GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Materials Science I, PG_00055734		
Field of study	Mechanical and Medical Engineering		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Materials Engineering and Bonding -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Szkodo	
	Teachers	dr inż. Grzegorz Gajowiec dr hab. inż. Marek Szkodo dr inż. Łukasz Pawłowski dr inż. Gabriel Strugała dr inż. Magdalena Jażdżewska dr inż. Marcin Wekwejt	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	0.0	30.0	0.0	0.0	75
	E-learning hours included: 0.0						
	Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=10201						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	75	2.0	48.0	125

Subject objectives	The aim of the course is to familiarize students with the structure of various groups of engineering materials, both at the atomic and microscopic level. Students learn about different types of crystal lattices occurring in metal and ceramic materials, and the defects of these lattices and their influence on macroscopic properties, learn about the types of phases occurring in alloys and learn to read information from the phase equilibrium systems of two-component alloys. They will learn the Fe-Fe3C equilibrium system.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U09] he/she is able to select proper constructive materials to design the device	Is able to use the available ones tools (catalog cards, standards, literature) for selection purposes suitable material for given purpose.	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W04] he/she has skills in the field mechanical testing of materials used in engineering and mechanical-medical area	Has basic knowledge theoretical, can indicate important properties of various materials and uses your knowledge to the issues practical.	[SW1] Assessment of factual knowledge
[K6_U07] he/she is able to identify the problem and list simple engineering tasks to solve this problem in practice, he/she is able to critically analyze the proposed technical solutions and conclude whether these solutions can be implemented to solve problems related to design of mechanical devices and mechanical-medical devices	Can solve a simple problem scientific and technical, plan experiment, analyze obtained results and formulate them appropriate conclusions. [SU3] Assessment of utilization skills knowledge obtained within item	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

Matter and its components. Interatomic bonds. Technical materials: natural and engineering relationshipsstructure, properties and applications. Crystalline, amorphous, glassy bodies. Basic characteristicsmain groups of engineering materials. Technological processes for obtaining metals and alloys.Basic metal alloys. Ceramic materials: structure and application. Polymeric materials: structure andapplication. Characteristics of composite materials. Structures of materials. Description of crystalline bodies:spatial network, nodes, lines and network planes. Types of spatial network. Miller Indicators. Networksspatial metals. Structures of ceramic materials. Structures of polymeric materials. Defectscrystal structure. Point defects: Frenkel and Schottky defects, vacancies. Diffusion: equationsdiffusion, interstitial, vacancy, rotational (exchange) diffusion mechanisms. The influence of point defectson diffusion and methods of use. Linear defects: alignment errors and dislocations. Unit dislocations ipartial, edge and screw dislocations. Movement of edge dislocations. Burger outline and vector.Low- and high-angle grain boundaries, angle of disorientation, conjugate, non-conjugate and semi-conjugate boundaries.The influence of point defects on mechanical properties. Structure of metal alloys. Solid solutionsintrastitial and interstitial, continuous and discontinuous. Superstructures. Strengthening solid solutions in processestechnological. Intermetallic phases: Laves, electronic. Interstitial phases. Balance systemsphase. Thermodynamic equilibrium. The concept of component and phase. Leverage rule. Gibbs phase rule.Phase equilibrium systems. Two-component phase equilibrium systems. Lack of elementssolubility in solid and liquid states. A system of elements with no solubility in the solid state.A system of elements with excellent mutual solubility in the solid state. A system of elements with partial solubility in the solid state with a eutectic and eutectoid mixture. A system of elements with partial solubility in the solid state with a peritectic and peritectic mixture. Ternary phase equilibrium systems. Four-component phase equilibrium systems. Iron-carbon and iron-cementite phase equilibrium systems. Phase and structural components: ferrite, austenite, primary, secondary and tertiary cementite, pearlite and ledeburite. Phase transformations during cooling of iron-carbon alloys. Receiving materials. Crystallization. Thermodynamic equilibrium of crystallization and subcooling. Crystallization nuclei. Homogeneous and heterogeneous nucleation. Crystallization kinetics. Manufacturing technologies: foundry and powder metallurgy. Forging. Plastic deformation mechanisms: slip and twinning. Recrystallization and recovery. Basics of heat treatment. Forms of heat treatment. Heat treatment of steel. Transformations of steel during cooling. Martensitic, bainitic and pearlitic transformation. CTP curves. Transformations of steel during heating. Selection of heating time and medium. Bainitic and martensitic hardening. Surface hardening. The concept of hardenability. Letting go. Structures of tempered steels. Sub-zero machining. Oversaturation and aging. Material properties. Physical properties: density, magnetic properties. Chemical properties: corrosion resistance. Mechanical properties: tensile, compressive, bending and fatigue tests. Hardness and microhardness tests. Material degradation. Brittle cracking. Material fatigue. High temperature degradation. Chemical, electrochemical and biological corrosion. Cavitation erosion. Iron alloys. Alloyed and unalloyed steels. Carbon and alloy cast steel. Carbon and alloy cast irons. Structures and applications.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
written exam, exam time 45 min	50.0%	100.0%

Recommended reading	Basic literature	1. Metal science. M. Głowacka (ed.). Gdańsk University of Technology, Gdańsk, 1996 (also: Gdańsk University of Technology website).2. Przybyłowicz K.: Metaloznawstwo. WNT, Warsaw, 1992.3. Dobrzański L.A.: Basics of materials science and metal science. WNT, Warsaw, 2002.4. Dobrzański L.A.: Engineering materials and material design. WNT, Warsaw, 2005.5. Przybyłowicz K., Przybyłowicz J.: Materials science in questions and answers. WNT, Warsaw, 2007.
	Supplementary literature	1. Ashby F.A., Jones D.R.: Engineering materials. Volume I and II. WNT, Warsaw, 1995.2. Callister W.D.: Materials Science and Engineering. Wiley and Sons,2000-2006.3. Dobrzański L.A.: Metal engineering materials. WNT, Warsaw, 2004.
	eResources addresses	Podstawowe https://www.scribd.com/doc/97339990/Materia%C5%82y-in%C5%BCynierskie-i-projektowanie-materia%C5%82owe-Leszek-Dobrza%C5%84ski - Uzupełniające Adresy na platformie eNauczanie: Materiałoznawstwo IMM sem. I, studia I stopnia - Moodle ID: 33414 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33414
Example issues/ example questions/ tasks being completed		1. List the types of atomic bonds, indicate strong and weak bonds and schematically draw the bondmetallic 2. Draw a graph explaining the dependence of the mechanical properties of metals on the density of dislocations in themcrystal lattice 3. Draw and describe the phase (structural) equilibrium diagram of two components that do not interact with each otherdissolve in the solid and eutectic state. Calculate the phase percentages using the leverage rulein thermodynamic equilibrium and indicate their chemical compositions on the graph. 4. Discuss the dispersion hardening of Al alloys.
Work placement	Not applicable	

Document generated electronically. Does not require a seal or signature.