GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Structural Research of Materials, PG_00059039		
Field of study	Materials Engineering, Materials Engineering, Materials Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Optional subject group 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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Materials Science and Technology -> Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Szkodo	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

E-learning hours included: 0.0

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	45	5.0	50.0	100

Subject objectives

The aim of the course is to familiarize students with the content of the subject and to achieve the assumed educational goals introducing students to:

1. Construction and principle of operation of light and electron microscopes.

2. Techniques of microscopic observations using various microscopes.

3. Preparation of samples for microscopic examination for various microscopic observation techniques.

4. Computer analysis of images obtained using microscopes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U01	Student Is able to select appropriate methods of obtaining contrast using a light and electron microscope.	[SU3] Assessment of ability to use knowledge gained from the subject
K6_U02	Student is able to operate light microscopes.	[SU3] Assessment of ability to use knowledge gained from the subject
K6_W06	Student can choose the right eyepiece for the selected lens	[SW1] Assessment of factual knowledge
K6_W04	Student Is able to select appropriate methods of obtaining contrast using a light and electron microscope.	[SW2] Assessment of knowledge contained in presentation
K6_K01	Student understands the need to improve competences in working with microscopes	[SK2] Assessment of progress of work

Subject contents	Lecture: Basics of optical microscopy: total and useful magnification and resolving power of the microscope. Microscopic examination methods: observations in bright and dark fields using polarized light, using phase contrast, and interference contrast. High temperature microscopy. Preparation of preparations for testing. Computer analysis of microscopic images. Image transformation methods. Methods for determining the volume fraction of structure components. Transmission electron microscopy: resolving power, lenses for the electron beam, electron lens errors. Microscope structure: electron gun, condenser lens system, magnifying system, preparation chamber. Contrast and diffraction in an electron microscope: diffraction and interference contrast, electron diffraction. Sample preparation: replicas, two-stage replicas, extraction replicas, thin metallic foils. Lecture: Basics of optical microscopy: total and useful magnification and resolving power of the microscope. Microscopic examination methods: observations in bright and dark fields using polarized light, using phase contrast, and interference contrast. High temperature microscopy. Preparation of preparations for testing. Computer analysis of microscopic images. Image transformation methods. Methods for determining the volume fraction of structure components. Transmission electron microscopy: resolving power, lenses for the electron beam, electron lens errors. Microscope structure: electron gun, condenser lens system, magnifying system, preparation chamber. Contrast and diffraction in an electron microscope: diffraction and interference contrast, electron diffraction. Sample preparation: replicas, two-stage replicas, extraction replicas, thin metallic foils.Laboratory: Preparation of metallographic sections: Section preparation operations: cutting, grinding, polishing, etching. protecting the edges of the sample against rounding. Methods of polishing specimensLecture: Basics of optical microscopy: total and useful magnification and resolving power of the microscope. Microscopic examination methods: observations in bright and dark fields using polarized light, using phase contrast, and interference contrast. High temperature microscopy. Preparation of preparations for testing. Computer analysis of microscopic images. Image transformation methods. Methods for determining the volume fraction of structure components. Transmission electron microscopy: resolving power, lenses for the electron beam, electron lens errors. Microscope structure: electron gun, condenser lens system, magnifying system, preparation chamber. Contrast and diffraction in an electron microscope: diffraction and interference contrast, electron diffraction. Sample preparation: replicas, two-stage replicas, extraction replicas, thin metallic foils. in, advantages and disadvantages of individual methods. Beilbi layer and its influence on sample digestion. Purposes of microscopic observations of etched and unetched specimens. Methods of digestion of specimens. Division of digestion methods according to their effects. Construction and principle of operation of SEM. Metallographic observations in bright field, dark field and polarized light: Construction and principle of operation of a light microscope. Resolving power of the microscope, useful magnification of the microscope. Selecting an eyepiece for the lens used. Metallographic observations on SEM. Determining the volume fraction of phases: Image types. Transforming images. Filters and morphological transformations. Quantitative determination of the volume fraction of phases. Using SEM to analyze the chemical composition of the preparation.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
colloquium at the end of the semester	50.0%	50.0%
Doing all practical exercises and passing them	100.0%	50.0%

Recommended reading

Basic literature

1. Szumer A., Ciszewski A., Radomski T.: Badania własności i mikrostruktury materiałów. Oficyna Wydawnicza P.W. Warszawa 2000

2. Dobrzański L. A., Hajduczek E.: Metaloznawstwo i obróbka cieplna stopów metali. Mikroskopia świetlna i elektronowa. WNT Warszawa 1987.

3. Przybyłowicz K.: Metody badań metali i stopów. Wydawnictwo AGH Kraków 1997

4. Kozubowski J.: Metody transmisyjnej mikroskopii elektronowej. Wyd. Śląsk, Katowice 1975 5. Barbacki A. Mikroskopia elektronowa. Wyd. Politechniki Poznańskiej, Poznań, 2005.

	Supplementary literature	1. Watt Ian M.: The principles and practice of electron microscopy, Cambridge University Press, Cambridge, 1985. 2. Wilkers P.: Fizyka ciała stałego. PWN, Warszawa 1979. 3. Szummer A.: Podstawy ilościowej mikroanalizy rentgenowskiej. Wyd. N-T, Warszawa, 1994.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Select the microscope eyepiece with an objective with 60x magnification and 0.5 aperture. Describe ways of obtaining contrast on light microscopes What is the Beilbi layer and how does it affect microscopic observations?	
Work placement	Not applicable	

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