	IM2A_PS2_MIKRS_w_
IM2A_PS2_MIKRS_fs_2	laboratory classes	Applying the acquired theoretical knowledge in practice: resolving electron diffraction patterns, microscope operation, diffraction contrast analysis.	30	Preparation to classes through independent studying of recommended issues.	30	IM2A_PS2_MIKRS_w_ IM2A_PS2_MIKRS_w_ IM2A_PS2_MIKRS_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 2. Shape memory alloys

Module code: IM2A_PS2_SMA_MF

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS2_SMA_1	Ma poszerzoną wiedzę z zakresu materiałów wykazujących pamięć kształtu w zastosowaniach technicznych oraz medycynie. Ma poszerzoną wiedzę w zakresie metod wytwarzania oraz przetwarzania stopów z pamięcią kształtu. Ma szczegółową wiedzę w zakresie zjawisk zaliczanych do efektu pamięci kształtu.	IM2A_W06 IM2A_W07 IM2A_W10	2 2 3
IM2A_PS2_SMA_2	Potrafi modyfikować przebieg odwracalnej przemiany martenzytycznej oraz zjawisk pamięci kształtu. Potrafi przygotować opracowanie naukowe zawierające omówienie wyników eksperymentu. Potrafi ukształtować strukturę stopów wykazujących pamięć kształtu. Umie projektować stopy wykazujące pamięć kształtu i prognozować ich właściwości.	IM2A_U03 IM2A_U10 IM2A_U19	1 1 2
IM2A_PS2_SMA_3	Ma świadomość ekonomicznych oraz pozatechnicznych aspektów zastosowania materiałów wykazujących pamięć kształtu w technice i medycynie. Potrafi myśleć w sposób kreatywny.	IM2A_K02 IM2A_K05	1 1

3. Module description

Description	Moduł Stopy z pamięcią kształtu ma umożliwić studentowi/studentce poznanie grupy materiałów funkcjonalnych, która charakteryzuje się możliwością zmiany kształtu oraz powrotu do kształtu pierwotnego. Zakres modułu obejmuje poznanie istoty zjawisk zaliczanych do efektu pamięci kształtu oraz czynników mających decydujący wpływ na odwracalność przemiany martenzytycznej oraz indukowanie efektu pamięci kształtu w materiałach inżynierskich. Moduł ten poszerza wiedzę z zakresu materiałów przynależących do grupy materiałów funkcjonalnych.
Prerequisites	Realizacja efektów kształcenia w modułów podstawowych.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS2_SMA_w_1	Written examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia.	IM2A_PS2_SMA_1, IM2A_PS2_SMA_2, IM2A_PS2_SMA_3
IM2A_PS2_SMA_w_2	Written test	Sprawdzenie znajomości i umiejętności interpretacji zjawisk zachodzących w stopach z pamięcią kształtu, sposobów modyfikowania pamięci kształtu.	IM2A_PS2_SMA_1, IM2A_PS2_SMA_2, IM2A_PS2_SMA_3
IM2A_PS2_SMA_w_3	Test	Ocena opanowania podstawowych wiadomości niezbędnych do indywidualnego wykonania ćwiczenia praktycznego.	IM2A_PS2_SMA_1, IM2A_PS2_SMA_2, IM2A_PS2_SMA_3
IM2A_PS2_SMA_w_4	Report	Ocena umiejętności kształtowania zjawisk pamięci kształtu.	IM2A_PS2_SMA_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS2_SMA _fs_2	laboratory classes	Zastosowanie poznanych wiadomości teoretycznej wiedzy w praktycznym poznaniu stopów z pamięcią kształtu oraz działania zjawisk pamięci kształtu oraz sposobów ich modyfikacji Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	30	Przygotowanie do ćwiczeń poprzez samodzielne studiowanie wskazanych zagadnień.	30	IM2A_PS2_SMA_w_2, IM2A_PS2_SMA_w_3, IM2A_PS2_SMA_w_4
IM2A_PS2_SMA_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień dotyczących istoty czynników warunkujących wystąpienie odwracalnej przemiany martenzytycznej oraz zjawisk pamięci kształtu w różnych grupach stopów. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień .	30	IM2A_PS2_SMA_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3

Module code: IM2A_PS3_MO

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_MO_1	Zna i rozumie pojęcia dotyczące fizykochemii materiałów i technologii optycznych. Ma wiedzę z zakresu materiałów optycznych.	IM2A_W01 IM2A_W02 IM2A_W07	3 3 4
IM2A_PS3_MO_2	Posiada umiejętność samodzielnego wyszukiwania informacji na temat metod syntezy materiałów optycznych i doboru materiałów inżynierskich do zastosowań optycznych oraz umie przewidywać ich właściwości. Potrafi zastosować różne metody badawcze do analizy właściwości materiałów optycznych.	IM2A_U01 IM2A_U07	2 2
IM2A_PS3_MO_3	Rozumie aspekty i skutki działalności inżynierskiej w dziedzinie materiałów i technologii optycznych.	IM2A_K02	3

