COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Civil Engineering and Environmental Sciences</td></tr>
<tr><td>Field of study</td><td colspan="6"></td><td colspan="2">Degree level and programme type</td><td></td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6"></td><td colspan="2">Study profile</td><td>academic profile</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Modelling of biotechnological processes</td><td colspan="2">Course code</td><td>IS-FCEE-00210W</td></tr>
<tr><td colspan="2">Course type</td><td>Erasmus</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td></td><td></td><td></td><td>30</td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Basic knowledge of fluid mechanics</td></tr>
<tr><td>Course objectives</td><td colspan="9">Students will learn basics of mathematical modelling and simulation, mathematical models of chemical reactions kinetics, population growth, enzymatic reactions and biokinetic growth. After completion of the module they should be able to build and analyze models of simple biotechnological processes using dedicated software for simulation dynamic systems.</td></tr>
<tr><td>Course content</td><td colspan="9"><u>Lectures</u>: Principles of mathematical modelling. Kinetics of chemical reactions. population growth and biochemical reactions. Batch, continuously stirred and plug-flow reactors. Biokinetic models of activated sludge process. Model calibration and validation.
<u>Specialization workshop</u>: First order chemical reaction model, cell growth in batch reactor and semi batch reactor (VENSIM). Comparison of cell growth in batch and continuously stirred tank reactor, parameters estimaton (AQUASIM). Biokinetic models of activated sludge (ASIM).</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Informational lectures (with multimedia presentations), practical exercises with simulation software</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture – written test; SW – reports form executed exercises</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">Student lists, classifies and discusses the concepts of mathematical modeling of biotechnological processes</td><td colspan="2">BT1_W09, BT1_U03</td></tr>
<tr><td>LO2</td><td colspan="7">Student is able to describe models of selected biotechnological processes</td><td colspan="2">BT1_U05</td></tr>
<tr><td>LO3</td><td colspan="7">Student can use the appropriate software to build a biotechnological process model</td><td colspan="2">BT1_W10, BT1_U05</td></tr>
<tr><td>LO4</td><td colspan="7">Student knows how to interpret results and verify</td><td colspan="2">BT1_W11</td></tr>
</table>

	calculations	
LO5	Student is aware of the responsibility for their own work, understands the need for further training	BT1_U12, BT1_U15
LO6		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written test	L
LO2	written test	L
LO3	execution of exercises	SW
LO4	execution of exercises	SW
LO5	execution of exercises, discussion of reports	SW
LO6		
Student workload (in hours)		No. of hours
Calculation	lecture attendance	15
	participation in classes, laboratory classes, etc.	30
	working on reports	30
	participation in student-teacher sessions related to the classes/seminar/project	5
	preparation for and participation in exam	10
	TOTAL:	90

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	50	2
Student workload – practical activities	60	2,4

Basic references	1. Close Ch. M., Frederick D. K. Modeling and analysis of dynamic systems. Boston : Hoghton Mifflin Company, 1993. 2. Tutorials / User's Manuals for computer software (VENSIM, ASIM, AQUASIM) – avialable online	
Supplementary references	1. Woods,R.L., Lawrence, K.L. Modeling and simulation of dynamic systems Upper Saddle River : Prentice-Hall, 1997.	
Organisational unit conducting the course	Department of Water Supply and Sewage Systems	Date of issuing the programme
Author of the programme	Dariusz Andraka, PhD	2020.02.28

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar