TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name
Modern polymer composite materials

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: 3, 2021

ECTS: 6
Total Hours: 216
Contact Hours: 64

- **Lectures:** 16
- **Labs:** 24
- **Practical experience:** 24

Assessment: exam

Division for Materials Science

Head of Division for Materials Science _____ Vasiliy A. Klimenov

Instructor(s) _____ Sergey V. Matrenin

Course Name

Course Overview

Course Objectives	Acquisition of system of knowledge and skills in the field of development of polymer composite materials for mechanical and electrical engineering.
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, practical classes and laboratory works. Application of finite element method for simulation of machining (milling, drilling, etc.) and metallurgical (casting, forging, rolling, etc.) processes;
Prerequisites (if available)	Materials Science; Polymer materials processing; Composite materials; Standardization and Metrology
Course Structure	• Polymer composite materials and their main properties, components of composite materials, compatibility of components, processability of components, mixing methods (dry mixing, compounding, sol-gel process). • Processing (manufacturing) methods (extrusion, injection molding, hot-melting pressing). • Estimation of main properties of polymer composite materials (electrical, mechanical, rheological, thermal, morphology).
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.
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 is obligatory to presence.
Teaching Aids and Resources	*Compulsory Readings:* 1. Штремель М.А. Материаловедение: неметаллические и композиционные материалы: курс лекций [Электронный ресурс]. - Москва: МИСИС, 2013. - 77 с. Схема доступа: https://e.lanbook.com/book/117282 2. Матренин С.В. Наноструктурные материалы в машиностроении: учебное пособие [Электронный ресурс] / С. В. Матренин, Б. Б. Овечкин. — Томск: Изд-во ТПУ, 2010. Схема доступа: http://www.lib.tpu.ru/fulltext2/m/2011/m33.pdf Бондалетова Л.И., Бондалетов В.Г. Полимерные композиционные материалы: учебное пособие [Электронный ресурс]. — Томск: Изд-во ТПУ, 2013. Схема доступа: http://www.lib.tpu.ru/fulltext2/m/2013/m280.pdf *Additional literature:* 1. Лабораторный практикум по химии и технологии полимеров [Электронный ресурс] учебное пособие: в 6 ч.:/ Н.М. Ровкина, А.А. Ляпков. — Томск : Изд-во ТПУ, 2010-2015. Схема доступа: http://www.lib.tpu.ru/fulltext2/m/2013/m377.pdf
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