GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00069420		
Field of study	Nanotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	4	Language of instruction	Polish
Semester of study	7	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Agnieszka Witkowska	
	Teachers	dr hab. inż. Agnieszka Witkowska	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	10.0	0.0	0.0	5.0	0.0	15

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	15	2.0	33.0	50

Subject objectives

The aim of the course is to familiarize students with the principles of synchrotron radiation generation and its unique research potential. Students will gain knowledge of advanced experimental techniques, particularly spectroscopic methods, applied in the analysis of nanomaterials. An important component of the course is the development of practical skills related to preparing professional beamtime proposals for synchrotron beamlines and understanding the procedures of conducting research in large international research facilities.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W06	The student possesses knowledge of the correlations between specific material properties (including electronic and structural properties at the atomic, nano-, and microscale) and advanced research methods based on synchrotron radiation, which can be applied to their analysis.	[SW1] Assessment of factual knowledge
K6_W07	The student has knowledge of advanced research methods employing synchrotron radiation, particularly spectroscopic techniques, and their application in the study of nanomaterials.	[SW1] Assessment of factual knowledge
K6_U06	While preparing an application for beamtime on a synchrotron experimental beamline, the student acquires the ability to present a scientific and/or technological problem clearly and accurately, in a manner understandable to reviewers who are often specialists in fields related to, but not identical with, the subject of the proposed research project.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject

<table>
<tr><td>Subject contents</td><td>Course content – lecture

Lecture:

1. Introduction: a brief history of synchrotron radiation (SR)
2. Electron motion in E and B fields and radiation of a relativistic electron
3. Sources of SR and methods of its generation
4. Properties of SR
5. Interaction of EM radiation with matter
6. Research methods available at synchrotron laboratories
7. X-ray spectroscopy methods
8. Examples of SR applications in nanomaterials spectroscopy

Project:

1. Introduction:

• Design of a measurement station
• Research techniques available at the Polish synchrotron SOLARIS
• General rules and access criteria for SR

2. Research proposal for access to a synchrotron beamline:

• Discussion of the proposal template and presentation of sample applications
• Development of an original research project aimed at investigating selected properties of a material (e.g., produced and analyzed as part of the students engineering diploma project)
• Preparation of a professional proposal for beamtime allocation at a chosen synchrotron experimental beamline to carry out the measurement project</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Mastered basic laws and issues in the field of electromagnetism, quantum physics and materials physics.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written examination (open questions and/or multiple choice test) on the content presented during the lecture</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Preparation and submission of an application for beamtime at the synchrotron experimental beamline</td><td>100.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>[1] Kowalski B., Paszkowicz W. (Editors) (2024) Promieniowanie synchrotronowe w fizyce i chemii ciała stałego: wybrane zagadnienia, UAM Publishing (in Polish)

[2] Attwood , D., & Sakdinawat , A. (2017). X Rays and Extreme Ultraviolet Radiation : Principles and Applications (2nd ed.). Cambridge: Cambridge University Press.

[3] Wllmott P. (2011), An introduction to synchrotron radiation : techniques and applications, John Wiley & Sons, Ltd.,</td></tr>
<tr><td>Supplementary literature</td><td>[1] Jens Als Nielsen, Des McMorrow (2011) Elements of Modern X ray Physics. John Wiley & Sons, Ltd.</td></tr>
<tr><td>eResources addresses</td><td>Supplementary
https://synchrotron.uj.edu.pl/ - Information about the Polish synchrotron SOLARIS. USERS tab: User ABC, access rules, and application process.</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Structure and operation of a synchrotron (basic methods of SR generation).

Properties of synchrotron radiation.

List and briefly describe two research methods that use synchrotron radiation.

Classify and briefly characterize X-ray spectroscopy methods according to a selected criterion.</td></tr>
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Practical activites within the subject	Not applicable

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