



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Bonding materials [S1MiBP1>SM]

### Course

Field of study

Mechanical and Automotive Engineering

Year/Semester

2/4

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

15

Other

0

Tutorials

0

Projects/seminars

0

### Number of credit points

2,00

### Coordinators

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### Lecturers

### Prerequisites

Knowledge: Basic knowledge of physics, chemistry, materials science, thermo-chemical treatment of metals and strength of materials and structures. Skills: Ability to use scientific and technical literature in Polish and English, the relevant standards and operating instructions for electrical and electronic devices. Social competences: Willingness to critically evaluate the knowledge acquired so far and to supplement this knowledge and practical skills, as well as to solve cognitive and practical problems by consulting experts in bonding.

### Course objective

The aim of the course is to familiarize students with the methods of bonding metal and non-metal materials and to develop the skills of their application in manufacturing or operational practice.

### Course-related learning outcomes

Knowledge:

1. Has knowledge of physics, including the basics of classical mechanics, optics, electricity and magnetism, solid state physics, quantum and nuclear physics, necessary to understand specialist lectures in the field of construction materials theory and materials science, theory of machines and mechanisms, theory of electric drives and mechatronic systems.
2. Has a basic, ordered knowledge of metal materials used in machine construction, such as alloys of iron, aluminum, copper, etc. used in machine construction, and in particular about their structure, properties, methods of production, heat and thermo-chemical treatment and the impact of machining plastic for their strength.
3. Has a basic, structured knowledge of non-metallic and composite materials used in the construction and operation of machines, mainly ceramic materials, synthetic materials, non-metallic natural materials (wood, glass, stone) and fuels, lubricants, technical gases, refrigerants, etc.

#### Skills:

1. Can obtain information from literature, the Internet, databases and other sources. Can integrate the obtained information, interpret and draw conclusions from it, and create and justify opinions
2. Is able to properly use modern equipment for measuring the main physical quantities used in machine research and production control.
3. Can design the technology of making a simple machine element and the technology of assembling and disassembling the machine.

#### Social competences:

1. Is ready to critically assess the knowledge and content received
2. Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in the event of difficulties in solving the problem on its own
3. Is ready to fulfill social obligations and co-organize activities for the benefit of the social environment.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:

- Written exam containing questions about the methods of joining materials, formulated by the lecturers in this subject;
- Passing laboratory exercises on the basis of a set of positively assessed reports from individual exercises, supported by questions and presence analysis.
- The threshold for passing the knowledge of the subject is 50% of the points obtained from the written exam, covering all the issues specified in the course programme.

### Programme content

The module programme covers the following topics:

1. Introduction to bonding materials
2. Essence (physics) and types of bonding
3. Gas (autogenous) welding
4. Electrical (arc) welding
5. Resistance, friction and pressure welding
6. Soldering and braze welding
7. Gluing materials
8. Assessment of the bonding quality of materials

### Course topics

The lecture programme covers the following topics:

1. Fundamentals and history of bonding. The essence of bonding. Cold and hot bonding. Types and mechanisms of bonding.
2. The physics and mechanisms of the welding connection. Divisions, types and classification of welds. Welding equipment and materials. Structure of the weld and joined materials after welding and their properties.
3. The essence, mechanism and technology of gas welding. Examples of gas welding and welding of plastics.
4. The essence and types of arc and hybrid welding. Welding MIG / MAG / TIG / GTAW. Arc welding

equipment and materials.

5. The essence, types and parameters of welding. Types of welded joints, e.g. resistance, friction, etc. Welding equipment.

6. The essence, types and parameters of soldering. Soldering materials and equipment. Braze welding technology. Braze welding parameters.

7. The essence of gluing and functions of adhesive joints. Types of adhesives and methods of their application. Assessment of the quality of glued joints.

8. Defects of joint structures and joined materials after bonding (especially after welding and fusing) and their properties. Destructive and non-destructive inspection of bonded joints, especially welded and fused joints. Quality standards for bonded joints, especially welded ones. Methods and organization of quality control.

The laboratory programme covers the following topics:

1. Health and safety instruction, and material gluing of structural components.

2. Diffusion bonding of structural components.

3. Welding of non-ferrous metal vehicle parts.

4. Adhesive bonding of materials (soldering, braze welding).

5. Joining of vehicle materials by resistance welding.

6. Assessment of welded joints by visual (VT), penetrant (PT) and magnetic particle (MT) methods.

7. Assessment of welded joints by ultrasonic method (UT).

### Teaching methods

Lecture with multimedia presentation.

Laboratory classes.

### Bibliography

Basic:

1. Sobieszcański J.: Spajanie. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2004.

2. Kolasa A.: Spajanie materiałów we współczesnej technice. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2010.

3. Tasak E.: Obróbka ubytkowa i spajanie. Uczelniane Wydawnictwo Naukowo-Dydaktyczne AGH, Kraków, 2021.

Additional:

1. Mirski Z.: Spajanie węglików spiekanych ze stalą. Wydawnictwo Politechniki Wrocławskiej, Wrocław, 2011.

2. Spajanie metali i tworzyw w praktyce. Czasopismo - kwartalnik, numery od 2004 r.

3. Polish-European Standards: PN-EN ISO 7500-1:2016-01. Badania niszczące spoin w metalach / Destructive testing methods of metal bonds.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00