Field of stu	udy	Aqu	aculture and Fish	eries				
Mode of study		stationary Level first cycle						
Graduate's qualification		inżynier				WNO	21K	
Fields of se	cience	agri	cultural sciences					
Disciplines of science		animal science and fisheries (100%)						
Education	al profile	gen	eral academic					
Module	,							
Course un	it	Waste management in aquaculture				-1 r		
Code								
Field of sn	ecialisation							
Administor		Don	artmont of Aquat		and Aquacultura	-		
FCTS		Department of Aquatic Bioengineering and Aquaculture						
ECTS		6.0 ECTS (forms) 6.0			_			
Form of co	ourse credit	exai	mination	Language	englisn			
Electives				Elective group				
Form of in	struction	Cod	Semester	Hours	ECTS	Weight	Credit	
laboratory	course	L	5	30	3.0	0.50	credits	
lecture		W	5	30	3.0	0.50	examination	
Leading te	eacher	Tórz Agnieszka (Agnieszka.Torz@zut.edu.pl)						
Other teac	chers	Sadowski Jacek (Jacek.Sadowski@zut.edu.pl)						
Prerequisit	tes							
W-1	The fundamental k	nowle	edge of chemistry ar	nd hydrochemistry				
W-2	Basic knowlege of l	oiolog	y, chemistry and ec	cology				
Module/co	urse unit objective	es						
C 1	Students should ge	t acq	uainted with the bas	sic factors and proce	esses conditioning the p	proper functioning	of Recyrculating	
C-1	Aquaculture Systems as a living environment for fish. Student could find a way for removal biogenic compouds from the system. Student could conect different parts of integrated multitrophic aquaculture.							
C-2	Acquire knowlege of estimation of chemical conditions of the waters of Recirculated Aquaculture Systems (RAS). Acquire knowlege of aquaponic and using microalgae for waters purification.							
Course coi	ourse content divided into various forms of instruction Number of hou							
T-L-1	Performance of an experiment using integrated multitrophic aquaculture to determine the level of 2							
T-L-2	Preparation of Recirculated Aquaculture System with chosen fish species					2		
T-1 -3	Estimation of waters conditions in Recirculated Aquaculture System (estimation of oxygen conditions,							
	concentrations of biogenic compounds, concentration of organic matter)							
T-L-4	Estimation of efficiency of nitrification process 4 Preparation of Recirculated Aquaculture System with plants (nurification of waters in Aquananic System)							
	Estimation of waters conditions in Aquaponic System (estimation of oxygen conditions, concentrations)							
T-L-0	of biogenic compounds, concentration of organic matter)							
T-L-/	Preparation of particular paper of waters conditions in RAS and Aquaponic System 6							
T-W-1	Circulation of nitrogen and phosphorus in recirculating aquaculture systems (RAS). 2 The importance of pH and carbonate system for the proper functioning of PAS 2							
T-W-3	I ne importance of pH and carbonate system for the proper functioning of RAS. 2 Filtration options as an example of removing excess substances from RAS. 2							
T-W-4	The importance of biofilters used in RAS - nitrification. denitrification and anammox processes.							
T-W-5	Possibilities of using hydroponics as an additional element in the framework of integrated multitrophic 2							
T-W-6	Microalgae – meaning and methods of breeding.							
T-W-7	Possibilities of using microalgae as an additional element in the framework of integrated multitrophic 2					2		
T-W-8	Basic knowlege of law regulations in waste water management in aguaculture 2							
T-W-9	Kinds of waste in a	quacu	ılture				2	
T-W-10	Biological methods of waste water purification (process of carbon, nitrogen and phosphorus elimination)							
T-W-11	Aquaponic Systems	Aquaponic Systems as a kind of waters savings 2						
T-W-12	Kinds of Aquaponic Systems 2							

