

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject Metal Science and Heat Treatment		Code 1010601221010610179
Field of study Transport	Profile of study (general academic, practical) (brak)	Year /Semester 1 / 2
Elective path/specialty -	Subject offered in: Polish	Course (compulsory, elective) obligatory
Cycle of study: First-cycle studies	Form of study (full-time, part-time) full-time	
No. of hours Lecture: 2 Classes: - Laboratory: 1 Project/seminars: -		No. of credits 4
Status of the course in the study program (Basic, major, other) (brak)		(university-wide, from another field) (brak)
Education areas and fields of science and art technical sciences		ECTS distribution (number and %) 4 100%
Responsible for subject / lecturer: dr hab. inż. Leszek Małdziński, prof. nadzw. email: leszek.maldzinski@put.poznan.pl tel. +4861 665-2238 Wydział Maszyn Roboczych i Transportu ul. Piotrowo 3 60-965 Poznań		
Prerequisites in terms of knowledge, skills and social competencies:		
1	Knowledge	Basic knowledge of metallurgy and heat treatment of metals: structure of metals and alloys, carbon and alloy steels, non-ferrous metal alloys, corrosion of steel, properties and application in practice.
2	Skills	Conduct some research in the field of metallurgy and heat treatment and testing properties of alloys and steels: annealing, hardening and tempering, nitriding and carburizing, metallographic examination (determination of hardness, thickness of diffusion layers, etc.).
3	Social competencies	The student is aware of the validity of technical activities, understands the need for the development and training
Assumptions and objectives of the course: Knowing the theoretical construction of metals and alloys. Understanding the basics of heat treatment and thermochemical treatment of steel and metals and their alloys. Knowing the species of non-alloy and alloy steels, their physical properties and performance and their application in practice		
Study outcomes and reference to the educational results for a field of study		
Knowledge: 1. Basic knowledge of metallurgy and heat treatment of metals: structure of metals and alloys, carbon and alloy steels, non-ferrous metal alloys, corrosion of steel, properties and application in practice - [K1A_W09]		
Skills: 1. Conducting some research in the field of metallurgy and heat treatment and study the properties of alloy steels: annealing, hardening and tempering, nitriding and carburizing, metallographic examination (determination of hardness, thickness of diffusion layers etc.). The student can obtain information from literature and databases, to interpret and justify opinions - [K1A_U03]		
Social competencies: 1. Consciousness of responsibility for their own work, willingness to comply with the rules of working in a team and take responsibility for collaborative tasks otowość podporządkowania się zasadom współpracy w zespole oraz ponoszenia odpowiedzialności za wspólnie realizowane zadania - [K1A_K04]		
Assessment methods of study outcomes		
Written and oral examination; written and oral exam		
Course description		

General characteristics of the material

The importance of materials in the manufacture process; manufacturing processes, the materials used in manufacturing processes.

Basic groups of engineering materials; metals and their alloys, polymers, ceramics, composites.

The structure of metals

Structure of matter; matter and its components, atomic structure, classification of chemical elements, the bond between the atoms.

The actual structure of metals; classification of defects in the crystalline structure, point defects, dislocations, the interaction between dislocations, the polycrystalline structure of metals, grain boundaries and interphase boundaries, the influence of defects on the properties of the crystalline structure of metals.

Metal alloys and their structure

Metal alloys and alloy phase, the overall message of metal alloys, solid solutions, intermetallic phases, interstitial phase, a mixture of phases.

Alloys of iron with carbon

Iron-carbon system; iron and its properties, the balance chart iron-carbon phase transformations during cooling with carbon iron alloys, iron alloys general classification of carbon.

Cast iron coal; general classification of carbon cast iron, graphite cast iron as a structural component, the effect of cooling rate on structure and properties of cast iron, ductile iron, cast iron and half-white, malleable cast iron, cast iron coal properties comparison.

