TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

**APPROVED BY**

Director of the School of Advanced Manufacturing Technologies _____ Alexey N. Yakovlev

**Course Name**
***Contemporary Issues in Material Science***

**Field of Study:** Major 22.04.01 Material Science and Technologies

**Programme name:** Material Science

**Level of Study:** Master Degree Programme

**Year of admission:** 2020

**Semester, year:** 2, 2021

**ECTS:** 3
**Total Hours:** 108
**Contact Hours:** 32

- **Lectures:** 16
- **Labs:** -
- **Practical experience:** 16

**Assessment:** credit test

**Division for Materials Science**

**Head of Division for Materials Science** _____ Vasiliy A. Klimenov

**Instructor(s)** _____ Sergey V. Panin

**Course Name**

**Course Overview**

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| **Course Objectives** | The course is devoted to the research, development and application of new structural and functional materials with pre-designed properties. Students will gain knowledge in the field of advanced materials (alloys, composites, hybrid materials, ceramics, nanostructured materials), as well as in the application and advanced technologies in materials science. |
| **Learning Outcomes** | Professional competence includes knowledge of research, development and application of new materials and structures, in particular:<br>- materials for structural and functional applications for various industries, including electronics, medicine, as well as surface hardening and coating technologies;<br>- principles for the development of new materials - nanostructured, smart, gradient and composite materials based on a ceramic, metal and polymer matrix;<br>- instruments for surface hardening and coating;<br>- production processes for advanced materials;<br>- selection of materials for various applications;<br>- selection of materials when designing products and structures;<br>- creating hybrid materials, including composites, sandwich panels, cellular composites, segmented structures;<br>- physical and chemical models of materials and production processes;<br>- laws and regulations regarding the use of new materials.. |
| **Course Outline** | The course includes lectures and practical exercises. Physical basis for the selection and application of metal, ceramic and polymer structural materials in various industries. Patterns of deformation and fracture of structural materials in terms of ensuring their durability. |
| **Prerequisites (if available)** | Solid state physics, Physical and mechanical properties of materials; Strength of materials; Material processing techniques |
| **Course Structure** | • Modern materials science: problems and prospects<br>• Metals and alloys<br>• Ceramics<br>• Polymers and composite materials<br>• Nanostructured materials<br>• Surface hardening technologies. Coatings.<br>• Material selection for various structural and functional applications, including practical examples;<br>• Selection of materials when designing products;<br>• Fundamentals of the choice of materials in the design of products, taking into account different production issues;<br>• Basic principles for the selection of hybrid materials, including composites, sandwich panels, cellular composites, segmented structures, including practical examples;<br>• Computer technology in the field of material science |
| **Facilities and Equipment** | Optical microscopes, Hardness testers, X-ray diffractometer XRD-7000, Transmission electron microscope JEM-2100, Scanning electron microscope JSM-7500, Polymer specimen preparation line (grinders, mixers, extruders, thermopress, etc), Optical profilometer New View 6200, Nano indenter Nanotest 600 and G200 (MTS), Universal electromechanic Inston 5582 and hydraulic BiSS UTM 150 testing machines. |

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| **Grading Policy** | In accordance with the TPU rating system, the following system is used. Few tests conducts during the semester in order to assess the quality of theoretical and practical experience. The total score is 100 points. The course is considered successfully completed with a score above 55 points. |
| **Course Policy** | When assessing student score, attendance is taken into account. Students are expected to actively participate in discussions on the subject. Attendance is strictly controlled. |
| **Teaching Aids and Resources** | *International scientific journals: Physical Review, Journal of Material Science, Journal of Composite Materials, Metallurgical and Materials Transactions, Journal of Materials Strategy, Carbon, International Ceramic Review, Journal of Electronics Materials, Journal of Applied Physics, Journal of Applied Polymer Science, Composite Science and Technology.* |
| **Instructor (-s)** | Sergey V. Panin, svp@ispms.tsc.ru, 286904 |