AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Modern Biophysics

Academic year: 2018/2019 Code: JBF-3-010-s ECTS credits: 3

Faculty of: Physics and Applied Computer Science

Field of study: Biophysics Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: prof. dr hab. Burda Kvetoslava (kvetoslava.burda@fis.agh.edu.pl)

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Module summary

Complexity of living matter will be discussed. Some attempts of its understanding on the molecular level using biophysical models and techniques will be presented.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student will understand the importance of continuous learning and combining knowledge from different fields of knowledge. Student will be able to formulate new problems and search for their solution.	BF3A_K01	Presentation
Skills			
M_U001	Student will understand basic molecular mechanisms regulating living organisms on all levels of their organization and will be able to indicate their potential application in new biotechnologies basing on biomimetics.	BF3A_U02, BF3A_U01	Presentation
Knowledge			

M_W001	Student will gain knowledge on organization properties of selected natural structures and complex systems on molecular level and understanding of mechanisms triggering their formation.	BF3A_W01	Presentation
M_W002	Student will understand the physico-chemical phenomena related to natural processes, which can be used for development of new nanomaterials or nanodevices.	BF3A_W02, BF3A_W01	Presentation

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Student will understand the importance of continuous learning and combining knowledge from different fields of knowledge. Student will be able to formulate new problems and search for their solution.	+	-	-	-	-	+	-	-	-	-	-
Skills												
M_U001	Student will understand basic molecular mechanisms regulating living organisms on all levels of their organization and will be able to indicate their potential application in new biotechnologies basing on biomimetics.	+	-	-	-	-	+	-	-	-	-	-
Knowledge												
M_W001	Student will gain knowledge on organization properties of selected natural structures and complex systems on molecular level and understanding of mechanisms triggering their formation.	+	-	-	-	-	+	-	-	-	-	-
M_W002	Student will understand the physico-chemical phenomena related to natural processes, which can be used for development of new nanomaterials or nanodevices.	+	-	-	-	-	+	-	-	-	-	-

Module content

Lectures

Modern Biophysics

"…Nature has developed materials, objects, and processes that function from the macroscale to the nanoscale. The emerging field of biomimetics allows one to mimic biology or nature to develop nanomaterials, nanodevices and processes which provide desirable properties. …" (B.Bhushan, "Biomimetics")
1.Bioinspired hierarchial-structured surfaces for green science and technology:
-Golden ratio and Fibonacci numbers.
-Lotus effect surfaces in nature. Natural superhydrophobic low adhesion self-cleaning surfaces.
-Nanofabrication methods characterization of micro-, nano- and hierachically structured lotus-like surfaces.
-Fabrication of superhydrophobic surfaces with high adhesion.
-Surfaces reducing turbulent flow (shark-skin, butterfly wing).
-Structure and colors.
2.Nanomaterials for biosensing.
3.Fuel cells:
-Fuel cell principles.
-The hydrogen oxidation/evolution reactions.
-The oxygen reduction/evolution reactions.
-Energy capture.
4.Molecular machines.

Seminar classes

Modern Biophysics

Presentation s on topics related to biomimetics and students' interests.

Method of calculating the final grade

Conditions for receiving credit:
active participation in lectures (L), presentation (P), summarizing discussion (D)
Weighted mean of all grades received according to the following formula:
K = 0.3 x L + 0.4 x P + 0.3 x D

Prerequisites and additional requirements

Basic physical/biophysical, chemical/biochemical and biological knowledge.

Recommended literature and teaching resources

B.Bhushan, Biomimetics, Springer, 2016
Ch.S.S.R.Kumar, Nanotechnologies for the Life Sciences. Nanomaterials – Toxicity, Health and Environmental Issues., vol.5, Wiley-VCH, 2007
C.N.Rao, A.Mueller, A.K.Cheetham, The chemistry of nanomaterials, vol.1, Wiley-VCH, 2004
Ch.S.S.R.Kumar, Nanodevices for the Life Sciences, Wiley-VCH, 2006
T.P.Waigh, Applied Biphysics. A modern Approach for Physical Scientists, Jhon Wiley & Sons, Ltd., 2007
C.A.Villee, Biology
E.H.Egelman (ed.) Comprehensive Biophysics, vol. 1-9, 2012
W.Vielstich, A.Lamm, H.A.Gasteiger, Hanbook of fuel cells, vol. 1 and 2, Jhon Wiley & Sons, Ltd., 2003
Scientific articles citated during the lectures.

Scientific publications of module course instructors related to the topic of

the module
According to the list of publications available on the Web of Science.

Additional information
Fall semester

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	12 h
Participation in seminar classes	8 h
Contact hours	5 h
Preparation of a report, presentation, written work, etc.	15 h
Summary student workload	40 h
Module ECTS credits	3 ECTS