(*faculty stamp*) **COURSE DESCRIPTION**

Z1-PU7	WYDANIE N1	Strona 1 z 3

1. Course title: BIOTECHNICAL SYSTEMS	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: MSc programme	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL)
7. Profile of studies: general	
8. Programme: Automatic Control	
9. Semester: 2	
10. Faculty teaching the course: Institute of Automatic Control, Rau1	
11. Course instructor: prof. Marek Kimmel, dr hab. inż. Witold Nocoń	
12. Course classification: programme courses	
13. Course status: compulsory /elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Dynamical systems, control fundamentals, probability and mathematical statistics It is assumed, that students possess a general knowledge about control systems, engineering, system dynamics and statistical processing of experimental data	

16. Course objectives:

Part 1: The primary goal of this part is to show how their knowledge of system dynamics and data processing could be applied in analysis of biological data on molecular level, bioinformatics and system biology and what is the goal of controlling processes at cellular and physiological levels. After the course the students should be able to understand the principles of gene sequencing and algorithms for sequence alignment, and equipment for measurements of gene expression profiles.

Part 2: After completion of this course, students should be able to name and generally describe the metabolic process involve in wastewater treatment, describe methods for measuring composition of wastewater, describe differences between different biomass involved. Using the matrix representation of reaction kinetics, students should be able to derive models of activated sludge reactors. Students should be able to generally describe, the necessary sub processes of the activated sludge wastewater treatment plant, and discuss different control strategies for continuous and batch wastewater treatment plants.

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
W1	The student knows and understands the central dogma of molecular biology as well as fundamentals of gene sequencing and molecular biology measurements	SP	WT,WM	K_W09, K_W10, K_W22
W2	The student know basics of cell biology and basic metabolic processes important from the perspective of wastewater treatment	SP	WT, WM	K_W02, K_W09
U1	The student is able to choose appropriate algorithm for processing of gene and protein sequence data.	PS	L	K_U04
U2	The student is able to choose a proper control strategy for continuous reactors that remove carbon, nitrogen and phosphorus compounds	SP, CL	L	K_U08 K_U11
U3	The student is capable of choosing and making use of software needed in molecular biology and functional genomics.	PS	L	K_U01, K_U05
K1	The student understands and can state a biological reactor type needed for removal of carbon, nitrogen and phosphorus compounds	PS, OS	L	K_K02

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Sem 5 - 30 h., Sem 6 - 30 h

19. Syllabus description:

Lectures:

Part 1: (Biotechnical systems in molecular biology)
1. Fundamental Dogma of Molecular Biology
2. Gene sequencing and sequence alignment
3. DNA microarrays and processing of gene expression data
4. Chosen models of systems biology
5. Genomics, proteomics, transcriptomics etc. – what are "omics" for and why control engineers should be involved in their study?
6. Control in molecular biology and in physiology

Part 2 (Wastewater Treatment Technologies and Systems):
1. Basic biological processes involved: enzymatic reactions, basic metabolic processes.
2. Composition of wastewater. Quantification of waste (COD, BOD measurements)
3. Organisms involved in wastewater treatment: autotrophic vs. heterotrophic biomass, aerobic vs. anoxic vs. anaerobic biomass.
4. Modeling of processes involved: biological growth, decay and hydrolysis, carbon utilization, nitrification, denitrification, biological phosphorus removal, anaerobic processes, fermentation, simultaneous nitrification-denitrification
5. Activated sludge method basics: matrix representation of reaction kinetics, process hydraulics, reactor kinetics. General understanding of different models: Activated sludge Model No. 1, 2 and 3.
6. Activated sludge method implementation: reactors and configurations (different configuration of continuous activated sludge processes, sequencing batch reactor). Mechanical treatment and biological treatment.
7. Control of activated sludge systems: control of continuous systems (sludge age, recirculation of sludge, excess sludge removal control), control of sequencing batch reactors.

Laboratory:

Part 1: A visit in laboratories of the Maria Curie Sklodowska Centre of Oncology, branch Gliwice including laboratory of molecular biology, laboratory of DNA microarrays and deep sequencing and PET station; individual project.

Part 2: Field trip to the Wastewater Treatment Plant in Gliwice

20. Examination: No

21. Primary sources:

[1] A. Polanski, M. Kimmel: Bioinformatics, Springer-Verlag, Berlin, 2007.

[2] M.C.K Khoo, Physiological Control Systems: Analysis, Simulation, and Estimation, Wiley, 1999

[3] Morgens Henze, Paul Harremoësm, Jes la Cour Jansen, Eric Arvin: wastewater treatment – Biological and Chemical Processes, Springer-Verlag, Berlin, 1995

22. Secondary sources:

[1] D W Mount, Bioinformatics: Sequence and Genome Analysis, CSHL Press, 2004
[2] Activated sludge models ASM1, ASM2, ASM2d, ASM3. edited by IWA Task Group on Mathematical Modelling for Design and Operation of Biological Wastewater Treatment.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/20
2	Classes	0/0
3	Laboratory	30/10
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	0/0
	Total number of hours	60/30

24. Total hours: 90

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):1

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*