TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name
Modern Methods of Structural Analysis in Materials Science

Field of Study: Major 22.04.01 Material Science and Technologies

Programme name: Materials Science

Level of Study: Master Degree Programme

Year of admission: 2019

Semester, year: 1, 2019

ECTS: 6
Total Hours: 216
Contact Hours: 64

- **Lectures:** 8
- **Labs:** 32
- **Practical experience:** 24

Assessment: exam

Division for Materials Science

Head of Division for Materials Science _____ Vasiliy A. Klimenov

Instructor(s) _____ Gulnara A. Voronova

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Course Name

Course Overview

Course Objectives	The subject is focused on training of specialists in the field of research and development of novel structural and functional materials. The students will obtain knowledge and skills in the field of computer simulation of materials and technological processes.
Learning Outcomes	Professional competency includes knowing of issues on the research and development of novel materials and structures, in particular: - materials for structural and functional applications for different industries, including electronics and medicine, and technology of surface hardening and coating; - principles for design of novel materials – nanostructured, smart, gradient and composite materials with ceramic, metal and polymer matrix; - technologic facilities and devices for surface hardening and coating deposition; - manufacturing processes for advanced materials; - methods for investigation of properties and diagnostics of loaded materials and structures; - physical and chemical models of materials and manufacturing processes; - law and regulatory issues of application of new materials.
Course Outline	The course involves lectures, laboratory works and practical classes and includes: - X-Ray analysis: background and main experimental technique. - Transmition and scanning electron microscopes.
Prerequisites (if available)	Theory of materials structure; Physical and mechanical properties of materials; Modelling and optimization of materials properties and technological processes
Course Structure	1. The Physics of X-rays. X-ray absorption. Obtaining and registration of x-rays. 2. The general theory of diffraction on crystal lattice. Geometrical interpretation of diffraction. The reflecting sphere. 3. The Multiplicity Factors of Intensity. Intensity measurements. 4. The most important X-ray methods. Interpretation of X-ray patterns. 5. A review of x-ray diffraction procedures as related to the quantitative analysis of particulates. X-ray analysis of alloy structures. 6. Transmission Electron Microscopy (TEM). Bright – field images, dark – field image. Microdiffraction. 7. Scanning Electron Microscopy. SEM, BSM images, X-ray energy analysis.
Facilities and Equipment	X-ray diffractometer, Transmission electron microscope, Scanning electron microscope, evaluating computer programs.
Grading Policy	In accordance with TPU rating system we use: - Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material and the results of practical activities (performance tests, perform tasks, problem solving). Max score for current assessment is 60 points, min – 40 points. - Course final assessment (exam/ credit test) is performed at the end of the semester. Max score for course final assessment is 40 points, min – 22 points. The final rating is determined by summing the points of the current assessment during the semester and exam (credit test) scores at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 80.
Course Policy	Class attendance will be taken into consideration when evaluating students' participation in the course. Students are expected to actively engage in class

	discussions about the assigned readings. Attendance is strictly controlled. All classes are obligatory to presence.
Teaching Aids and Resources	Main: 1. Structure from Diffraction Methods: Inorganic Materials Series 2. Duncan W. Bruce (Editor). ISBN: 978-1-119-95322-7. 360 pages. 2014. 3. Basic Concepts of X-Ray Diffraction. Emil Zolotoyabko. ISBN: 978-3-527-33561-9. 304 pages. 2014. 4. Basic Concepts of X-Ray Diffraction. Emil Zolotoyabko. ISBN: 978-3-527-33561-9. 304 pages. 2014 Additional: 1. Microscopy techniques for materials science. 2002. ISBN 1-85573-587-3. 2. Analytical electron microscopy for materials science. 2006. ISBN 4-431-70336-5 3. Microstructural Characterization of Materials. 2nd Edition. David Brandon Wayne D. Kaplan. ISBN: 978-0-470-02785-1. 550 pages. 2008. Internet: 1. http://portal.main.tpu.ru:7777/SHARED/v/KSN 2. http://e.lanbook.com/books/element.php?pl1_cid=25&pl1_id=8689
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