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Study programme "Material Science and Nanotechnologies"

Main attributes

Title	Material Science and Nanotechnologies
Identification code	WMM0
Education classification code	45526
Level and type	Academic Master Study
Higher education study field	Physic, Materials Science, Mathematics and Statistic
Head of the study field	Juris Blūms
Department responsible	Faculty of Material Science and Applied Chemistry
Head of the study programme	Remo Merijs-Meri
Professional classification code	
The type of study programme	Full time
Language	Latvian, English
Accreditation	13.09.2023 - 14.09.2029; Accreditation certificate No 2023/28-A
Volume (credit points)	80.0
Duration of studies (years)	Full time studies - 2,0
Degree or/and qualification to be obtained	Master degree of engineering science in material science and nanotechnologies / –
Qualification level to be obtained	The 7th level of European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQF)
Programme prerequisites	Bachelor degree of engineering science in materials science or chemical technology or bachelor degree of natural sciences in chemistry or physics, or biology, or comparable education

Description

Abstract	The study programme focused on the development of new materials and the use of modern technologies offers the acquisition of higher level technical education based on skills and competencies. In parallel with in-depth theoretical knowledge, the acquisition of practical skills is promoted not only in scientific institutes in Latvia, but also in manufacturing companies or foreign partner institutions within the ERASMUS+ mobility programmes specializing in “Materials Physics”, “Biomaterials”, “Traditional Inorganic Materials and Nanomaterials”, “Polymer Materials and Composites (including Nanocomposites)”. The study programme includes general study courses on modelling and calculation of physical processes of materials, creation of innovative products and technologies, various study courses of professional specialization, as well as internship, offering students opportunities to create a study plan according to individual interests. Graduates of the study programme will be able to work as technical experts, consultants and engineers in a manufacturing company engaged in materials processing and process modelling, development of new materials and technologies, product design, testing, certification and quality laboratories, as well as participate in innovative product development by founding a start-up company.
Aim	The aim of the study programme is to prepare progressively thinking, new technology and knowledge-oriented, highly qualified specialists in materials science and high value-added technologies, including nanotechnologies, with specialization in the following fields “Material Physics”, “Biomaterials”, “Traditional Inorganic Materials and Nanomaterials” and “Polymer Materials and Composites (including Nanocomposites)”, as well as for further doctoral studies.
Tasks	The tasks of the study programme are: - to ensure competitive academic master's level education in the European Higher Education Area in accordance with the Bologna recommendations, preparing students for work in leading positions, to develop skills of scientific research work and to promote their use; - to provide students with in-depth knowledge in the chosen field of specialization, to develop expert skills and develop competencies not only to solve conventional everyday problems, but also tackle technically and scientifically challenging innovative problems both in accordance with labour market requirements and future industry development trends; - to develop the student's skills in identifying problems, formulating goals and solving them, finding an opportunity to use both laboratory-wide infrastructure and industrial equipment in cooperation with the manufacturer; - to promote knowledge transfer and develop the student's skills in presenting scientific results not protected by patent rights in international conferences and / or publishing in highly-ranked scientific journals; - to stimulate the interest of students and graduates in doctoral studies, lifelong learning, as well as academic and scientific excellence.

Learning outcomes	Learning outcomesThe graduate of the study programme: - shows expanded and specialized knowledge and understanding of the fundamental issues, as well as the most current discoveries and development trends of the chosen field of specialization of materials science and nanotechnology; - is familiar with the methods of industrial production processes and scientific research planning, implementation, processing of results, analysis and interpretation, as well as modelling of physical processes of materials, understanding their essence and areas of application; - is able to practically and theoretically apply knowledge about the fundamental issues, the most current discoveries and development trends of the chosen field of specialization of materials science and nanotechnology, as well as is able to transfer this knowledge to others; - is able to reasonably choose, plan and independently use methods and equipment for material development, characterization, as well as processing, analysis and modelling of results; - is able to summarize, compare and reasonably discuss the obtained results of research and/or production process in scientific works or technical instructions, reports and present these results to both industry specialists and the general public; - is able to propose and develop innovative scientific and market-oriented projects in accordance with the project calls, market requirements and available resources, as well as is able to perform technical expertise of the manufacturer's products, - is able to critically evaluate and substantiate the importance of the introduction of modern materials and innovative technological solutions in research and production processes; - is able to competently explain and substantiate the use of technical means, modelling approaches and results processing and analysis methods to solve technical problems of manufacturers' products, as well as to develop modern materials and technologies to meet market demands in competitive conditions.
Final/state examination procedure, assessment	The assessment system of the study results is based on RTU Regulations on the assessment of learning outcomes. The assessment methods for each study course are defined by the responsible academic staff. Assessment of each study course is carried out according to 10 grade scale or in the case of a test as pass/fail. The fulfilment of the study programme ends with the State Examination, organized as a public defence of Master Thesis at the meeting of Final Examination Committee (FEC). This includes also examination of theoretical knowledge, scientific background and practical competences essential for the selected specialization. The FEC consists of at least 3 persons, including head of structural unit implementing the study programme. Alternatively, the FEC consists of professor or associated professor approved by the head of the structural unit and at least two scientific degree-holding specialists of the selected field, which can be invited from another structural unit. The FEC is approved by the Dean of the Faculty. The student's knowledge, skills and competence are evaluated collegially by the FEC in a closed meeting on a 10-grade scale, based on the author's presentation, the quality of answers to questions related to the developed work, the most important fundamental and branch/sub-branch theoretical study courses, and reviewer's notes, as well as considering the evaluation of the supervisor and reviewer.
Description of the future employment	The graduate of the study programme can be employed in virtually any field related to the development of new materials and modelling of properties for the creation of various innovative products according to consumer needs, selection of appropriate materials for technologically, ecologically and economically sustainable composite products, natural and synthetic materials (including wood, polymers, rubber, textiles, silicates, metals, biomaterials, semiconductors) and their various forms (monolithic body, fibre, coating, aerogel/hydrogel) for a specific product for use in construction, transport, energy, electronics, medicine, agriculture and other sectors. A materials scientist manages the development of new materials, manages the processes of material processing, monitors quality assurance, and convinces investors about the most promising investment opportunities in the development of innovative products. In turn, a specialist in nanotechnology is competent to work in high-tech companies on the development of new high value-added nanomaterials and their conformity assessment for innovative applications in energy, electronics, medical technology, transport, as well as other sectors of national economy. Thus, the field of work of both a material scientist and a nanotechnology specialist include innovative product development companies, new product development laboratories, product conformity assessment and quality control laboratories, and material technical expertise and certification centres.
Special enrollment requirements	English language proficiency equivalent to at least CEFR B2 level.
Opportunity to continue studies	After successful completion of the study programme, it is possible to continue studies in doctoral study programmes in Latvia and abroad, for example, in RTU doctoral study programme ”Chemistry, Materials Science and Engineering”.

