AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Biocybernetics

Academic year: 2019/2020 Code: ZSDA-3-0228-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: dr hab. Bielecki Andrzej (bielecki@agh.edu.pl)

Module summary

Knowledge of selected biological structures and processes that are or may be the inspiration of algorithms will be the effect of education. Among other things, evolutionary processes, communication in the animal and plant world, and processes in organisms will be discussed. The algorithms based on discussed biological processes and structures as well as their formal and electronic models will be presented. The applications of the discussed algorithms will be considered as well.

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)
Skills: he can			
M_U001	The student is able to discuss scientific topics and professionally present the results of his research.	SDA3A_U02, SDA3A_U01	Activity during classes
M_U002	The student is able to discuss current scientific results in biocybernetics.	SDA3A_U04, SDA3A_U02	Participation in a discussion
Knowledge: he knows and understands			
M_W001	The student knows selected biology issues and is able to create their models. He is also able to develop algorithms inspired by biological phenomena. He can search for biological phenomena that can be the basis for solving IT problems.	SDA3A_W02, SDA3A_W01	Activity during classes

M_W002	Acquainting with current scientific trends in biocybernetics.	SDA3A_W02	
M_W003	The student is able to discuss scientific topics related to cybernetics and professionally present research results.	SDA3A_W04	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
15	5	0	0	0	0	10	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
Skills: he can												
M_U001	The student is able to discuss scientific topics and professionally present the results of his research.	-	-	-	-	-	+	-	-	-	-	-
M_U002	The student is able to discuss current scientific results in biocybernetics.	-	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	The student knows selected biology issues and is able to create their models. He is also able to develop algorithms inspired by biological phenomena. He can search for biological phenomena that can be the basis for solving IT problems.	+	-	-	-	-	-	-	-	-	-	-
M_W002	Acquainting with current scientific trends in biocybernetics.	+	-	-	-	-	-	-	-	-	-	-

M_W003	The student is able to discuss scientific topics related to cybernetics and professionally present research results.	-	-	-	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	15 h
Preparation for classes	2 h
Realization of independently performed tasks	1 h
Contact hours	1 h
Inne	2 h
Summary student workload	21 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

1. Information and signal processing in biological systems.
2. Untypical evolutionary mechanisms.
3. Conditioned reflexes and activity automatization as a basis of AI systems.
4. Molecular automata as the basis of living systems.

Seminar classes

1. Information and signal processing in biological systems.
2. Untypical evolutionary mechanisms.
3. Conditioned reflexes and activity automatization as a basis of AI systems.
4. Molecular automata as the basis of living systems.

Teaching methods and techniques:

Lectures: Lectures.
Seminar classes: Discussions and presentations (reports).

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

Class attendance, participation in discussions, preparing a presentation.

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

Lectures:
– Attendance is mandatory: Yes

– Participation rules in classes: Participation in the lectures.
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Participation in discussion and preparing presentations.

Method of calculating the final grade

Attendance at all classes is the basis for obtaining a satisfactory grade. If, moreover, the student actively participated in the discussions, he gets a good grade. If, in addition, the student has prepared a presentation, he receives a very good grade.

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

Individual consultations.

Prerequisites and additional requirements

Prerequisites and additional requirements not specified

Recommended literature and teaching resources

Recommended literature – scientific articles – will be provided by the lecturer at the beginning of the semester in order to take into account the most recent scientific results. Sample topics below.

1. Rohwer F., Barott K. (2013),
Viral information,
Biology and Philosophy, vol.28, 283-297.

2. Trewavas A.J. (1999),
How plants learn.
Proceedings of the National Academy of Science, vol.96, 4216-4218.

3. Jablonka E., Lamb M.J. (2007),
Precis of evolution in four dimensions,
Behavioral and Brain Sciences, vol.30, 353-392.

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

1.Bielecki A., Gierdziewicz M., Kalita P. (2019),
A study on efficiency of 3D partial differential diffusive model of presynaptic processes,
Biocybernetics and Biomedical Engineering, accepted.

2.Bielecki A. (2015),
A general entity of life – a cybernetic approach,
Biological Cybernetics, vol.109, 401-419.

3.Bielecki A. (2014)
A model of human activity automatization as a basis of artificial intelligence systems,
IEEE Transactions on Autonomous Mental Development, vol.6, 169-182.

4.Bielecki A., Kalita P. (2012),
Dynamical properties of the reaction-diffusion type model of fast synaptic transport,
Journal of Mathematical Analysis and Applications, vol.393, 329-340.

5.Bielecki A., Kalita P., Lewandowski M., Siwek B. (2010),

Numerical simulation for neurotransmitter transport model in axon terminal of presynaptic neuron, Biological Cybernetics, vol.102, 489-501.

6.Bielecki A., Kalita P., Lewandowski M., Skomorowski M. (2008),
Compartment model of neuropeptide synaptic transport with impulse control,
Biological Cybernetics, vol.99, 443-458.

7.Bielecki A., Kalita P. (2008),
Model of neurotransmitter fast transport in axon terminal of presynaptic neuron,
Journal of Mathematical Biology, vol.56, 559-576.

8.Kokoszka A., Bielecki A., Holas P. (2001),
Mental organization according to metabolism of information and its mathematical description,
International Journal of Neuroscience, vol.107, 173-184.

9.Bielecki A., Kokoszka A., Holas P. (2000),
Dynamic systems theory approach to consciousness,
International Journal of Neuroscience, vol.104, 29-47.

Additional information

None