3. Module description

Description	Moduł Materiały optyczne ma za zadanie przedstawienie wybranych zagadnień dotyczących klasycznych i zaawansowanych materiałów optycznych. Celem wykładu jest wyjaśnienie zjawisk absorpcji i emisji światła w różnych ośrodkach amorficznych i krystalicznych, poznanie procesów promienistych i niepromienistych zachodzących w materiałach oraz ich mechanizmów, omówienie właściwości optycznych materiałów decydujących o potencjalnych możliwościach ich zastosowania. Po ukończeniu kursu student powinien opanować wiedzę na temat otrzymywania, struktury i właściwości materiałów optycznych oraz obszaru ich zastosowań.
Prerequisites	Podstawy nauki o materiałach.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS3_MO_w_1	Written examination	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz ćwiczenia.	IM2A_PS3_MO_1, IM2A_PS3_MO_2, IM2A_PS3_MO_3
IM2A_PS3_MO_w_2	Test	Pisemny sprawdzian opanowania podstawowych wiadomości niezbędnych do wykonania ćwiczenia praktycznego.	IM2A_PS3_MO_1, IM2A_PS3_MO_2, IM2A_PS3_MO_3
IM2A_PS3_MO_w_3	Report	Ocena wykonania ćwiczenia praktycznego, analizy otrzymanych wyników oraz poprawności formułowania wniosków.	IM2A_PS3_MO_1, IM2A_PS3_MO_2, IM2A_PS3_MO_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS3_MO _fs_2	laboratory classes	Ćwiczenia obejmujące rozwiązywanie praktycznych problemów z zakresu materiałów optycznych. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni laboratoryjnych.	30	Przygotowanie zagadnień związanych z tematem wykonywanego ćwiczenia. Indywidualne opracowanie wyników ćwiczeń i przygotowanie sprawozdań.	15	IM2A_PS3_MO_w_2, IM2A_PS3_MO_w_3
IM2A_PS3_MO_fs_1	lecture	Wykład omawiający podstawowe zagadnienia związane z współczesnymi materiałami optycznymi. Wykład prowadzony z wykorzystaniem środków multimedialnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	30	IM2A_PS3_MO_w_1

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3

Module code: IM2A_PS3_RMS

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_RMS_1	Ma poszerzoną wiedzę w zakresie technik otrzymywania, przetwórstwa, odzysku oraz recyklingu metali i stopów.	IM2A_W06 IM2A_W07	2 4
IM2A_PS3_RMS_2	Ma podstawową wiedzę o trendach rozwojowych w obszarze różnych technologii recyklingu, obróbki i nowoczesnych technik kształtowania materiałów.	IM2A_W11 IM2A_W18	3 2
IM2A_PS3_RMS_3	Potrafi dokonać doboru procesu technologicznego w celu uzyskania produktu o określonej strukturze i właściwościach użytkowych.	IM2A_U03 IM2A_U04 IM2A_U07	4 4 4
IM2A_PS3_RMS_4	Potrafi zaprojektować lub wskazać techniki i technologie służące pozyskiwaniu materiałów z przekształcania odpadów.	IM2A_U08 IM2A_U11 IM2A_U19	2 2 3
IM2A_PS3_RMS_5	Ma świadomość ważności i rozumie znaczenie recyklingu materiałów dla ochrony środowiska oraz otrzymywania produktów o szerokim spektrum zastosowania.	IM2A_K02 IM2A_K05	2 2

3. Module description

Description	Moduł Recykling metali i stopów ma umożliwić studentowi/studentce zapoznanie się z podstawowymi zagadnieniami dotyczącymi metod recyklingu metali i stopów. Dzięki temu student/studentka powinna uzyskać lepsze zrozumienie procesów technologicznych służących do otrzymywania materiałów inżynierskich oraz sposobów ich przerabiania dla uzyskania określonych właściwości. Pozwoli to na wyrobienia umiejętności wyboru stosownej technologii dla uzyskania wyrobu o żądanych właściwościach użytkowych.

Prerequisites	Wymagana jest realizacja efektów kształcenia modułów fizyki, chemii, nauki o materiałach oraz projektowania i grafiki inżynierskiej.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS3_RMS_w_1	Written exam	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia laboratoryjne.	IM2A_PS3_RMS_1, IM2A_PS3_RMS_2, IM2A_PS3_RMS_3
IM2A_PS3_RMS_w_2	written test	Ocena opanowania podstawowych wiadomości ogólnych niezbędnych do wykonania ćwiczenia praktycznego.	IM2A_PS3_RMS_1, IM2A_PS3_RMS_2, IM2A_PS3_RMS_3
IM2A_PS3_RMS_w_3	report	Ocena wykonania ćwiczenia praktycznego oraz poprawności opisania uzyskanych wyników i sformułowania wniosków.	IM2A_PS3_RMS_3, IM2A_PS3_RMS_4, IM2A_PS3_RMS_5

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS3_RMS_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień dotyczących technik recyklingu metali i stopów. Wykład prowadzony jest z wykorzystaniem środków multimedialnych.	30	Czytanie zalecanej literatury, przygotowanie do egzaminu.	30	IM2A_PS3_RMS_w_1
IM2A_PS3_RMS_fs_2	laboratory classes	Zastosowanie poznanych wiadomości teoretycznych pozwoli na identyfikację metali i stopów na podstawie struktury i ich właściwości oraz na praktyczne zbadanie wpływu recyklingu na właściwości wybranych metali i stopów. Ćwiczenia wykonywane są indywidualnie przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	30	Przygotowanie do sprawdzianów, czytanie instrukcji laboratoryjnych, opracowanie sprawozdań.	10	IM2A_PS3_RMS_w_2, IM2A_PS3_RMS_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Advanced IT techniques in medicine

Module code: IM2A_PS3_ZIMED

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_ZIMED_1	Learning the ways of image data acquiring, coding and storing for the needs of medicine. Learning principles of operation and the type of information delivered by selected measuring and diagnostic devices (X-ray, ultrasonograph, ECG, EEG, NMR) as well as principles of image processing; their qualitative and quantitative analysis	IM2A_U01 IM2A_W11 IM2A_W15	1 2 2
IM2A_PS3_ZIMED_2	Modelling in biology and medicine	IM2A_W05 IM2A_W11	3 3
IM2A_PS3_ZIMED_3	Development of the awareness of IT role in the process of medical decisions making	IM2A_K02	1

