COURSE DESCRIPTION CARD - SYLLABUS

Course name
Surface engineering

Course

Field of study
Mechanical engineering
Area of study (specialization)
Mechanical technology
Level of study
Second-cycle studies
Form of study
part-time

Year/Semester
2/4
Profile of study
general academic
Course offered in
Polish
Requirements
elective

Number of hours

Lecture
8
Laboratory classes
Other (e.g. online)
Tutorials
8
Projects/seminars

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Prerequisites in terms of knowledge, skills and social competencies:
Knowledge: basic knowledge of materials technology, technical drawing, metrology and manufacturing techniques.
Skills: ability to design processes part like housing

Social competencies: understanding the need to broaden their competence, willingness to work in teams

Course objective

Learn the basics of surface engineering of machine parts and tools.

Course-related learning outcomes

Knowledge

A student who has completed the course can:

1. The student is able to define the surface engineering, surface layer and coating and list the basic zones of the surface layer
2. Student is able to list the basic methods of producing surface layers and wear-resistant coatings
3. Student is able to determine the components of technological quality and provide examples of parameters characterizing the usable quality of tools and machine parts
4. Student is able to divide hard and superhard coating materials due to their structure and dominant type of chemical bonds

Skills

A student who has completed the course can:

1. The student has the ability to self-study - searching on the Internet, analyzing and synthetic development of materials on a selected topic in the field of surface engineering
2. Student is able to determine the methods and methods of heat and thermo-chemical treatment of steel in order to obtain the desired mechanical properties
3. Student is able to list the basic characteristics of CVD and PVD techniques used in the production of wear-resistant coatings
4. Student is able to use understanding from the indicated sources of knowledge (list of basic literature)

Social competences

A student who has completed the course can:

1. The student is able to actively engage in project classes in solving the problems raised
2. The student is able to cooperate as part of a project team and fulfill their duties under the division of work within a team
3. The student is able to demonstrate responsibility for own work and joint responsibility for the effects of the work of the entire team in the form of demonstrating basic orientation in the scope of the entire project.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:

Lecture assessment based on colloquium or written exam (student's activity will be take into account for final mark). Mark criteria:
40,0%-55,0%.
55,1%-70,0%,

70,1%- 80,0%,
80,1%-90,0%,
90,1%-100%
Project:

Classes:

Elaborate a technological project for selected part like housing. The project should be largely carried out on the design class. To obtain a positive assessment of the student should demonstrate the orientation of the content and substantive of the project. This will be verified during the design review and discussions with the student. The final mark will also be taken of student activity during classes - carried out within a further entrusted tasks.

Programme content

LECTURES

1. Historical outline of surface engineering development.
2. Surface engineering and its thematic scope.
3. Surface layers
   - defining the concepts of surface layer, coating and core material (substrate),
   - the degree of saturation of the coherence forces of solid surface atoms,
   - simplified and detailed models of the top layer and substrate with anti-wear coating in a vacuum and gas environment,
   - coating zones and surface layer.
4. Technological and usable quality of the tool or machine part
   - defining the concepts of technological and usable (operational) quality of a tool or machine part,
   - parameters characterizing the technological and functional quality of the tool or machine part.
5. Anti-wear coatings
   - division of coatings by structure,
   - characteristics of simple and complex single-layer coatings (multi-component, metastable and multi-phase),
   - characteristics of multilayer coatings (from simple, complex, simple and complex and gradient materials),
   - division of coatings due to the dominant type of chemical bond (with the dominance of metallic, ionic and covalent bonds).
   - homogeneous areas of transition metal nitrides and carbides
6. Production of coatings by CVD methods.
   - basics of chemical deposition of hard-melting compounds (variants of the CVD process),
   - high, medium and low temperature CVD methods (HTCVD - APCVD,, MTCVD, PACVD),
7. Production of coatings by PVD methods.
   - characteristics of the PVD technique,

- types of ion - solid interaction depending on the kinetic energy of the ion,
- division of PVD methods in terms of methods of depositing material vapors onto the substrate.

Classes:
Preparation of a surface engineering topic (optional) from: implantation technique, ion and plasma techniques, tribological, mechanical and anti-corrosive properties of implanted materials, fluorescent treatments and ion sputtering, development of PVD technique, CVD and PVD techniques in shaping the surface properties of machine parts and tools, technological and operational properties of coatings deposited by PVD methods, tribological, anti-corrosive and decorative properties of coatings produced in a low-temperature plasma environment.

Teaching methods

Lecture: multimedia presentation illustrated with examples given on a board, problem solving.

Classes: solving practical problems, searching for sources, teamwork, discussion

Bibliography

Basic

1. Burakowski T., Wierzchoń T.: Inżynieria powierzchni metali. Wydawnictwa Naukowo- Techniczne, Warszawa 1995.
2. Burakowski T., Wierzchoń T., Surface Engineering of metals. CRC Press Boca Raton London New York Washington D.C., 1999.
3. Dobrzański L.A., Podstawy nauki o materiałach I metaloznawstwo, WNT Warszawa-Gliwice 2002.
4. Dobrzański L.A., Hajduczek E., Marciniak J., Nowosielski R., Metaloznawstwo i obróbka cieplna materiałów narzędziowych, WNT, Warszawa 1990.
5. Kupczyk M., Inżynieria powierzchni. Narzędzia skrawające. Wyd. Politechniki Poznańskiej, Poznań 2015.
6. Kupczyk M., Inżynieria powierzchni. Część I - Rodzaje i charakterystyka warstw powierzchniowych, . Wyd. Politechniki Poznańskiej, Poznań 2018.
7. Kupczyk M., Wytwarzanie i eksploatacja narzędzi skrawających z powłokami przeciwzużyciowymi. Wydawnictwo Politechniki Poznańskiej, Poznań 2009.
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9. Wysiecki M., Nowoczesne materiały narzędziowe, WNT, Warszawa 1997.

Additional

1. Bunshah R.F., Blocher J., Bonifield T., Fish J., Ghate P.B., Jacobson B., Mattox D., Mc Guire G., Schwartz., Thornton J., Tucker R., Deposition technologies for films and coatings - developements and applications, Noyes Publications, Park Ridge, New Jersey, USA 1994.
2. Glang R.: Vacuum evaporation. Handbook of thin film technology. Ed. R. Glang, McGraw-Hill Book Co., New York 1980.
3. Olszyna A.R., Ceramika supertwarda, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001.

4. Zdunek K., IPD. Plazma impulsowa w inżynierii powierzchni, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2004.

Breakdown of average student's workload

	Hours	ECTS
Total workload	16	4,0
Classes requiring direct contact with the teacher	8	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	8	2,0

[1] delete or add other activities as appropriate