# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | | Code |
|---|---|---|
| **Surface Engineering** | | **1010625211010610430** |
| Field of study: **Mechanical Engineering** | Profile of study (general academic, practical): **general academic** | Year /Semester: **1 / 1** |
| Elective path/specialty: **Internal Combustion Engines** | Subject offered in: **Polish** | Course (compulsory, elective): **obligatory** |
| Cycle of study: **Second-cycle studies** | Form of study (full-time,part-time): **part-time** | |
| No. of hours: Lecture: **9** Classes: **-** Laboratory: **-** Project/seminars: **-** | | No. of credits: **1** |
| Status of the course in the study program (Basic, major, other): **other** | (university-wide, from another field): **university-wide** | |
| Education areas and fields of science and art | | ECTS distribution (number and %) |

## Responsible for subject / lecturer:

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | Student is obligated to know about basic sciences like physics, chemistry and subjects carried out in I cycle of study like physical chemistry, thermodynamics, material engineering, mechanic, materials durability, machine designing. |
| 2 | **Skills** | Student should have general skills of problem identification, methods of their solving and skills of engineering tasks solving.<br>Student should understand basic phenomenon taking place in solid states,<br>and to be able to identify and characterized them. |
| 3 | **Social competencies** | Student shows the willingness of improvement of the knowledge of interdisciplinary subjects.<br>Student wants to getting to know about new technologies and engineering solutions. |

## Assumptions and objectives of the course:

The aim of the course: ?Surface engineering? is getting to know by student with the aspect of the most importation filed of material engineering in machines range, namely with designing, researching and application of surface layer and coatings.

## Study outcomes and reference to the educational results for a field of study

### Knowledge:

1. Has extensive knowledge about the processes occurring in the surface layer of machine construction elements, and surface engineering methods - [M2_W07]

### Skills:

1. Is able to correctly choose the machining technology for typical parts of working machines, taking into account the latest achievements in material engineering - [M2_U01]

### Social competencies:

1. Is ready to critically evaluate knowledge and content that received - [M2_K01]

## Assessment methods of study outcomes

- written examination

## Course description

1. Basic issues: surface engineering, tribology, surface layer, coating, surface layer, proper surface layer, sorption, adsorption, absorption, internal boundary of the surface layer, thickness of the surface layer, surface
2. Operational properties of the surface layer
3. Construction of the top layer (zones)

4. General characteristics of the surface layer (division into descriptive and measurable features)

5. Geometric structure of the surface, waviness and roughness, measurement methods of geometric structure parameters, block diagram of a typical profilometer, surface profile, measuring section, elementary section, surface roughness parameters, surface bearing capacity, material content, material length of the profile element

6. Microhardness, Vickers method, variable hardness law, Knoop method

7. Own stresses, types of internal stresses, X-ray method of stress stresses, Barkhausen effect

8. Methods of chemical composition analysis 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 for the analysis of the structure of surface layers of solid bodies, 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, thermo-mechanical methods, thermal methods, thermo-chemical methods, chemical and electrochemical methods, physical (essence, types, application)

## Basic bibliography:

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 bibliography:

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;

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. Preparation for lectures | 1 |
| 2. Participation in lectures | 9 |
| 3. Own learning on the basis of lecture | 8 |
| 4. Consultation | 1 |
| 5. Preparation for verification of knowledge | 5 |
| 6. Participation in verification of knowledge | 1 |

## Student’s workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 25 | 1 |
| Contact hours | 11 | 0 |
| Practical activities | 0 | 0 |