3. Module description

Description	The module Advanced IT techniques in medicine shall enable students learning IT techniques in medicine with special emphasis on the ways of image data acquiring, processing, coding, storing, and analysing. Owing to that students shall understand the role of digital techniques in the field of medical data processing and analysing by means of statistical methods and also based on heuristic methods to support decisions in medical systems. The introduction to modelling in biology and medicine is the second issue. Students will learn basic models of population and interactions between populations.
Prerequisites	The achievement of effects of education of mathematics and IT techniques in medicine modules is recommended.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS3_ZIMED_w_1	Oral examination	Checking the theoretical knowledge provided during the lecture and deepened by own student's interests	IM2A_PS3_ZIMED_1, IM2A_PS3_ZIMED_2, IM2A_PS3_ZIMED_3
IM2A_PS3_ZIMED_w_2	Written report 1	Report on the exercise carried out during classes (image processing) and expanded by the student on his/her own.	IM2A_PS3_ZIMED_1
IM2A_PS3_ZIMED_w_3	Written report 2	Report on the exercise carried out during classes (simulation of a biological or medical process) and expanded by the student on his/her own.	IM2A_PS3_ZIMED_2

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS3_ZIMED_fs_1	lecture	The lecture shall enable a look at sources (X-ray, ultrasonograph, ECG, EEG, NMR, tomography) and at acquiring medical data, mainly image data, and also at decision making based on qualitative, quantitative, statistical or supported by heuristic methods analyses. Moreover, student shall understand dynamic relationships between populations, based on modelling. The lecture is delivered with the use of multimedia and teaching programs.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_PS3_ZIMED_w_
IM2A_PS3_ZIMED_fs_2	laboratory classes	Practical resolution of problems based on examples. Learning the difference between various graphical files, mastering basics of image purification methods. Qualitative and quantitative analysis of image examples. Models of interactions between populations. Exercises are performed by students individually with the use of computers in the teaching laboratory.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Individual and critical preparation of exercise results.	20	IM2A_PS3_ZIMED_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Modelling implants properties by means of FEM

Module code: IM2A_PS3_MES

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_MES_1	Understanding the finite element method (FEM) and its application to design implants; learning possibilities and limitations of the finite element method and the FEM application to simulate physical properties of implants.	IM2A_W02 IM2A_W03 IM2A_W07 IM2A_W08 IM2A_W15	5 2 2 2 2
IM2A_PS3_MES_2	The skill to analyse implants properties based on results obtained by the finite element method.	IM2A_K05 IM2A_U08	1 5
IM2A_PS3_MES_3	Development of the awareness of the need to model and produce implants.	IM2A_K02	5

3. Module description

Description	The module Modelling implants properties by means of FEM shall enable that students are knowledgeable about possibilities of the finite element method application to model materials for implants. Owing to that students shall achieve a better understanding of materials modelling problems and of correlations between results and the actual materials and their properties, which shall result in deepening the skill of implants shaping with the use of structure and properties of engineering materials for medical applications.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS3_MES_w_1	Exam	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PS3_MES_1, IM2A_PS3_MES_2, IM2A_PS3_MES_3
IM2A_PS3_MES_w_2	Report	The assessment of the skill to use the FEM and results interpretation by correct formulation of conclusions.	IM2A_PS3_MES_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS3_MES_fs_1	lecture	The lecture shall enable understanding issues related to the modelling of implants, processes and mechanisms enabling affecting their properties shaping. The lecture is delivered with the use of multimedia, demonstrations and the FEMM and FLUX 2D/3D software.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_PS3_MES_w_1
IM2A_PS3_MES_fs_3	laboratory classes	The application of learned theoretical knowledge in practical modelling of implants. Classes are performed by students individually with the use of software.	30	Preparation of theoretical basics and issues related to the topic of performed simulation. Independent preparation of a theoretical introduction. Individual preparation of results.	20	IM2A_PS3_MES_w_2

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Modelling of processes proceeding in engineering materials

Module code: IM2A_PS3_MODEL

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_MODEL_1	Understanding the role of modelling on an atomic level in the analysis and predictions of atomic processes resulting in diffusion mixing, precipitation processes, phase transformations, materials cracking.	IM2A_W03	5
IM2A_PS3_MODEL_2	Learning assumptions, possibilities and limitations of classical techniques of molecular modelling and statistical models (Monte Carlo method); understanding limitations of classical methods and knowledge of hybrid methods assumptions	IM2A_W15	5
IM2A_PS3_MODEL_3	The skill to define assumptions, possibilities and limitations of modelling methods as well as to select a model for the set problem and expected results; the skill of independent learning complex simulation and modelling methods.	IM2A_K05 IM2A_U02 IM2A_U08	1 2 5
IM2A_PS3_MODEL_4	Development of the awareness of the need for modelling as the link between the basic knowledge on a micro level and materials properties on a macro level.	IM2A_K04	5