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Course content divided into various forms of instruction NL						Nun	nber of	⁻ hours		
<i>T-W-13</i> Using microalgae in purification of waste waters in Recircultated Aquaculture Systems									2	
Student workload - forms of activity							Nun	Number of hours		
A-L-1 participation in classes							30			
A-L-2	preparation of papers							30		
A-L-3	A-L-3 study of bibliography								30	
A-W-1	-W-1 participation in classes								30	
A-W-2 self-studying							50			
A-W-3 study of bibliography							10			
Teaching r	nethod	ds / tools								
M-1	lecture	25								
M-2	exercises (lab)									
M-3	lectures with multimedial instruments									
M-4	working at the chemical laboratory									
M-5	preparation of the paper									
Evaluation	meth	ods (F - progressive, P - final)								
5-1	Р	An exam (50% of results for 3.0)								
5-2	F	Observations of Students								
5-3	F	observation of students activity duri	ng laboratories							
5-4	F	observation of students working in c	ooperation							
S-5	Р	estimation of paper	•							
Designed learning outcomes			Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content Teaching methods		Evaluation methods	
Knowledge	2		1				•			
AQF_1A_C19_ The student k proper functionsystems.	W01 nows the oning of	e factors and processes conditioning the integrated multitrophic aquaculture	AQF_1A_W04	P6S_WG	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4	T-W-5 T-W-6 T-W-7	M-1	S-1
AQF_1A_C19_W02 The student knows the principles of laboratory work and the principles of instrumental analysis.			AQF_1A_W01	P6S_WG	P6S_WG	C-1	T-L-1		M-2	S-2
AQF_1A_C19_W03 Knowledge of waste water management techniques			AQF_1A_W01 AQF_1A_W04	P6S_WG	P6S_WG	C-2	T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7	T-W-8 T-W-9 T-W-10 T-W-11 T-W-12 T-W-13	M-3 M-5	S-3
Skills										
AQF_1A_C19_U01 The student is able to control the hydrochemical conditions of waters in the integrated multitrophic aquaculture system. The student is able to use laboratory equipment.			AQF_1A_U10	P6S_UW		C-1	T-L-1	T-W-5	M-2	S-2
AQF_1A_C19_U02 Student will get abilities in laboratory analyses related to the waste water management			AQF_1A_U01	P6S_UW	P6S_UW	C-2	T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7	T-W-8 T-W-9 T-W-10 T-W-11 T-W-12 T-W-13	M-4	S-4
Social competences										
AQF_1A_C19_K01 Improvement of social and personal competencies including self-awareness, self-management, social awareness, relationship skills, responsible decision-making.						M-1 M-2	S-2			
AQF_1A_C19_K02 Student will get knowledge how to design and perform experiments, including results analysis.			AQF_1A_K01	P6S_KK P6S_KR		C-2	T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7	T-W-8 T-W-9 T-W-10 T-W-11 T-W-12 T-W-13	M-3 M-4 M-5	S-3 S-5