Heat treatment of steels

General description of the heat treatment,

Phase transitions occurring during the heat treatment of steel; changes taking place in the steel during: heating, cooling, hardening, tempering, precipitation hardening,

Thermo-chemical treatment of steel

Theoretical basis of thermo-chemical treatment ; thermo -chemical and its classification, chemical phenomena occurring during thermo-chemical treatment

Diffusion saturation of non-metals and metals steel ; carburizing, nitriding, bonding , diffusion saturation of steel metallic elements , complex thermo -chemical

The role of alloying elements in the steels

The importance of the alloying elements : dissolved in solutions of solids, carbides and nitrides , intermetallic phases ,

The effect of alloying elements on the basic properties of steel and other ferrous alloys

Alloy steels and their meaning

Distribution of alloy steels

Alloy structural steels and heat treatment ; general characteristics , low-alloy structural steels weldable structural steels for quenching and tempering , structural steels for nitriding and carburizing , spring steels , alloy steels for rolling bearings .

Alloyed tool steels and heat treatment ; general characteristics , alloy tool steel for cold work tool steels alloyed hot work , high-speed steels .

Steels and alloys of iron with special properties ; general characteristics , corrosion-resistant steels , alloy steels for use at elevated temperatures, heat-resistant and heat resistant steels , steels for use in low temperature , precipitation hardened martensitic type ? maraging ? , abrasion resistant steels , steels and alloys with special magnetic properties

Cast iron and cast steel alloy

Alloy cast iron ; general characteristics of alloyed cast iron , cast iron with high wear resistance , cast iron alloy corrosion resistant , heat-resistant alloy cast iron and heat resistant cast iron alloy for low temperature alloy cast iron with special physical properties.

Cast steel alloy : general characteristics of the alloy cast steel , alloy structural steel , alloy steel corrosion-resistant , heat-resistant alloy steel and heat resistant , cast alloy tool .

Non-ferrous metals and their alloys

Copper and its alloys ; general classification of copper alloys , brass , copper-nickels , tin bronzes, aluminum , manganese bronze , beryllium bronzes , brown silicon

Aluminium and its alloys ; general classification aluminum alloys, aluminum alloys with silicon , aluminum and magnesium alloys , aluminum alloys with copper , multicomponent alloys of zinc , aluminum alloys with manganese

Other non-ferrous metals and their alloys; nickel, nickel alloys , zinc and its alloys, magnesium and its alloys, tin and lead and their alloys, refractory metals , cobalt and its alloys , precious metals and their alloys , non-ferrous metal alloys with shape memory

Corrosion of metals and alloys

Basic bibliography:		
1. S. Rudnik: Metaloznawstwo. PWN, Warszawa, 1996		
2. F. Staub; Metaloznawstwo, 1979		
3. W. Luty [i in.]: Poradnik inżyniera. Obróbka cieplna stopów żelaza, 1977		
4. L. Dobrzański: Metaloznawstwo z podstawami nauki o materiałach. WNT, Warszawa, 1996		
5. S. Prowans: Metaloznawstwo. PWN, Warszawa, 1988		
6. K. Przybyłowicz: Metaloznawstwo. WNT, Warszawa, 1996		
7. L. A. Dobrzański: Metaloznawstwo i obróbka cieplna,		
8. L. A. Dobrzański: Podstawy nauki o materiałach i metaloznawstwo, WNT, Gliwice 2002		
9. Karol Przybyłowicz, Janusz Przybyłowicz, ?Materiałoznawstwo w pytaniach i odpowiedziach? , Wydawnictwo Naukowo-Techniczne, 2004		
Additional bibliography:		
1. Michael Ashby i in.: ?Inżynieria materiałowa? tom I i II, Wydawnictwo Galaktyka, 2006		
2. Michael Ashby i in.: ?Materiały inżynierskie? tom I i II, WNT, 1996		
3. Poradnik Inżyniera: ?Obróbka cieplna metali?, WNT, 1979		
4. Mały poradnik mechanika, tom I i II, WNT1999		
5. Wilhem Domke: ?Vademecum materiałoznawstwa?, NT, 1997		
6. Feliks Wojtking, Jurij Soncew: Materiały specjalnego przeznaczenia, Wydawnictwo Politechniki Radomskiej, 2001		
Result of average student's workload		
Activity		Time (working hours)
Student's workload		
Source of workload	hours	ECTS
Total workload	100	5
Contact hours	45	2
Practical activities	15	1