3. Module description

Description	The module Modelling of processes proceeding in engineering materials shall show students the relationships between the knowledge about the matter properties on an atomic level and macro features of engineering materials. It comprises presentation of classical methods of molecular modelling (DM) or statistical Monte Carlo (MC) methods and shows their practical limitations. It shows an increasingly large importance of hybrid techniques, which combine modelling on a micro level with modelling of other material parts on a macro level and problems of matching the solutions at the contact of atomic and continuous areas.
Prerequisites	It is required to achieve effects of education of physics, chemistry, crystallography, and thermodynamics modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS3_MODEL_w_1	Oral examination	Verification of the knowledge based on the lectures content and attended classes.	IM2A_PS3_MODEL_1, IM2A_PS3_MODEL_2, IM2A_PS3_MODEL_3, IM2A_PS3_MODEL_4
IM2A_PS3_MODEL_w_2	Practical test	Modification of model parameters in the provided program and interpretation of their impact on the obtained results	IM2A_PS3_MODEL_1, IM2A_PS3_MODEL_2
IM2A_PS3_MODEL_w_3	Report	Understanding the recommended literature on hybrid methods.	IM2A_PS3_MODEL_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS3_MODEL_fs_1	lecture	TThe lecture shall enable understanding issues related to relationships between the atomic structure, the material structure and phenomena occurring in engineering materials and their properties. Both classical and hybrid modelling methods will be presented. The lecture is to be delivered in a classical way.	30	Recalling issues related to the structure and defects in materials, issues of thermodynamics (equilibrium)	10	IM2A_PS3_MODEL_w
IM2A_PS3_MODEL_fs_3	laboratory classes	Because of hybrid models numerical complexity, the classes will comprise mainly examples of classical modelling methods (molecular or MC) Examples will be based on programs included in the Hermann handbook.	30	Recalling basics of programming and the analysis of program code in a higher-order language (Fortran, Basic, Pascal).	20	IM2A_PS3_MODEL_w

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Non-magnetic nanomaterials

Module code: IM2A_PS3_NMN

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_ NMN _1	Understanding relationships between the structure and properties of non-magnetic nanomaterials, understanding phenomena of processes resulting in those materials properties changes.	IM2A_W12	5
IM2A_PS3_ NMN _2	Learning phenomena, processes, manufacturing methods and mechanisms responsible for changing physical properties of non-magnetic nanomaterials.	IM2A_W11	3
IM2A_PS3_ NMN _3	The skill to analyse the structure and properties of non-magnetic nanomaterials and to select manufacturing methods of non-magnetic nanomaterials for technical applications.	IM2A_K05 IM2A_U17 IM2A_U18	1 5 5
IM2A_PS3_ NMN _4	Development of the awareness of the need to produce and to affect the structure to change non-magnetic nanomaterials properties.	IM2A_K04	5

3. Module description

Description	The module Non-magnetic nanomaterials shall enable that students are knowledgeable about non-magnetic nanomaterials structure and about methods, phenomena, and processes enabling those materials manufacturing and properties changing. Owing to that students shall achieve a better understanding of correlations between manufacturing methods, non-magnetic nanomaterials structure and mechanisms affecting their properties. The understanding of relationships and correlations between those materials properties and their structure shall result in honing the skill to form materials of expected physical properties for applications in technology.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_PS3_ NMN _w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_PS3_ NMN _1, IM2A_PS3_ NMN _2, IM2A_PS3_ NMN _3, IM2A_PS3_ NMN _4
IM2A_PS3_ NMN _w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_PS3_ NMN _1
IM2A_PS3_ NMN _w_4	Report	Assessment of the skill to understand manufacturing mechanisms in connection with non-magnetic nanomaterials properties by a correct formulation of conclusions.	IM2A_PS3_ NMN _3, IM2A_PS3_ NMN _4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_PS3_ NMN _fs_1	lecture	The lecture shall enable understanding issues related to the structure of non-magnetic nanomaterials, phenomena, processes, and mechanisms enabling affecting their properties shaping. The lecture is delivered with the use of multimedia and demonstrations.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_PS3_ NMN _w_1
IM2A_PS3_ NMN _fs_3	laboratory classes	The application of acquired theoretical knowledge to experimental learning of non-magnetic nanomaterials structure and of mechanisms enabling shaping their properties. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	20	IM2A_PS3_ NMN _w_3, IM2A_PS3_ NMN _w_4

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Physical methods of materials testing

Module code: IM2A_PS3_FMBM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_PS3_FMBM_1	Understanding operation principles of specialised instruments used to measure and analyse engineering materials properties. Understanding theoretical basics and the idea of measurement used in modern research techniques. Presenting benefits of so-called cross-experiments with the application of various measuring techniques.	IM2A_W05 IM2A_W11 IM2A_W13	5 5 5
IM2A_PS3_FMBM_2	Independent performance of an analysis of example measurement curves with the use of numerical analysis methods learned in other subjects. Independent selection of the analysis method for the research problem. Determination of material characteristics.	IM2A_U03 IM2A_U07	5 5
IM2A_PS3_FMBM_3	Development of the skill of new knowledge acquisition, problem analysis, drawing conclusions based on mathematical equations, acquiring the skill to interpret ideas and concepts.	IM2A_K01 IM2A_K04	5 5

3. Module description

Description	The module Physical methods of materials testing shall enable students learning modern measuring techniques - the physical idea underlying a specific technique and principles of instruments operation. Students shall learn results analysis methods used for a specific method. They shall acquire the skill to select an appropriate research method for a specific problem of engineering materials characteristics determination.
Prerequisites	The knowledge of a course in mathematics, physics and chemistry on a university level is required as well as passing the testing methods subject from the first level of education.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_PS3	Oral examination	Verification of the knowledge based on the lectures content, recommended literature and	

