Polish course name	**NOWOCZESNE MATERIAŁY I TECHNOLOGIE**
English course name	**MODERN MATERIALS AND TECHNOLOGIES**
Course code	**WIP-MDL-D1-MMAT-02**
Field of study	**Materials design and logistics**
Level of qualification	**First degree**
Form of study	**Full-time**
Semester	**2**
Number of ECTS points	**3**
Ways of assessment	**Test**

Number of hours per semester

Lecture	Seminar	Classes	Laboratory	Project
15			15	

TEACHERS:

Dr hab. inż. Józef Iwaszko, prof. PCz.

COURSE OBJECTIVES:

- **C1** Providing students with knowledge about modern engineering materials, including their structures, properties and applications.
- **C2** Acquainting students with selected modern technologies of manufacturing engineering materials.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES:

1. Knowledge of the basics of the science of the structure of matter.
2. Knowledge of the rules of work safety when using machines and technological devices.
3. Ability to use various sources of information, including manuals and technical documentation.
4. Ability to work independently and in a group.
5. Ability to correctly interpret and present the results of laboratory test.

COURSE CONTENT

LECTURE

- **L1** Basic criteria for the classification of composites.
- **L2** Characteristics of modern composite reinforcing fibers.
- **L3** Technologies for the production of modern composites.
- **L4** Powder metallurgy technology.
- **L5** Modern coating technologies.
- **L6 - L8** Modern carbon materials, including fullerenes, nanotubes and graphene
- **L9** Shape memory materials.
- **L10** Metallic glass, technologies for the production of amorphous materials, properties and application of metallic glasses.
- **L11 - L13** Nanomaterials, nanotechnologies - properties and selected manufacturing technologies.
- **L14** Superconductor, the phenomenon of superconductivity, properties and application of superconductors.
- **L15** Final test.

LABORATORY

- **Lab1, Lab2** Fibrous materials: glass, carbon, Kevlar and vectran fibers: microstructural studies and selected properties.
- **Lab3 - Lab5** Fiber-reinforced composite materials - contact method for the production of composites, microstructural tests and selected properties.
- **Lab6, Lab7** Composite materials reinforced with particles - determination of volume and weight fractions of the reinforcing phase.
- **Lab8, 9, 10** Materials produced by powder metallurgy methods - microstructural and mechanical tests of tool steels obtained by the traditional method and the powder metallurgy method.
- **Lab11** Shape memory materials - determination of the temperature characteristic for two-way transformation in the nitinol alloy.
- **Lab12** TBC (thermal barrier coatings) - microstructural studies.
- **Lab13, Lab14** Metallic glasses - microstructural and x-ray structure tests.
- **Lab15** Final test.

BASIC REFERENCES

1. A. Huczko, A. Dąbrowska, M. Kurcz, Grafen. Otrzymywanie, charakterystyka, zastosowania, Wydawnictwa Uniwersytetu Warszawskiego, 2016 r.

2. L.A. Dobrzański, Materiały Inżynierskie i projektowanie materiałowe. WNT, Warszawa, 2006 r.
3. L.A. Dobrzański: Zasady doboru materiałów inżynierskich z kartami charakterystyk, Wyd. Politechniki Śląskiej, Gliwice 2000 r.
4. Jerzy Nowacki, Spiekane metale i kompozyty z osnową metaliczną, Wydawnictwo-Naukowo-Techniczne 2005 r.
5. A. Huczko, M. Kurcz, M. Popławska, Nanorurki węglowe. Otrzymywanie, charakterystyka, zastosowanie, Wydawnictwa Uniwersytetu Warszawskiego, 2017 r.
6. Królikowski Wacław, Polimerowe kompozyty konstrukcyjne, Wydawnictwo Naukowe PWN, 2020 r.
7. Krzysztof Ziewiec, Szkła metaliczne otrzymywane z jednorodnej fazy ciekłej oraz z zakresu niemieszalności cieczy, Wydawnictwo Naukowe Uniwersytetu Pedagogicznego w Krakowie, 2012 r.
8. L. Dobrzański, G. Matula, Podstawy metalurgii proszków i materiały spiekane, Wydawca: International OCSCO World Press, 2012 r.
9. A. Boczkowska, G. Krzesiński, Kompozyty i techniki ich wytwarzania, 2016 r., Wydawnictwo: Politechnika Warszawska.

SUPPLEMENTARY REFERENCE MATERIALS

1. Nowicki Jan: Materiały kompozytowe, Wyd. Pol. Łódzkiej, 1993 r.
2. Boczkowski A., Kapuściński J., Puciłowski K., Wojciechowski S.: Kompozyty, Wyd. Pol. Warszawskiej, Warszawa 2000 r.
3. Michael F. Ashby, Dawid R. H. Jones: Materiały inżynierskie, własności i zastosowanie, t.1, WNT, Warszawa, 1995 r.
4. J. Iwaszko, M. Sajed, Technological Aspects of Producing Surface Composites by Friction Stir Processing - A Review, Journal of Composites Science (J. Compos. Sci.) 2021, 5, 323; DOI:10.3390/jcs5120323.
5. J. Iwaszko, K. Kudła, K. Fila, “Technological aspects of friction stir processing of AlZn5.5MgCu aluminium alloy”, Bulletin of The Polish Academy of Sciences, Technical Sciences , Vol. 66, (2018), 713-719. DOI: 10.24425/125338.
6. J. Iwaszko, K. Kudła, Effect of friction stir processing (FSP) on microstructure and hardness of AlMg10/SiC composite, Bulletin of The Polish Academy of

Sciences, Technical Sciences, Vol. 67, No. 2, 2019, DOI: 1 0.24425/bpas.2019.126530.