Courses

No	Code	Name	Credit points
A		**Compulsory Study Courses**	**24.0**
A.1		**Study courses on the current achievements in the field**	**12.0**
1	KPI749	Modern Materials	4.0
2	KST766	Advanced Technologies of Materials	4.0
3	BKA703	Modeling and Simulation of Physical Processes	4.0
A.2		**Field-Specific Theoretical Basic and IT Study Courses**	**12.0**
		Biomaterials	*12.0*
1	KVT741	Drug Delivery Systems and Nanotechnologies	3.0
2	KVT753	Cell Biology	3.0
3	KVT748	Biomaterials as Drug Delivery Systems	3.0
4	KVT739	Biocompatibility of Biomaterials	3.0
		Materials physics	*12.0*
1	MFT704	Solid-state Physics	8.0
2	KFM706	Physics of New Materials	4.0
		Polymer materials and composites (including nanocomposites)	*12.0*
1	KPI745	Polymers Chemistry and Physics	6.0
2	KPI746	Technology of Polymer Materials	6.0
		Traditional inorganic materials and nanomaterials	*12.0*
1	KST750	Technology and Properties of Glass-Like Coatings	3.0
2	KST751	Traditional and New Ceramic Chemistry and Technology	3.0
3	KST752	Research Methods of Nanomaterials	3.0
4	KST755	Silicate Materials for Construction	3.0
B		**Compulsory Elective Study Courses**	**20.0**
B1		**Field-Specific Study Courses**	**16.0**
		Biomaterials	*16.0*
1	KVT750	Tissue Engineering and Regenerative Medicine	3.0
2	KVT751	Research Project - Biomaterials Research and Characterisation	5.0
3	KVT752	Biomaterials for Bone Tissue Regeneration	5.0
4	KVT749	Principles of Cleaner Production	3.0
		Materials physics	*16.0*
1	KFO700	Smart Nanostructured Materials	4.0
2	KFO701	Nanophotonics	4.0
3	KFP701	Semiconductor Nanostructures	4.0
4	KFO702	Nanostructured Metamaterials	4.0
5	KFM702	Photonics Materials and Devices	4.0
6	KFP700	Laser Technology of Nanomaterials	4.0
		Polymer materials and composites (including nanocomposites)	*16.0*
1	KPI747	Soft Matter Physics	4.0
2	KPI741	Recycling of Polymer Materials	4.0
3	KPI744	Analysis of Polymer Materials	4.0
4	KPI742	Chemistry and Technology of Polymer Fibre Materials	4.0
5	KPI743	Selection of Polymer Materials and Product Design	4.0
6	KPI748	Biopolymers and Bionanomaterials Chemistry and Technology	4.0
7	KPI751	Ageing of Polymer Materials	4.0
8	KPI752	Technical Textiles in Materials Science	4.0
		Traditional inorganic materials and nanomaterials	*16.0*
1	KST756	Thin Films and Sol-gel Coatings	4.0
2	KST757	Oxide Nanomaterials and Applications	4.0
3	KST758	Conservation and Restoration of Inorganic Materials	4.0
4	KST764	Research Project - Traditional Inorganic Materials and Nanomaterials	4.0
B2		**Humanities and Social Sciences Study Courses**	**4.0**
1	HSP488	Business Sociology	2.0
2	HSP485	Communication Psychology	2.0
3	HSP430	Social Psychology	2.0
4	HSP446	Pedagogy	2.0
5	IRO308	Organization and Planning of Small Business	2.0
6	IEU534	Project Quality and Risk Management	3.0
7	IDA700	Basics of Labour Protection	1.0

C		**Free Elective Study Courses**	**12.0**
D		**Practical Placement**	**4.0**
1	ĶVT757	Internship in Biomaterials	4.0
2	ĶPI756	Internship in Polymer Materials and Composites	4.0
3	ĶST763	Internship in Traditional Inorganic Materials and Nanomaterials	4.0
E		**Final Examination**	**20.0**
1	MFB002	Master Thesis	20.0
2	ĶVT755	Master Thesis	20.0
3	ĶPI754	Master Thesis	20.0
4	ĶST765	Master Thesis	20.0
5	ĶNĶ002	Master Thesis	20.0