RĪGAS TEHNISKĀ UNIVERSITĀTE

Reģ.Nr.90000068977, Ķīpsalas iela 6A, Rīga, LV-1048, Latvija

Tālr.:67089999; Fakss:67089710, e-pasts:rtu@rtu.lv, www.rtu.lvwww.rtu.lv

# Study programme "Material Science and Nanotechnologies"

*Main attributes*

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| Title | Material Science and Nanotechnologies |
| Identification code | WMM0 |
| Education classification code | 45526 |
| Level and type | Academic Master (Second Cycle) Studies |
| Higher education study field | Physic, Materials Science, Mathematics and Statistics |
| Head of the study field | Juris Blūms |
| Department responsible | Faculty Of Natural Sciences And Tehnology |
| Head of the study programme | Dmitrijs Stepanovs |
| 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*

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| 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:<br>- 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;<br>- 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;<br>- 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;<br>- 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;<br>- to stimulate the interest of students and graduates in doctoral studies, lifelong learning, as well as academic and scientific excellence. |

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| Learning outcomes | Learning outcomesThe graduate of the study programme:<br>- 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;<br>- 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;<br>- 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;<br>- 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;<br>- 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;<br>- 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,<br>- is able to critically evaluate and substantiate the importance of the introduction of modern materials and innovative technological solutions in research and production processes;<br>- 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 |
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| **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 |

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| **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 |