_FMBM_w_1		attended classes	IM2A_PS3_FMBM_1, IM2A_PS3_FMBM_2, IM2A_PS3_FMBM_3
IM2A_PS3 _FMBM_w_2	Weekly reports	Assessment of mastering the skill of independent performance of an experiment, of measuring results analysis	IM2A_PS3_FMBM_3
IM2A_PS3 _FMBM_w_3	Interview	Assessment of laws of physics understanding and their interpretation and application in materials engineering issues	IM2A_PS3_FMBM_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_PS3 _FMBM_fs_1	lecture	The lecture shall enable understanding basic physical principles used in modern measuring techniques and principles of measuring instruments operation. The whole is illustrated with demonstrations and multimedia presentations	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	15	IM2A_PS3_FMBM_w_
IM2A_PS3 _FMBM_fs_3	laboratory classes	Participation in experiments on determination of material characteristics. Analysis of results obtained. (approx. 5 exercises/semester) illustrating the lecture issues. Independent formulation of conclusions.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	15	IM2A_PS3_FMBM_w_ IM2A_PS3_FMBM_w_

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Specialised subject 3. Testing biomaterials corrosion resistance and biocompatibility

Module code: IM2A_PS3_MBOKiBB

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
PS3_MBOKiBB_1	Understanding the role and importance of corrosion resistance and biocompatibility of biomaterials used in medicine and technology	IM2A_W02	2
PS3_MBOKiBB_2	Deepened knowledge from the field of biological environment action on biomaterials used in implantation techniques	IM2A_W08 IM2A_W09	3 3
PS3_MBOKiBB_3	The skill to apply knowledge related to operation of instruments as well as traditional and new technologies for biomaterials surface modification to obtain an effective improvement to their corrosion resistance and biocompatibility	IM2A_U11	3
PS3_MBOKiBB_4	The skill to define and explain, based on examples, the types and mechanisms of corrosion destruction occurring on biomaterials in contact with the living organism environment and also to recognise complications, to determine the reasons of their origination and to suggest prevention methods	IM2A_U14	2
PS3_MBOKiBB_5	The skill to forecast the biomaterials corrosion rate in the environment of systemic tissues and fluids based on in vitro measurements and to design medical products intended for implants and medical instruments, featuring a high corrosion resistance and biocompatibility	IM2A_U15	3

3. Module description

Description	The module Testing biomaterials corrosion resistance and biocompatibility shall ensure that students learn testing methods allowing to determine the life of metallic implants in the environment of living tissues and systemic fluids in a human organism and the biomaterials biocompatibility. The module shall enable that students are knowledgeable about types of metallic biomaterials corrosion (general, pitting, crevice, stress) and about principles of the testing methodology for corrosion processes and corrosion resistance of materials for medical implants and instruments. The module shall also enable proficiency in the field of issues related to in vitro and in vivo tests for biomaterials biocompatibility assessment. The understanding of the correlation existing between the biomaterial type, its structure and surface condition and functional properties referred to applications in medicine and technology

	shall result in acquiring by students the skill of proper biomaterial selection for implantation, satisfying requirements of biocompatibility and of high corrosion resistance
Prerequisites	The knowledge of chemistry, materials science, corrosion and corrosion protection, materials electrochemistry, metallic biomaterials, and tissue engineering modules is required

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
PS3_MBOKiBB_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended laboratory classes	PS3_MBOKiBB_1, PS3_MBOKiBB_2, PS3_MBOKiBB_3, PS3_MBOKiBB_4, PS3_MBOKiBB_5
PS3_MBOKiBB_w_2	Written tests	Checking the skill to use the acquired knowledge to assess and examine biomaterials corrosion destruction and to make decisions on the way to improve their corrosion resistance and biocompatibility	PS3_MBOKiBB_1, PS3_MBOKiBB_2, PS3_MBOKiBB_3, PS3_MBOKiBB_4, PS3_MBOKiBB_5
PS3_MBOKiBB_w_3	Weekly reports	The assessment of mastering the skill of independent performance of a practical exercise and of a team work, of measurement results and measurement error analysis as well as of formulating the conclusions properly	PS3_MBOKiBB_3, PS3_MBOKiBB_4, PS3_MBOKiBB_5
PS3_MBOKiBB_w_4	Interview	The assessment of understanding the reasons and mechanisms of the course and studying biomaterials corrosion processes and biocompatibility	PS3_MBOKiBB_1, PS3_MBOKiBB_2

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
PS3_MBOKiBB_fs_	lecture	The lecture shall enable learning extended knowledge about biomaterials application in implantation techniques. The lecture is aimed at providing knowledge about the biological environment action on biomaterials and materials used in medicine and technology. It presents the measuring methodology used to assess biomaterials biocompatibility and corrosion resistance. The lecture is delivered using demonstrations and modern audio-visual aids	30	The work with the recommended literature comprising independent acquisition of knowledge related to issues presented during the lectures	10	PS3_MBOKiBB_w_1
PS3_MBOKiBB_fs_2	laboratory classes	Individual and team performance of tests reflecting the lecture issues in teaching laboratories and using scientific-research instruments in scientific laboratories. Independent processing of obtained results, preparing graphs, analysis of experimental error and formulation of conclusions	30	Preparation of theoretical basics and issues related to the subject matter of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results	20	PS3_MBOKiBB_w_2, PS3_MBOKiBB_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Surface structure and its modifications

Module code: IM2A_SPJM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_SPJM_1	Understanding the engineering materials surface and surface layers structure; knowing phenomena and processes occurring on the material - environment interface; knowing methods for surface modification to improve functional properties of engineering materials.	IM2A_W06 IM2A_W07	2 1
IM2A_SPJM_2	Students have knowledge about modern testing methods for the structure and properties of material surface layers.	IM2A_W13	3
IM2A_SPJM_3	Students have the skill to choose appropriate protection methods or to improve surface properties of engineering materials.	IM2A_U11 IM2A_W06	2 3
IM2A_SPJM_4	Students have knowledge about economic and environmental aspects of surface modification.	IM2A_K02 IM2A_U13 IM2A_W18	2 1 5

