COURSE DESCRIPTION CARD - SYLLABUS

Course name
Surface engineering [S2MiBP1>IP]

Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
1/1

Area of study (specialization)
Railway Vehicles

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

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Lecturers

Prerequisites

Knowledge: The student should have knowledge of basic sciences, i.e. physics and chemistry, as well as knowledge of subjects carried out at the first degree of studies, i.e. physical chemistry, thermodynamics, material engineering, mechanics, material strength, machine construction. Skills: The student should demonstrate the general ability to identify problems, create algorithms, ways of solving them and the ability to solve engineering tasks. The student should understand the basic phenomena occurring in solids, be able to identify and characterize them. Social competences: The student is ready to deepen the knowledge of interdisciplinary subjects. The student is open to learning about new technologies and engineering solutions.

Course objective

The course covers the basic issues of surface engineering and tribology. The surface layer, coating, surface layer, proper surface layer, operational properties of the surface layer along with its general characteristics of the surface layer are discussed. The geometric structure of the surface, waviness and roughness, methods of measuring geometric structure parameters, block diagram of a typical profilometer, surface profile, measurement section, elementary section, surface roughness parameters, surface load capacity, material share, material length of a profile element are described. Hardness, Vickers method, Knoop method, others are characterized. Residual stresses, types of residual stresses, X-ray method of self-stress testing, Barkhausen effect are described Methods of analyzing the chemical composition of surface layers of solids, photoelectron spectroscopy (UPS, XPS), Auger electron spectroscopy (AES), X-ray fluorescence analysis (XRF), secondary ion mass spectroscopy (SIMS) and methods of analyzing the structure of surface layers of solids, microscopy electron microscopy (ME): transmission electron microscopy (TEM), scanning electron microscopy (SEM); tunnel spectroscopy: (FEM, FIM, STM) atomic force microscope (AFM), X-ray diffraction (XRD), reflectometry. Various methods of producing surface layers are described, such as mechanical, thermo-mechanical, thermal methods, thermo-chemical methods, chemical and electrochemical and physical methods.

Course-related learning outcomes

Knowledge:
Has extensive knowledge of the processes taking place in the surface layer of machine structural elements and surface engineering methods.
Has extensive knowledge of selected departments of technical mechanics related to the selected specialization.
He knows the main development trends in the field of mechanical engineering.

Skills:
He can correctly select the optimal material and its processing technology for typical parts of working machines, taking into account the latest achievements in material engineering.
Can program the technological process of manufacturing machine parts, including the development of a simple program to control the machine tool.
He can design the technology of exploitation of a selected machine with a high degree of complexity.

Social competences:
He is ready to critically assess his knowledge and received content.
It is ready to fulfill social obligations, inspire and organize activities for the benefit of the social environment.
It is ready to initiate actions for the public interest.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

-written verification

Programme content

1. Basic issues: surface engineering, tribology, surface layer, coating, surface layer, proper surface layer, sorption, adsorption, absorption, inner border of the surface layer, thickness of the surface layer, surface
2. Exploitation properties of the surface layer
3. Construction of the surface layer (zone)
4. General characteristics of the surface layer (division into descriptive and measurable features)
5. Geometric structure of the surface, waviness and roughness, methods of measuring the parameters of the geometric structure, block diagram of a typical profilometer, surface profile, measuring section, elementary section, surface roughness parameters, surface load capacity, material proportion, material length of the profile element
6. Microhardness, the Vickers method, the law of variable hardness, the Knoop method
7. Residual stresses, types of residual stresses, X-ray method of residual stress tests, Barkhausen effect
8. Methods for analyzing the chemical composition of surface layers of solids, photoelectron spectroscopy (UPS, XPS), Auger electron spectroscopy (AES), X-ray fluorescence analysis (XRF),

secondary ion mass spectroscopy (SIMS)
9. Methods of analyzing the structure of surface layers of solids, electron microscopy (ME): transmission electron microscopy (TEM), scanning electron microscopy (SEM); Tunnel spectroscopy: (FEM, FIM, STM) atomic force microscope (AFM), X-ray diffraction (XRD), reflectometry
10. Methods of producing surface layers, mechanical methods, thermal methods? mechanical, thermal methods, thermo-chemical methods, chemical and electrochemical methods, physical (essence, types, application)

Course topics

The classes cover aspects related to the structure of the surface layer of machine elements, ways of modifying it and its impact on properties, and methods of assessing it.

Teaching methods

Lecture with multimedia presentation

Bibliography

Basic
1. T. Burakowski: Aerologia. Powstanie i rozwój. Wyd. Instytutu Technologii Eksploatacji, Radom 2007.
2. T. Burakowski: Rozważania o synergizmie w inżynierii powierzchni. Wyd. Pol. Radomskiej 2007.
3. L.A. Dobrzański: Kształtowanie struktury i własności powierzchni materiałów inżynierskich i biomedycznych, Gliwice 2009
4. P. Kula: Inżynieria warstwy wierzchniej. Wyd. Politechniki Łódzkiej, Łódź, 2000.
5. A. Młynarczak: Obróbka powierzchniowa i powłoki ochronne. Wyd. Politechniki Poznańskiej, Poznań, 1998.
6. M. Kupczyk: Inżynieria powierzchni. Powłoki przeciwzużyciowe na ostrza skrawające. Wyd. Politechniki Poznańskiej, Poznań 2004.
7. Zb. Lawrowski: Tribologia-tarcie, zużycie, smarowanie. PWN, W-wa, 1993
8. St. Pytko: Podstawy tribologii i techniki smarowniczej. Wyd. AGH, Kraków, 1989
9. D. Ozimina: Przeciwzużyciowe warstwy wierzchnie w układach tribologicznych. Wyd. Politechniki Świętokrzyskiej. Kielce, 2002
10. L.A. Dobrzański, R. Nowosielski: Metody badania metali i stopów. Badania własności fizycznych. WNT, W-wa, 1987
Additional
1. K. Oczoś : Kształtowanie materiałów skoncentrowanymi strumieniami energii. Wyd. Politechniki Rzeszowskiej , Rzeszów, 1988.
2. J. Kusiński: Lasery i ich zastosowanie w inżynierii materiałowej. Wyd. ?Akapit", Kraków, 2000.
3. W. Waligóra: Odporność na zmęczenie powierzchniowe stali łożyskowej poddanej obróbce laserowej. Wyd. Politechniki Poznańskiej, Poznań. 1994.
4. M. Paczkowska: Ocena wpływu borowania laserowego na strukturę żeliwa sferoidalnego i odporność na zużycie elementów z niego wykonanych (rozprawa doktorska), Politechnika Poznańska 2007
5. M. Paczkowska: Kształtowanie odporności na zużycie tribologiczne elementów maszyn z żeliwa przez laserową obróbkę cieplną (LOC), Wydawnictwo PP, Poznań, 2016
6. L. A. Dobrzański.: Metaloznawstwo z podstawami nauki o materiałach, WNT, 1998;

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	10	0,50