LEARNING OUTCOMES

› **EU1** The student is able to characterize the essence and properties of modern engineering materials.
› **EU2** The student is able to describe the application of modern engineering materials.
› **EU3** The student is able to discuss the technologies of producing modern engineering materials.
› **EU4** The student knows modern technologies for the production of engineering materials and can indicate their advantages over standard technologies.

TEACHING TOOLS

› Lecture with the use of audiovisual aids.
› Laboratory:
- measuring instruments and research apparatus,
- test stands for making test samples,
- examples of finished products and semi-finished products manufactured by various techniques.

WAYS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

› **F1**. Assessment of the mastery of the teaching material being the subject of laboratory tasks - final test.
› **P1**. Assessment of the mastery of the teaching material within the lectures - final test.

STUDENT WORKLOAD

Form of activity	Number of hours	ECTS
Contact hours with the teacher		
Lectures	15	0,6
Seminar		
Classes		
Laboratory	15	0,6

Project		
Test		
Exam		
Total contact hours	30	1,2
Student's own work		
Getting acquainted with the indicated literature	15	0,6
Preparation for seminar		
Preparation for classes		
Preparation for lab	15	0,6
Project preparation		
Consultation	4	0,16
Preparation for the test	11	0,44
Total student's own work	**45**	**1,8**
Total number of hours/ ECTS points for the course	**75**	**3,0**

ADDITIONAL INFORMATION

Timetable of classes	https://wip.pcz.pl/dla-studentow/plan-zajec/studia-stacjonarne
Information about the consultation (time + place)	https://wip.pcz.pl/dla-studentow/konsultacje-dla-studentow

MATRIX OF LEARNING OUTCOMES REALISATION

Learning outcome	**Reference of given outcome to outcomes defined for whole program**	**Course objectives**	**Course content**	**Ways of assessment**
EU 1	K_W03, K_W04, K_K02,	C1	L1, L2, L6 - L9, L11 - L15, Lab1 - Lab15	F1, P1
EU 2	K_W03,	C1	L1 - L4,	F1, P1

	K_W04, K_K02,		L6 - L15 Lab1 - Lab15	
EU 3	K_W03, K_W04, K_U03, K_K02,	C2	L3 - L5, L10 - L15 Lab1 - Lab15	F1, P1
EU4	K_W03, K_W04, K_U03, K_K02,	C2	L3 - L5, L10 - L15 Lab1 - Lab15	F1, P1

FORM OF ASSESSMENT - DETAILS

EU1 The student is able to characterize the essence and properties of modern engineering materials.

- 2,0 The student has not mastered the basic knowledge about the nature and properties of modern engineering materials.
- 3,0 The student has acquired a basic knowledge of the essence and properties of modern engineering materials.
- 3,5 The student has almost well mastered the knowledge of the essence and properties of modern engineering materials.
- 4,0 The student has mastered the knowledge of the essence and properties of modern engineering materials.
- 4,5 The student has almost very well mastered the knowledge about the essence and properties of modern engineering materials.
- 5,0 The student has mastered the knowledge of the essence and properties of modern engineering materials very well, is able to comprehensively characterize the properties of these materials and make a comparison with the properties of other materials.

EU2 The student is able to describe the application of modern engineering materials.

- 2,0 The student is not able to describe the application of modern engineering materials.
- 3,0 The student mastered the basic knowledge about the use of modern engineering materials.

- 3,5 The student has mastered the knowledge almost well and can correctly indicate the areas of application of modern engineering materials.
- 4,0 The student has mastered the knowledge well and is able to indicate the areas of application of modern engineering materials.
- 4,5 The student has mastered the knowledge almost very well and is able to indicate the areas of application and specific examples of the use of modern engineering materials to an almost very good degree.
- 5,0 The student has mastered the knowledge very well and is able to indicate the areas of application and specific examples of the use of modern engineering materials to a very good degree.

EU3 The student is able to describe the technologies of producing modern engineering materials.

- 2,0 The student does not have a basic knowledge of the technology of producing modern engineering materials.
- 3,0 The student has a basic knowledge of the technology of manufacturing modern engineering materials.
- 3,5 The student has almost well mastered the knowledge of the technology of producing modern engineering materials.
- 4,0 The student has mastered the knowledge of the technology of manufacturing modern engineering materials.
- 4,5 The student has almost very well mastered the knowledge of the technology of producing modern engineering materials.
- 5,0 The student has mastered the knowledge of the technology of manufacturing modern engineering materials very well and is able to discuss in detail the specificity of the processes underlying these technologies.

EU4 The student knows modern technologies for the production of engineering materials and is able to indicate their advantages over standard technologies.

- 2,0 The student does not know modern technologies for the production of engineering materials and is not able to indicate their advantages over standard technologies.
- 3,0 The student has a basic knowledge of modern technologies for the production of engineering materials and is able to indicate their advantage over standard technologies in a general manner.

- 3,5 The student has mastered the knowledge to an almost good degree about modern technologies for the production of engineering materials and to an almost good degree is able to indicate their advantage over standard technologies.
- 4,0 The student has a good command of the knowledge of modern technologies for the production of engineering materials and is able to show their advantage over standard technologies.
- 4,5 The student has almost very well mastered the knowledge of modern technologies for the production of engineering materials and is able to almost very well characterize their advantage over standard technologies.
- 5,0 The student has mastered the knowledge of modern technologies for the production of engineering materials and is able to characterize in detail their advantage over standard technologies.