3. Module description

Description	The module Surface structure and its modifications shall enable that students are knowledgeable about engineering materials surface structure, physio-chemical phenomena occurring on the interface, tribological properties as well as modification methods enabling improvement to functional properties of engineering materials; that they master modern testing methods for the structure and properties Owing to that students shall achieve a full understanding of the structure and properties relationships between the substrate, the layer and external conditions. The understanding of those relationships shall result in acquiring the skill to shape the surface structure so as to obtain better functional properties of engineering materials required in the intended use conditions.
Prerequisites	It is required to achieve effects of education in physics, chemistry, rudiments of materials science or materials science modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_ SPJM _w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_SPJM_1, IM2A_SPJM_2, IM2A_SPJM_3, IM2A_SPJM_4
IM2A_ SPJM _w_2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise.	IM2A_SPJM_1, IM2A_SPJM_2, IM2A_SPJM_3
IM2A_ SPJM _w_3	Sprawozdanie	Assessment of the skill of understanding the need for shaping the surface layers structure and their influence on engineering materials functional properties	IM2A_SPJM_1, IM2A_SPJM_2, IM2A_SPJM_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_SPJM _fs_1	lecture	The lecture shall enable understanding the issues related to the surface structure, physio-chemical phenomena, the need for surface layers manufacturing to improve functional properties of engineering materials. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	25	IM2A_ SPJM _w_1
IM2A_SPJM _fs_2	laboratory classes	Application of the acquired theoretical knowledge to a practical learning of surface modification methods to improve functional properties of materials. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	30	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	35	IM2A_ SPJM _w_2, IM2A_ SPJM _w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Tissue engineering

Module code: IM2A_IT

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_IT_1	Understanding physiological, biological and physio-chemical phenomena and processes accompanying the interaction of human tissues and their substitutes in the form of biomaterials as well as understanding methods for tissue reconstruction. Learning the testing methods and principles of tissues for reconstruction production with respect to the needs for applications in human organisms. Understanding the designing methods and principles of tissue engineering application together with methods of tissue reconstruction in medicine.	IM2A_W02 IM2A_W06 IM2A_W07 IM2A_W08	4 4 4 3
IM2A_IT_2	The skill to design properties of tissues for medical applications.	IM2A_K05 IM2A_U17	1 4
IM2A_IT_3	Development of social awareness with emphasis on threats and benefits of tissue engineering application in medicine.	IM2A_K02 IM2A_K04 IM2A_K06	3 3 3

3. Module description

Description	The module Tissue engineering shall enable that students are knowledgeable about physiological, biological and physio-chemical aspects related to the tissue reconstruction in medicine. Owing to that students shall achieve understanding of correlations between tissues of a living organism and tissue reconstruction methods as well as possibilities to reduce effects of interactions. The understanding of those relationships shall result in deepening the skill of tissue reconstruction principles and the testing methods to control phenomena on the phase boundary on a micro- and nano-metres scale.
Prerequisites	Achievement of effects of eduction in the modules: introduction to biomaterials, ceramic biomaterials, metallic biomaterials, polymers for medicine, materials surface engineering, selected issues from biomaterials toxicology, materials degradation in a biological environment, biological and physiological aspects of biomaterials, materials testing methods.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_ IT_w_1	Written test	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_IT_1, IM2A_IT_2
IM2A_ IT_w_2	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_IT_1, IM2A_IT_2, IM2A_IT_3
IM2A_ IT_w_3	Report	The assessment of the skill of designing simple implants and artificial organs for medical and veterinary applications	IM2A_IT_3

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_ IT_fs_1	lecture	The lecture shall enable understanding the issues related to tissue engineering and testing methods for physiological, biological and physio-chemical phenomena and processes on the phase boundary on a micro- and nano-metres scale. The lecture is delivered with the use of multimedia	15	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	15	IM2A_ IT_w_1
IM2A_ IT_fs_2	practical classes	The application of the acquired theoretical knowledge in practical learning of methods for tissue reconstruction used in medicine as well as in designing new ones. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	15	Preparation to classes through independent studying of recommended issues.	15	IM2A_ IT_w_2, IM2A_ IT_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Unconventional biomaterials

Module code: IM2A_MOMF

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_MOMF_1	Student ma poszerzoną wiedzę merytoryczną w zakresie podstawowych metod i procesów otrzymywania krystalicznych, amorficznych i polimerowych a także modyfikowania powierzchni inżynierskich materiałów funkcjonalnych. Student zna i rozumie podstawowe relacje pomiędzy warunkami wytwarzania a strukturą uzyskanego materiału. Ponadto ma podstawową wiedzę merytoryczną z zakresu planowania eksperymentu i opracowania danych doświadczalnych.	IM2A_W06 IM2A_W07 IM2A_W12	4 3 2
IM2A_MOMF_2	Student potrafi ocenić materiały w oparciu o ich właściwości chemiczne oraz przydatność wybranych procesów wytwarzania inżynierskich materiałów funkcyjnych. Potrafi zapisać konkretny problem w postaci równań matematycznych, analizować równania opisujące właściwości materiałów wraz z dyskusją założeń leżących u ich podstaw. Umie zaplanować i przeprowadzić eksperymenty, zinterpretować uzyskane wyniki i wyciągnąć wnioski. Potrafi gromadzić informacje z podanej literatury, baz danych i innych dostępnych źródeł; potrafi uzyskane informacje integrować, dokonywać ich interpretacji i krytycznej oceny, wyciągać wnioski oraz formułować i wyczerpująco uzasadniać opinie. Ponadto student potrafi przygotować opracowanie na temat realizacji eksperymentu zawierającego omówienie uzyskanych wyników oraz ocenę ich niepewności.	IM2A_U01 IM2A_U03 IM2A_U07 IM2A_U08 IM2A_U09 IM2A_U10 IM2A_U11	3 4 4 2 4 2 2
IM2A_MOMF_3	Student ma świadomość oraz zna możliwości dalszego dokształcania się. Widzi konieczność wszechstronnej, naukowej analizy problemów z zakresu otrzymywania inżynierskich materiałów funkcyjnych. Potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy.	IM2A_K01 IM2A_K04 IM2A_K05	2 2 2

