COURSE DESCRIPTION CARD - SYLLABUS

Course name
Anti-wear surface layers created by welding methods [S1MiTPM1>PWWWMS]

Course

Field of study
Materials and technologies for automotive industry

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student has basic knowledge of physics, material science, chemistry, environmental protection, mechanics. Has the ability to think logically, use information obtained from the library and the Internet. Understand the need to learn and acquire new knowledge.

Course objective

To learn about welding methods of changing the properties of the surface layer by surfacing and hot spraying by various methods intended for the manufacture of new parts and regeneration of automotive parts.

Course-related learning outcomes

Knowledge:
1. Graduates know and understand the needs for producing antiwear surface layers by welding methods.
2. Student with on and understands the methods of surfacing with dissimilar additive materials in the form of powders and wires.
3. The graduate knows and understands the ways to non-invasively change the properties of the surface

layer by thermal spraying with different materials.
4. The graduate is able to make the selection of additive materials and coatings specified by the operating conditions of automotive parts.
5. The graduate understands the need for regeneration of automotive parts in relation to the logical economic and economic factor.

Skills:
1. The graduate is able to make a selection of additional material for surfacing and thermal spraying.
2. The graduate understands the need to prepare the family material before starting the process of changing the properties of the surface layer.
3. Graduates are able to select the process parameters of surfacing and thermal spraying.
4. Graduates are able to distinguish the effects of wear and tear such as abrasion, erosion, corrosion and assess the suitability and feasibility of remanufacturing automotive parts.

Social competences:
1. The student is able to cooperate in a group.
2. The student is aware of the role of automotive welded joint testing and inspection processes in the modern economy and for society.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: credit on the basis of an exam consisting of 5 general questions (credit in case of correct answers to min. 3 questions: <3 = ndst, 3 = dst, 3.5 = dst+, 4 = db, 4.5 = db+, 5 = bdb).
Laboratory: Credit on the basis of an oral or written answer on the content of each laboratory exercise performed, a report on each laboratory exercise as indicated by the instructor of laboratory exercises. In order to receive credit for the laboratory exercises, all exercises must be passed (a passing grade on the answer and a passing grade on the report).

Programme content

Characterization of the type and size of automotive components to be welded as a basic criterion for the selection of the method and apparatus in terms of low/high energy welding. Preparation of the parent material for welding, surfacing and thermal spraying as a key technological procedure determining the correct welding metallurgy, adhesion and cohesion of coatings. Define the apparatus facilities due to weight, dimensions and production scale in the high-volume aspect of automotive production. Define the human factor in modern welding production and justify the use of robotic welding systems in high-volume automotive production. Select the welding method with regard to energy density, heating and cooling dynamics, and obtaining the best possible welding results for components protected against corrosion with zinc coating. Performance of welded joints using modern welding materials in the form of solid and powder wires - analysis of SWC in terms of strength of welded and welded joints. Characterization of the number of cycles describing the service life of electrodes used in spot welding in the automotive industry. Qualitative analysis of joints made by low-energy arc, laser micro-plasma and electron beam methods. Analysis of the extent of the heat-affected zone in the aspect of welding with low-energy and high-energy methods due to the amount of heat introduced. Moreover, presentation the metallurgy of surfacing and thermal spraying of coatings intended for the production of new elements and regeneration. Distinction of the methods of operational load of parts of industrial systems and, in connection with this, the selection of the welding process and additional materials. Description of the change in the protective properties of surface layers as a function of the energy the welding process and the additional material type in the form of solid wires, cored wires and powders with their morphology and chemical composition in the aspect of use a conventional and ultra-fine-grained materials. Explanation of the methodology of surfacing and thermal spraying using heat sources in the form of a flame, electric arc, plasma jet, laser beam - with the division of these processes into low- and high-energy (supersonic).

Course topics

Lectures:
1. Characteristics of heat sources used in thermal spraying methods in automotive.
2. Classification of wear methods for automotive parts and ways to select coating materials for thermal

spraying and surfacing.
3. Metallurgy of thermal spraying and surfacing for methods with different energy density of the heat source.
4. Description of methods of surface preparation of automotive parts before the formation of a surface layer by welding methods.
5. Justification of the use of the method of changing the properties of the surface layer of automotive parts in ecological and economic aspects.
Laboratories:
1. Characterization of coating materials in the form of powder wire powders and solid wires.
2. Performance of surfacing by flame, arc-free and protective gas atmosphere methods in a low-energy variant.
3. Fabrication of protective coatings by thermal spraying methods using dissimilar coating materials in the form of solid wires and powder wires.
4. Determination of the effect of process parameters on the change of surface layer properties by changing the geometry of the surfacing and the surface condition of the coatings.

Teaching methods

Lecture: multimedia presentation, presentation illustrated by examples given on the blackboard, discussion of physical exhibits presented.
Laboratory: discussion of the issue by the lecturer in order to substantively prepare students for the course of the classes. Preparation of equipment, materials and details for analysis / technological process / laboratory operational tests. Registration of analysis and measurement results constituting the basis for preparing a report on the classes.

Bibliography

Basic:
1. Pawłowski L., The Science and Engineering of Thermal Spray Coatings, Wiley 2008
2. Klimpel A.,: Napawanie i natryskiwanie cieplne, WNT Warszawa 2000.

Additional:
1. Global scientific literature resources like SCOPUS, Elsevier, etc. for keywords or phrases - “thermal spraying, surfacing, automotive”.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	2,00
Classes requiring direct contact with the teacher	32	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	43	1,50