



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Material science

### Course

Field of study

Aviation Engineering

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

1/1

Profile of study

general academic

Course offered in

Requirements

compulsory

### Number of hours

Lecture

30

Laboratory classes

15

Other (e.g. online)

0

Tutorials

Projects/seminars

### Number of credit points

1

### Lecturers

Responsible for the course/lecturer:

prof. dr hab. inż. Leszek Małdziński email:

leszek.maldzinski@put.poznan.pl

Responsible for the course/lecturer:

tel. 6166652238 Faculty of Civil Engineering and

Transport

### Prerequisites

Knowledge: The student should have knowledge of basic sciences, i.e. physics and chemistry, as well as knowledge of subjects carried out at the first degree of studies, i.e. physical chemistry, thermodynamics, mechanics, material strength, aviation construction.

The student should demonstrate the general ability to identify problems, create algorithms, ways of solving them and the ability to solve engineering tasks. The student should understand the basic phenomena occurring in solids, be able to identify and characterize them.

Social competences: The student is ready to deepen the knowledge of interdisciplinary subjects. The student is open to learning about new technologies and engineering solutions.



## Course objective

The aim of the course is to familiarize students with metals, plastics, ceramics and composites. In particular, getting acquainted with their structure and properties.

## Course-related learning outcomes

### Knowledge

Student has knowledge of significant directions of development and the most important technical achievements and other related scientific disciplines, in particular aviation engineering

### Skills

Student can obtain information from various sources, including literature and databases, both in Polish and in English, integrate them properly, interpret and critically evaluate them, draw conclusions, and comprehensively justify their opinions

### Social competences

Student is aware of the social role of a technical university graduate, in particular understands the need to formulate and transfer to the society, in an appropriate form, information and opinions on engineering activities, technological achievements, as well as the achievements and traditions of the profession of an aviation engineer

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written verification

## Programme content

Classification of basic groups of engineering materials: metals and their alloys, plastics, ceramics and glass, composites.

Technical metals and metal alloys. Crystalline structure and polymorphism. Kinds of crystalline structure defects and their influence on the properties. Phases in metal alloys – solid solutions, carbides, nitrides, intermetallic phases, non-metallic inclusions. Phase equilibrium systems and their practical utilization for the selection of alloy microstructure and properties. Fe-Fe<sub>3</sub>C diagram. kinds of phases in iron alloys. Transformations taking place in steels. Carbon steels, alloy steels. Cast steels. Cast irons. Hardenability, influence of alloy additives on steel hardenability. Purposes and bases of heat treatment operations. Basic kinds of heat treatment. Kinds of annealing. Hardening and tempering. Non-ferrous metals. Application of metals in aviation construction.

Plastics, polymer structure, covalent and van der Waals bonds, crystalline and amorphous structure, manufacturing methods, polymer processing, molding, properties, types (plastomers, elastomers), examples of use.

Selected properties of ceramic materials and composites their assessment: general properties (density,



viscosity, melt index, mechanical properties (yield stress, elongation relative at the yield point, tensile strength, modulus of elasticity in tensile, bending strength), impact strength (Charpy, Isolde method), hardness (Rockwell, pressing the ball).

Selected properties of ceramic materials; dielectricity, poor electrical conductivity, resistance to heat shocks, asymmetry of compressive and tensile strength

Processing of ceramics; forming by: rolling, drawing, spreading, blow ironing, glass fiber drawing, isostatic ironing (e.g. candles ignition), extruding with a screw press, turning (in plaster and on a mold plaster), casting in plaster mold. Special ceramic materials and their properties and used in industry: carbon fibers, diamond, nanotubes, fullerenes.

Special types of composites, their properties and application: metal matrix composites particle hardening, dispersion hardening, sinters based on non-ferrous metals, metal-ceramic, sintered carbides, cermets, fiber composites, layer composites.

Composites manufacturing methods:

Selection of engineering materials for the construction of selected engineering structures: for a beam, for a mirror telescope, on some elements of the car (bodywork, bumpers), on elements of houses (e.g. walls external-bearing).

### Teaching methods

Lecture with multimedia presentation

### Bibliography

Basic

1. L. A. Dobrzański: Podstawy nauki o materiałach i metaloznawstwo, WNT, Gliwice 2002
2. K. Przybyłowicz, J. Przybyłowicz, Materiałoznawstwo w pytaniach i odpowiedziach, WNT, 2009
3. M. Ashby i in.: Inżynieria materiałowa tom I i II, Wydawnictwo Galaktyka, 2006
4. M. Ashby i in.: Materiały inżynierskie tom I i II, WNT, 1996
5. W. Domke: Vademecum materiałoznawstwa, NT, 1997
6. L.A. Dobrzański, R. Nowosielski: Metody badania metali i stopów. Badania własności fizycznych. WNT, W-wa, 1987

Additional

1. Mały poradnik mechanika, tom I i II, WNT, 2002
2. L. A. Dobrzański.: Metaloznawstwo z podstawami nauki o materiałach, WNT, 1998;



### Breakdown of average student's workload

	Hours	ECTS
Total workload	30	1,0
Classes requiring direct contact with the teacher	20	0,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	15	0,5

<sup>1</sup> delete or add other activities as appropriate