

FACULTY of CHEMISTRY

SUBJECT CARD**Name of subject in Polish** Nanotechnologia**Name of subject in English** Nanotechnology**Main field of study (if applicable):** Chemical Engineering and Technology**Specialization (if applicable):** Advanced Chemical Engineering**Profile:** academic**Level and form of studies:** 2nd level**Kind of subject:** obligatory**Subject code** W03CET-SM2009W, W03CET-SM2009L**Group of courses** NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	25		50		
Form of crediting (Examination / crediting with grade)	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		2		
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		1.2		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of physical chemistry
2. Fundamentals of biotechnology
3. Fundamentals of materials engineering

SUBJECT OBJECTIVES

C1 To become familiar with the concepts of nanotechnology.

C2 To become familiar with methods of obtaining and characterising nanomaterials.

C3 To become familiar with the possible applications of nanoengineering and nanomaterials in various fields.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the concepts of nanotechnology

PEU_W02 Has knowledge of methods of obtaining nanomaterials

PEU_W03 Has knowledge of characterisation techniques for nanomaterials

PEU_W04 Knows the applications of nanotechnology and nanomaterials in various fields

relating to skills:
 PEU_U01 Can select a method and synthesise a chosen nanomaterial
 PEU_U02 Can carry out investigations of nanomaterial properties and their characterisation using specialised equipment
 PEU_U03 Can analyse and process the obtained test results

relating to social competences:
 PEU_K01 Is able to cooperate in a laboratory group
 PEU_K02 Feels responsible for the results of the assigned task

PROGRAMME CONTENT		
	Lecture	Number of hours
Lec 1	Organising lesson. Credit requirements. Introduction -History of the development of nanotechnology and its applications in various fields. Properties of nanomaterials and how they differ from macroscale materials. New trends in nanotechnology.	2
Lec 2	Nanoemulsions - manufacturing methods, characterisation and stability testing and applications.	2
Lec 3	Metallic nanoparticles with the example of bionanosilver - preparation, properties and practical applications.	2
Lec 4	Synthesis of metal oxide-based nanomaterials and their potential applications	2
Lec 5	Definition of drug carriers. Mechanisms of release.	2
Lec 6	Externally applied drug carriers - construction, use.	2
Lec 7	Carriers in targeted therapy - construction, application.	2
Lec 8	Written course credit.	1
	Total hours	15

	Laboratory	Number of hours
Lab 1	Preparation, characterisation and stability testing of nanoemulsions.	5
Lab 2	Bioinspired synthesis and characterisation of silver nanoparticles.	5
Lab 3	Green synthesis of zinc oxide nanocrystals and their characterisation.	5
Lab 4	Preparation of encapsulator drug carriers.	5
Lab 5	Preparation of core-shell drug carriers.	5
Lab 6	Printing of carriers on a bio-printer. Control of drug release.	5
	Total hours	15

TEACHING TOOLS USED
N1. Lecture with multimedia presentation
N2. Laboratory instructions
N3. Laboratory workstations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Credit test
F1 (laboratory) P=F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Laboratory exercise reports (arithmetic mean)
3.0 jeżeli $3.00 \leq P < 3.25$ 3.5 jeżeli $3.25 \leq P < 3.75$ 4.0 jeżeli $3.75 \leq P < 4.25$ 4.5 jeżeli $4.25 \leq P < 4.75$ 5.0 jeżeli $4.75 \leq P$		
PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE:</u>		
[1] S.M. Jafari, D.J. McClements „Nanoemulsions: Formulation, Applications, and Characterization”, Academic Press, 2018 [2] V.A. Basiuk, E.V. Basiuk “Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials”, Springer, 2015 [3] M. Rai, C. Posten “Green biosynthesis of nanoparticles: mechanisms and applications”, CBA International, 2013 [4] A.D.Sezer “Application of Nanotechnology in Drug Delivery” https://www.intechopen.com/books/application-of-nanotechnology-in-drug-delivery [5] J.L.Arias “Nanotechnology and Drug Delivery” https://www.taylorfrancis.com/books/e/9780429073533		
<u>SECONDARY LITERATURE:</u>		
[1] M. Naito, T. Yokoyoma, K. Hosokawa, K. Nogi “Nanoparticle technology handbook”, Elsevier B.V., 2018 [2] H. Sarma, S.J. Joshi, R. Prasad, J. Jampilek „Biobased Nanotechnology for Green Applications”, Springer, 2022 [3] Inamuddin, A.M. Asiri “Applications of nanotechnology for green synthesis”, Springer, 2020 [4] D.L. Feldheim, C.A. Foss “Metal nanoparticles: synthesis, characterization, and applications”, Marcel Dekker, Inc., 2002		
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