TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name

Condition Monitoring and Reliability Inspection of Materials and Parts

Field of Study: Major 22.04.01 Material Science and Technologies

Programme name: Material Science

Level of Study: Master Degree Programme

Year of admission: 2019

Semester, year: 3, 2020

ECTS: 6
Total Hours: 216
Contact Hours: 48

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

Assessment: exam

Division for Materials Science

Head of Division for Materials Science _____ Vasiliy A. Klimenov

Instructor(s) _____ Sergey V. Panin

Course Name

Course Overview

Course Objectives	The aim of the subject is to introduce the principles and methods in the field technical diagnostics and non-destructive testing to be applied for different materials and structures. Special attention is paid to optical and acoustical methods and their combination, as well as to novel information technologies in material science.
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. Design and operation principles of structural health monitoring systems and basic of fracture mechanics for estimating materials mechanical state and predicting life time;
Prerequisites (if available)	Materials Science; Theory of materials structure; Physical and mechanical properties of materials
Course Structure	• Methods for non-destructive testing; • Acoustical methods for non-destructive testing and structural health monitoring: ultrasonic method, acoustic emission method, modal analysis for ultrasonic and low frequency methods, vibration-based methods; • Optical methods for condition monitoring (thin foil sensors) and strain gaging using resistive and optical fiber sensors; • Development of wireless (power supply and data transfer) sensors for structural health monitoring;
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: Domestic and international scientific and engineering journals* *Structural health monitoring, Engineering Structures, Smart Structures and Systems, Structural Control & Health Monitoring, Earthquake Engineering & Structural Dynamics, Iranian Journal of Environmental Health Science & Engineering, Sensors, Smart Materials & Structures* *Additional Readings: Domestic and international scientific and engineering journals* *Journal of Materials Research, Russian Chemical Bulletin, Computers & Structures, Engineering economics, Future Generation Computer Systems, Journal of Environmental Management* *Internet*: *http://shm.sagepub.com/*
Instructor (-s)	Sergey V. Panin, svp@ispms.tsc.ru, 286904