Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00DEGKL-0023	Name of the course	Polish	**Inżynieria Molekularna**	
			English	**Molecular Engineering**	
Type of the course	Specialty subjects				
Course coordinator	Prof. dr hab. inż. Tomasz Ciach				
Implementing unit	Faculty of Chemical and Process Engineering	Scientific discipline / disciplines*	Chemical Engineering, Chemical Sciences, Materials Engineering, Biomedical Engineering, Physical Sciences		
Level of education	Education of doctoral students	Semester	Winter semester		
Language of the course	English				
Type of assessment:	Credit	Number of hours in a semester	15	ECTS credits	1
Minimum number of participants	4	Maximum number of participants	30	Available for students (BSc, MSc)	Yes

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	3	-	-	-	-
	in a semester	15	-	-	-	-

* does not apply to the Researcher's Workshop-

1. Prerequisites

Completed subject - general chemistry, organic chemistry, Knowledge in the field of organic chemistry, biochemistry, material engineering

2. Course objectives

The aim of the proposed series of lectures is to familiarize PhD students with topics of broadly understood molecular engineering. It is an interdisciplinary look at the synthesis, modification, but mostly on the applicability of organic chemistry and intermolecular interactions in the field of nanotechnology. A series of lectures will describe the type of chemical bonds, guest-host, acceptor-donor and hydrogen interactions, as well as their applicability in the process of nanomaterials development. The scope of conjugation of biologically active molecules (peptides, sugars, DNA) leading to the production of bio-materials will be discussed in detail. The main goal of the lecture is to equip PhD students with the knowledge necessary to carry out material modification (polymers, glass, silicone) by its conjugation with biologically active compounds (peptides, DNA, drugs, fluorophores). By completing the lecture in the form of presentations, doctoral students will be equipped with soft skills so necessary in scientific work.

3. Course content (separate for each type of classes)

Lecture

W1. Lecture 1. Introduction to molecular engineering, molecular interactions

W2. Lecture 2. Molecular building blocks

W3. Lecture 3. Host-Guest interactions

W4. Lecture 4. Bioconjugation: modification of materials with bioactive molecules

W5. Lecture 5. Surface modification

W6. Lecture 6. PhD's review session - – exam session

Laboratory

4. Learning outcomes

	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*

Knowledge			
K02	He has established knowledge necessary for the advanced materials preparation processes, i.e. for preparing functional surfaces, polymers, bio-conjugated materials	SD_W2 (P8S_WG)	Presentation evaluation; evaluation of activity during the class
K03	He has knowledge of new trends and the most important achievements in the field of nanotechnology and in functional-materials preparation including sensors, functional materials, functional surfaces	SD_W3 (P8S_WG)	Presentation evaluation; evaluation of activity during the class
Skills			
S01	He can get information from the literature, data bases, and other sources in order to comply with projects concerning functional materials engineering including sensors, functional materials, and functional surfaces.	SD_U1 (P8S_UW)	Presentation evaluation; evaluation of activity during the class
S02	He can prepare and handle a project concerning the design and engineering of functional materials using advanced chemistry, and molecular engineering and test the developed products.	SD_U4 (P8S_UK)	Presentation evaluation; evaluation of activity during the class
S03	He can, based on the acquired knowledge of molecular engineering and molecules function design functional material suitable for market needs	SD_U6 (P8S_UK)	Presentation evaluation; evaluation of activity during the class
Social competences			
SC01	He can use advanced molecular engineering knowledge in the issues of chemistry, material, and bio-material engineering.	SD_K4 (P8S_KO)	Presentation evaluation; evaluation of activity during the class

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria

Lecture attendance - 1 pt/lecture; Final presentation 5 pts. Pass of 8 pts upwards.

6. Literature

Basic literature:

[1] Nanochemistry: A Chemical Approach to Nanomaterials, Geoffrey A Ozin, André Arsenault, Ludovico Cademartiri, RSC Publishing 2008, Print ISBN 978-1-84755-895-4

[2] Organic Synthesis and Molecular Engineering, Mogens Brøndsted Nielsen, 2013, ISBN: 978-1-118-73648-7

[3] Bioconjugate Techniques - 3rd Edition, Greg Hermanson, Academic Press 2013, Print ISBN: 9780123822390

Supplementary literature:

[1] Supramolecular Chemistry, Second Edition, Jonathan W. Steed, Jerry L. Atwood, John Wiley & Sons, Ltd 2009, Print ISBN:9780470512333

[2] Intermolecular and Surface Forces, Jacob N. Israelachvili, 2011, ISBN: 978-0-12-375182-9

[3] Fundamentals of Soft Matter Science, Linda S. Hirst, 2012, ISBN: 978-1439827758

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	15
2	Hours of consultations with the academic teacher, exams, tests, etc.	1
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	5
4	Amount of time devoted to the preparation for exams, test, assessments	10
	Total number of hours	**31**
	ECTS credits	**1**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)