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Outcomes	Grade	Evaluation criterion				
Knowledge						
AQF_1A_C19_W01	2,0	Students performing at this level demonstrate no evidence of the knowledge, skills, and practices embodied by the course assessed at their grade level. The range for the grade of 2.0 is from 0% to 50% of the total possible score (100%).				
	3,0	Students performing at this level demonstrate a minimal command of the knowledge and/or skills embodied by the course assessed at their grade level. The range for the grade of 3.0 is from 51% to 60% of the total possible score (100%).				
	3,5	Students performing at this level demonstrate a beginning command of the knowledge and/or skills embodied by the course assessed at their grade level. The range for the grade of 3.5 is from 61% to 70% of the total possible score (100%).				
	4,0	Students performing at this level demonstrate a developing command of the knowledge, skills, and practices embodied by the course at their grade level. The range for the grade of 4.0 is from 71% to 80% of the total possible score (100%).				
	4,5	Students performing at this level demonstrate a moderate command of the knowledge, skills, and practices embodied by the course. Students at this level are approaching the standards at their grade level. The range for the grade of 4.5 is from 81% to 90% of the total possible score (100%).				
	5,0	Students performing at this level demonstrate a distinguished and strong command of the knowledge, skills, and practices embodied by the course. Students at this level are meeting or extending the standards at their grade level. The range for the grade of 5.0 is from 91% to 100% of the total possible score (100%).				
AQF_1A_C19_W02	2,0	Students performing at this level demonstrate no evidence of the knowledge, skills, and practices embodied by the course assessed at their grade level. The range for the grade of 2.0 is from 0% to 50% of the total possible score (100%).				
	3,0	Students performing at this level demonstrate a minimal command of the knowledge and/or skills embodied by the course assessed at their grade level. The range for the grade of 3.0 is from 51% to 60% of the total possible score (100%).				
	3,5	Students performing at this level demonstrate a beginning command of the knowledge and/or skills embodied by the course assessed at their grade level. The range for the grade of 3.5 is from 61% to 70% of the total possible score (100%).				
	4,0	Students performing at this level demonstrate a developing command of the knowledge, skills, and practices embodied by the course at their grade level. The range for the grade of 4.0 is from 71% to 80% of the total possible score (100%).				
	4,5	Students performing at this level demonstrate a moderate command of the knowledge, skills, and practices embodied by the course. Students at this level are approaching the standards at their grade level. The range for the grade of 4.5 is from 81% to 90% of the total possible score (100%).				
	5,0	Students performing at this level demonstrate a distinguished and strong command of the knowledge, skills, and practices embodied by the course. Students at this level are meeting or extending the standards at their grade level. The range for the grade of 5.0 is from 91% to 100% of the total possible score (100%).				
AQF_1A_C19_W03	2,0					
	3,0	Basic knowledge about techniques of waste water treatment and laboratory methods				
	3,5					
	4,0					
	4,5					
Skille	5,0					
	1	Students performing at this level demonstrate as evidence of the knowledge, skills, and practices embedded by the source				
AQF_IA_CI9_001	2,0	assessed at their grade level. The range for the grade of 2.0 is from 0% to 50% of the total possible score (100%).				
	3,0	assessed at their grade level. The range for the grade of 3.0 is from 51% to 60% of the total possible score (100%).				
	3,5	Students performing at this level demonstrate a beginning command of the knowledge and/or skills embodied by the course assessed at their grade level. The range for the grade of 3.5 is from 61% to 70% of the total possible score (100%).				
	4,0	Students performing at this level demonstrate a developing command of the knowledge, skills, and practices embodied by the course at their grade level. The range for the grade of 4.0 is from 71% to 80% of the total possible score (100%).				
	4,5	Students performing at this level demonstrate a moderate command of the knowledge, skills, and practices embodied by the course. Students at this level are approaching the standards at their grade level. The range for the grade of 4.5 is from 81% to 90% of the total possible score (100%).				
	5,0	Students performing at this level demonstrate a distinguished and strong command of the knowledge, skills, and practices embodied by the course. Students at this level are meeting or extending the standards at their grade level. The range for the grade of 5.0 is from 91% to 100% of the total possible score (100%).				
AQF_1A_C19_U02	2,0					
	3,0	Basic laboratory skills				
	3,5					
	4,0					
	4,5					
	5,0					
Other social com	npetence	25				
AQF_1A_C19_K01	2,0	Students performing at this level demonstrate no evidence of increased social and emotional skills, improved attitude toward self and others, improved positive social behaviors, decreased conduct problems and emotional distress.				
	3,0	Acceptable student's achivements in increased social and emotional skills, improved attitude toward self and others, improved positive social behaviors, decreased conduct problems and emotional distress.				
	3,5	Below average student's achivements in increased social and emotional skills, improved attitude toward self and others, improved positive social behaviors, decreased conduct problems and emotional distress.				
	4,0	Average student's achivements in increased social and emotional skills, improved attitude toward self and others, improved positive social behaviors, decreased conduct problems and emotional distress.				
	4,5	Above average student's achivements in increased social and emotional skills, improved attitude toward self and others, improved positive social behaviors, decreased conduct problems and emotional distress.				
	5,0	Oustanding student's achivements in increased social and emotional skills, improved attitude toward self and others,				

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Other social com	petenc	es
AQF_1A_C19_K02	2,0	
	3,0	Basic knowledge about methods of waste water treatment
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Goddek S., Joyce A., Kotzen B., Burnell G.M., Editors, Aquaponic food production systems. Combined Aquaqulture and hydroponics production technologies for the future, COST European Cooperation in Science & Technology, Springer open, 2019, i

2. Lekang O.J., Aquaculture engineering, Wiley, 2013

3. Standards methods for examination of water and wastewater, Am. Publ. Health Ass., Washington, 1995

4. Brummett R.E., Aquaculture technology in developing countries, Taylor and Francis, 2013

5. Perumal (Eds.), Advances in marine and brackishwater aquaculture, Springer, 2014

6. VanderZwaag D.L., Chao G., Aquaculture law and policy: towards principled access and operations, Taylor and Francis, 2012

Supplementary reading

1. Yep B., Zheng Y.,, Aqaponic trends and challenges - A review, Journal of Cleaner Production, 2019

2. Dunkam R.A., Aquaculture and fisheries biotechnology: genetics approaches, CABI, 2011