3. Module description

Description	Moduł Metody otrzymywania materiałów funkcjonalnych ma umożliwić studentom zorientowanie się w podstawowych metodach wytwarzania wybranych grup materiałów funkcjonalnych tj.: materiałów metalicznych, półprzewodnikowych, kompozytowych, ceramicznych i polimerowych. W ramach zajęć student/studentka uzyska podstawową wiedzę, dotyczącą teorii krystalizacji, wzrostu, syntezy i procesów technologicznych, niezbędną przy wytwarzaniu

	materiałów funkcjonalnych. Studenci poznają budowę i zasadę działania podstawowych urządzeń umożliwiających wytwarzanie materiałów funkcjonalnych. Po ukończeniu kursu student/studentka powinni rozumieć relację pomiędzy warunkami otrzymywania materiałów funkcjonalnych, a ich strukturą. Powinni uzyskać umiejętności kształtowania struktury i właściwości materiałów funkcjonalnych poprzez odpowiedni dobór metody i parametrów wytwarzania. Ponadto, studenci zyskują świadomość w zakresie wpływu metod wytwarzania i procesów technologicznych na środowisko naturalne.
Prerequisites	podstawy fizyki, chemii i inżynierii materiałowej.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_MOMF_w_1	Written test	Weryfikacja wiedzy w oparciu o treść wykładów, wskazaną literaturę oraz odbyte ćwiczenia. Obejmuje ona w szczególności ocenę nabytych umiejętności analizy i mechanizmów kształtowania: a.struktury i właściwości metalicznych materiałów funkcyjnych, b.struktury i właściwości ceramicznych materiałów funkcyjnych w procesie spiekania, c.właściwości materiałów polimerowych w zależności od zaplanowanej budowy łańcucha makrocząsteczki i przewidywania wpływu modyfikacji struktury materiału na finalne właściwości materiału.	IM2A_MOMF_1, IM2A_MOMF_2, IM2A_MOMF_3
IM2A_MOMF_w_2	Test	Ocena opanowania podstawowych wiadomości niezbędnych do indywidualnego wykonania ćwiczenia praktycznego.	IM2A_MOMF_1, IM2A_MOMF_2, IM2A_MOMF_3
IM2A_MOMF_w_3	Report	Ocena umiejętności rozumienia metod otrzymywania i mechanizmów kształtowania struktury materiałów funkcjonalnych.	IM2A_MOMF_1, IM2A_MOMF_2, IM2A_MOMF_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_MOMF_fs_1	lecture	Wykład ma umożliwić zrozumienie zagadnień teoretycznych i praktycznych związanych z podstawowymi metodami otrzymywania materiałów funkcjonalnych.	30	Praca ze wskazaną literaturą obejmująca samodzielne przyswojenie wiedzy w odniesieniu do podstawowych zagadnień.	10	IM2A_MOMF_w_1
IM2A_MOMF_fs_2	laboratory classes	Zastosowanie zdobytej wiedzy teoretycznej w praktycznym poznaniu związków między metodą i parametrami wytwarzania, a strukturą i właściwościami materiałów funkcjonalnych. Ćwiczenia wykonywane są przez studentów z wykorzystaniem wyposażenia pracowni dydaktycznych oraz naukowych.	30	Przygotowanie teoretycznych podstaw i zagadnień związanych z tematem wykonywanego ćwiczenia. Samodzielne opracowanie wstępu teoretycznego. Indywidualne opracowanie wyników ćwiczenia.	20	IM2A_MOMF_w_2, IM2A_MOMF_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Unconventional biomaterials

Module code: IM2A_NIEKON

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_NIEKON_1	Acquiring the knowledge about bioresorbable materials, smart biomaterials, polymer medicine carriers, bioglasses and biosensors, learning the silicones application in medicine	IM2A_W06 IM2A_W10	5 2
IM2A_NIEKON_2	Acquiring the knowledge about biomaterials of natural origin - blood, connective tissue, bone, collagen fibres - collagen structure and properties.	IM2A_W07 IM2A_W09	5 5
IM2A_NIEKON_3	The skill of determining methods of intelligent textile materials manufacturing and methods of collagen obtaining	IM2A_K05 IM2A_U15 IM2A_U16	1 5 5
IM2A_NIEKON_4	Development of the awareness of engineering activities related to manufacturing of unconventional biomaterials impact on development of various areas of economy and of social life Showing the understanding of interactions originating as a result of undertaking the engineering activities affecting a human organism and the environment, and also the necessity to take responsibility for the decisions made. Demonstrating the awareness and possibility of sustained development of own skills and knowledge about the biomaterials structure designing.	IM2A_K01 IM2A_K02	2 5

3. Module description

Description	The module Unconventional biomaterials shall extend students knowledge about biomaterials. It will allow learning about the structure of bioresorbable materials, polymer medicine carriers, bioglasses and biosensors, learning the silicones application in medicine. Owing to that students shall acquire broader knowledge of biomaterials.
Prerequisites	It is required to achieve effects of education of physics, chemistry, crystallography, and biomaterials modules.

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
IM2A_NIEKON_w_1	Written examination	Verification of the knowledge based on the lectures content, recommended literature and attended classes	IM2A_NIEKON_1, IM2A_NIEKON_2, IM2A_NIEKON_3, IM2A_NIEKON_4
IM2A_NIEKON_w_2	Written test	Checking the acquired skills of unconventional biomaterials recognition	IM2A_NIEKON_1, IM2A_NIEKON_2, IM2A_NIEKON_3, IM2A_NIEKON_4
IM2A_NIEKON_w_3	Test	Assessment of mastering the basic knowledge necessary for individual performance of a practical exercise	IM2A_NIEKON_1, IM2A_NIEKON_2
IM2A_NIEKON_w_4	Report	Assessment of the skill of understanding mechanisms of unconventional biomaterials action	IM2A_NIEKON_3, IM2A_NIEKON_4

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
IM2A_NIEKON_fs_1	lecture	The lecture shall enable understanding issues related to the structure of unconventional biomaterials as well as phenomena, processes and mechanisms enabling affecting their properties shaping.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues	25	IM2A_NIEKON_w_1
IM2A_NIEKON_fs_2	laboratory classes	The application of learned theoretical knowledge in practical learning of unconventional biomaterials. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories	15	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	20	IM2A_NIEKON_w_2, IM2A_NIEKON_w_3

1.	Field of study	Materials Science and Engineering
2.	Academic year of entry	2017/2018 (summer term)
3.	Level of qualifications/degree	second-cycle studies
4.	Degree profile	general academic
5.	Mode of study	full-time

Module: Unconventional techniques for materials manufacturing

Module code: IM2A_NTWM

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
IM2A_NTWM_1	Understanding relationships between the structural perfection and parameters and conditions of single-crystals production, understanding phenomena of kinetic and thermal processes proceeding during a single-crystal growth and solidification of composite materials, including those of single-crystal matrix.	IM2A_W06 IM2A_W07	2 2
IM2A_NTWM_2	Learning basic methods for producing and characterising single-crystals and composites with a single-crystal matrix as well as aviation superalloys monocrystalline on a macroscopic scale, and also phenomena, processes proceeding on the crystallisation front.	IM2A_W06 IM2A_W13	3 2
IM2A_NTWM_3	The skill to analyse phase diagrams in view of possibility to produce single-crystals of predetermined phase composition and the skill to choose a method for obtaining a specific material.	IM2A_U11 IM2A_U19	2 2
IM2A_NTWM_4	Development of the awareness of the need for obtaining monocrystalline materials of predetermined structure.	IM2A_K04	2

3. Module description

Description	The module Unconventional techniques for materials manufacturing shall enable that students are knowledgeable about methods for monocrystalline materials production and shall enable understanding mechanisms of their growth and the formation of a real structure. Owing to that and based on the analysis of phase equilibrium diagrams they will be capable of analysing the course of single-crystals growth and of predicting the chemical and phase composition as well as the kinetics of their crystallisation. These capabilities apply also to the production of complex polyphase materials monocrystalline on a macroscopic scale, including aviation monocrystalline superalloys. This module will provide students with an additional possibility to learn methods for structural perfection assessment of monocrystalline materials. Owing to that students shall achieve a better understanding of correlations between the structure of monocrystalline materials and conditions of their producing, which in turn will enable obtaining the skill to form the structure and properties of monocrystalline materials by appropriate conditions of their producing.
Prerequisites	It is required to achieve effects of education of the modules: physics, chemistry, crystallography, materials testing methods and thermodynamics.

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
IM2A_NTWM_w_1	Written test	Verification of the knowledge based on the lectures content, recommended literature and attended classes.	IM2A_NTWM_1, IM2A_NTWM_2, IM2A_NTWM_3, IM2A_NTWM_4
IM2A_NTWM_w_2	Written test	Checking the acquired knowledge of analysis and of mechanisms for single-crystals structure forming and of mechanisms for development of polyphase materials monocrystalline on a macroscopic scale.	IM2A_NTWM_1, IM2A_NTWM_2, IM2A_NTWM_3, IM2A_NTWM_4
IM2A_NTWM_w_3	Report	Assessment of the skill to understand mechanisms for monocrystalline materials structure forming and to predict results of the production process in a form of properly formulated conclusions.	IM2A_NTWM_3, IM2A_NTWM_4

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
IM2A_NTWM_fs_1	lecture	The lecture shall enable understanding issues related to mechanisms of structure and defects of monocrystalline materials development, phenomena and processes on the solidification front, which in turn will allow obtaining the planned structure of those materials. The lecture is delivered with the use of multimedia.	30	The work with the recommended literature comprising independent acquisition of knowledge related to basic issues.	10	IM2A_NTWM_w_1
IM2A_NTWM_fs_2	laboratory classes	Application of the acquired theoretical knowledge in practical learning of production methods, including directional crystallisation methods, monocrystalline materials and mechanisms enabling forming their structure and properties. Exercises are performed by students individually with the use of equipment of teaching and scientific laboratories.	45	Preparation of theoretical basics and issues related to the topic of performed exercise. Independent preparation of a theoretical introduction. Individual preparation of exercise results.	5	IM2A_NTWM_w_1, IM2A_NTWM_w_2, IM2A_NTWM_w_3