AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Modern tools in biophysics

Academic year: 2019/2020 Code: ZSDA-3-0042-s ECTS credits: 3

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH 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)

Module summary

Introduction to modern biophysical experimental tools and techniques which are used to study of biological systems ranging from molecular to the cellular levels. The background and application of key tools used in imaging, detection, general quantitation, and biomolecular interaction studies, which span multiple length and time scales of biological processes both in model and natural systems 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: is able to			
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.	SDA3A_K01, SDA3A_K03, SDA3A_K02	Presentation, Participation in a discussion, Activity during classes
Skills: he can			
M_U001	Student can select a method which is appropriate to investigate the given biosystem.	SDA3A_U07, SDA3A_U02, SDA3A_U05, SDA3A_U01, SDA3A_U04, SDA3A_U03	Presentation, Participation in a discussion, Involvement in teamwork, Case study, Activity during classes
Knowledge: he knows and understands			

M_W001	Student will acquire basic knowledge about modern physical methods.	SDA3A_W03, SDA3A_W02, SDA3A_W01	Presentation, Participation in a discussion, Involvement in teamwork, Activity during classes
M_W002	Student will gain knowledge on application of modern physical methods in studies of selected properties of natural isolated structures and large complex biosystems.	SDA3A_W03, SDA3A_W02, SDA3A_W01	Presentation, Participation in a discussion, Involvement in teamwork, Activity during classes

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
30	24	6	0	0	0	0	0	0	0	0	0

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	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
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: he can												
M_U001	Student can select a method which is appropriate to investigate the given biosystem.	+	+	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student will acquire basic knowledge about modern physical methods.	+	+	-	-	-	-	-	-	-	-	-

M_W002	Student will gain knowledge on application of modern physical methods in studies of selected properties of natural isolated structures and large complex biosystems.	+	+	-	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	30 h
Realization of independently performed tasks	30 h
Contact hours	5 h
Summary student workload	95 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

Modern tools in biophysics

1. Physical background of UV-VIS-IR absorption, emission, and elastic light scattering methods. Their applications in studies of complex bio-systems.
2. Non-fluorescence and fluorescence microscopy of high resolution.
3. TW lasers.
4. X-ray methods.
5. Radio frequency and microwave resonance spectroscopies.
6. Methods that use gamma rays, electrons and neutrons.
7. Scanning probe microscopy and force spectroscopy.
8. Synchrotron radiation in studies of structural and dynamical properties of bio-systems.

Auditorium classes

Modern tools in biophysics

Team work on research papers related to the topics of the course.

Teaching methods and techniques:

Lectures: Blackboard and multimedia presentation
Auditorium classes: Blackboard and multimedia presentation

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

Students are obligated to catch up on the material presented on lectures / auditorium classes where they were absent. Those who miss more than 20% will have to pass a test checking their knowledge of

the material presented during the course before the end of the semester.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: Yes
– Participation rules in classes: Attendance is mandatory

Students are obligated to catch up on the material presented on lectures / auditorium classes where they were absent. Those who miss more than 20% will have to pass a test checking their knowledge of the material presented during the course.
Auditorium classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Attendance is mandatory

Students are obligated to catch up on the material presented on lectures / auditorium classes where they were absent. Those who miss more than 20% will have to pass a test checking their knowledge of the material presented during the course.

Method of calculating the final grade

Conditions for receiving credit:

Paper presentation and discussion: 60 % (P)
Debates (lectures): 40 % (D)

Weighted mean of all grades received according to the following formula:
K = 0.6 x P + 0.4 x D

Obtaining a positive evaluation (K) requires all positive partial evaluations (P and D).

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Students who miss more than 20% of teaching hours will have to pass a test checking their knowledge of the material presented during the course before the end of the semester.

Prerequisites and additional requirements

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

Recommended literature and teaching resources

1. Vij DR (ed.) Handbook of Applied Solid State Spectroscopy, Springer New York USA, 2006
2. E.H.Egelman (ed.) Comprehensive Biophysics, vol. 1-9, 2012
3. Jóźwiak Z, Bartosz G (red.) Biofizyka, PWN, Warszawa 2005
4. Lakowicz JR , Principles of fluorescence spectroscopy, Springer 2006
5. W.R.Hendee, G.S.Ibbott, E.G.Hendee, Radiation Therapy Physics., Willey-Liss New Jersey, 2005
6. B.Nölting, Methods in Modern Biophysics, Springer –Verlag Heidelberg, 2004
7. Braga PC, Ricci D (ed.) Atomic Force Microscopy. Biomedical Methods and Applications. Human Press, New Jersey 2004
8. Lectures + Scientific articles citated during the lectures.

Scientific publications of module course instructors related to the topic of the module

Selected publications:
[1] 1. D.Latowski, K.Burda and K.Strzałka (2000) A Mathematical Model Describing Kinetics of Conversion of Violaxanthin to Zeaxanthin via Intermediate Antheraxanthin by the Xanthophyll cycle Enzyme Violaxanthin Deepoxidase, J.Theor. Biol. 206: 507-514
[2] K.Burda and G.H.Schmid (2001) Heterogeneity of the Mechanism of Water Splitting in Photosystem

II, Biochim. Biophys. Acta 1506: 47-54
[3] K.Burda, K.P.Bader and G.H.Schmid (2001) An Estimation of the Size of the Water Cluster present at the Cleavage Site of the Water Splitting Enzyme, FEBS Lett. 491: 81-84
[4] K.Burda, J.Kruk, G.H.Schmid, K.Strzałka (2003) Inhibition of oxygen evolution in photosystem II by copper(II) ions is associated with oxidation of cytochrome b559, Biochemical J. 371: 597-601
[5] J.Kruk, M.Jemioła-Rzemińska, K.Burda, G.H.Schmid and K.Strzałka (2003) Scavenging of Superoxide Generated in Photosystem I by Plastoquinol and Other Prenyllipids in Thylakoid Membranes, Biochemistry, 42: 8501-8505
[6] M.Kaczmarska, M.Fornal, F.H.Messerli, J.Korecki, T.Grodzicki, K.Burda, Erythrocyte Membrane Properties in Patients with Essential Hypertension. Cell Biochemistry and Biophysics, 67 (2013) 1089–1102
[7] J. Fiedor, K. Burda, Potential Role of Carotenoids as Antioxidants in Human Health and Disease. Nutrients (2014), 466-488
[8] D.Augustyńska, M.Jemioła-Rzemińska, K.Burda, K.Strzałka, Influence of polar and nonpolar carotenoids on structural and adhesive properties of model membranes. Chemico- Biological Interactions, 239 (2015)19–25
[9] M. Cyrklaff, S. Srismith, B. Nyboer, K.Burda et al., Oxidative insult can induce malaria-protective trait of sickle and fetal erythrocytes. NATURE COMMUNICATIONS, vol. 7 (2016) 13401
[10] K.Burda, Dynamics of electron transfer in photosystem II. CELL BIOCHEMISTRY AND BIOPHYSICS, 47 (2007), 271-284
[11] M.Sarna,(...), K.Burda et al. Atomic force microscopy analysis of retinal pigment epithelium cells subjected to photodynamic stress, PIGMENT CELL & MELANOMA RESEARCH 24 (2011) 818-818

Additional information

any semester