GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2021-2022

Recirculating Aquaculture Systems RAS (I002859)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size *(nominal values; actual values may depend on programme)*

Credits	**7.5**	**Study time**	**200 h**	**Contact hrs**	60.0 h

Course offerings in academic year 2022-2023

A (semester 2)	English	Gent

Lecturers in academic year 2022-2023

Attramadal, Kari Johanne Kihle	TRONDH01	lecturer-in-charge
Østerhus, Stein Wold	TRONDH01	co-lecturer
Vadstein, Olav	TRONDH01	co-lecturer

Offered in the following programmes in 2022-2023	**crdts**	**offering**
International Master of Science in Health Management in Aquaculture	7.5	A

Teaching languages

English

Keywords

Freshwater and seawater RAS, RAS ecosystem, microbial community, technology and biology, species and stages of fish, waste management, risk assessment

Position of the course

Recirculation aquaculture systems (RAS) significantly reduces water demand, increases water quality control, allows for rapid growth at year-round stable temperatures, facilitates utilization of waste, facilitates a good bacterial environment, and provides a basis for more controlled and predictable production both in freshwater and seawater. The course will provide a broad introduction to RAS and how water treatment can help to create a stable and optimal water environment in the system. Design, dimensioning, start-up, operation, waste management, resource utilization, risk assessment and action plans will be addressed. The subject will hold an interdisciplinary profile, where the technological function and the importance of biological, chemical and physical factors are seen in connection to each other. The course will cover both RAS in freshwater and seawater, for the production of smolt, postmolt, marine fry and marine ongrowing, as well as other relevant species for production in RAS in Norway. The course will also provide insight into how the needs of selected technology and treatment methods change according to the species and life stage.

Contents

The course has an iinterdisciplinary profile; technological function and the importance of biological, chemical and physical factors

- RAS in freshwater and seawater
- RAS ecosystem characteristics
- Design, dimensioning, start-up, operation
- Water treatment
- Microbial management
- Creation of stable and optimal microbial water environment
- Technology and treatment for different species and life stages
- Production of smolt, postmolt, marine fry and marine on-growing
- Waste management and resource utilization
- Risk assessment

Initial competences

Competence for admission to EM AquaH study program and first semester courses at UGent.
Batchelor of marine science and aquaculture for national program MSOCEAN

Final competences

1 The student should be able to explain the most important biological needs and mechanisms that affect the growth, survival and welfare of the fish in aquaculture, especially in RAS.
2 The student should be able to list the most important water quality variables in RAS, interpret limiting values for the most important water quality variables and assess whether the water quality is acceptable for the production organism.
3 The student should be able to list the different types of water treatment required in a recycling plant.
4 The student should be able to design a simple RAS, dimension biofilter and CO2-degasser according to a given feed load and be able to justify the selection of the order of water treatment components.
5 The student should be able to provide an overview of the available technological solutions and the principle of how the water treatment components work, critical factors for functionality and how the water treatment components affect each other.
6 More specifically, the student should be able to explain the function and effect of a drum filter, a protein skimmer, a hydrocyclone, a membrane filter, a fixed bed biofilter, a moving bed biofilter, UV disinfection, disinfection with oxidants and a CO2-degasser.
7 The student should be able to explain how a change in pH affects CO2 toxicity, alkalinity, ammonia toxicity, toxicity of aluminum and H2S, as well as the effectiveness of the biofilter and CO2-degasser.
8 The student should be able to propose a good tank design and plan for logistics through the facility in relation to the given culture organism.
9 The student should be able to give an overview of the most important factors for starting and operating a RAS.
10 The student should be able to assess where to begin looking for errors if there are any problems with the operation of a RAS.
11 The student should be able to discuss, and propose measures and action plans when water treatment components fail, when the fish shows signs of disease, and when one or more of the most important water quality variables are beyond the limiting values for the cultured organism.
12 The student should be able to list different types of sensors and measurement methods to measure the most important water quality variables in RAS.
13 The student should be able to use correct measurement methods and information to assess the need for and effect of various forms of water treatment and actions in the RAS.
14 The student should be able to decide where to measure in the RAS and be able to make a plan for measuring water quality and maintenance of sensors in a RAS.
15 The student should be able to provide an overview of how physiochemical and biological factors can threaten the health of the cultured organism in RAS.
16 The student should be able to give examples of how water treatment and design of RAS affects the microbiology of the system.
17 The student should be able to analyze and plan biosecurity into a RAS.
18 The student should be able to explain how the ammonium oxidizing and nitrite oxidizing bacteria contribute in the biofilter and how they compete with the heterotrophic bacteria.
19 The student should also be able to explain how the most important water quality variables affect these bacteria groups and the effectiveness of the biofilter.
20 The student should be able to estimate the amount and form (dissolved in water, in gasous or particulate form) of the most important waste streams resulting from a given feed amount in a RAS, and be able to suggest ways for handling or utilizing the waste streams.
21 The student should be able to discuss different alternative options for disposal and utilization of the waste streams from RAS in an economic, practical and environmental perspective.
22 The student should be able to present an example of an aquaponic system and to explain the flows of resources in the aquaponic system.
23 The student should be able to use professional terminology and communicate well with the industry that designs, builds and operates

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Guided self-study, demonstration, excursion, lecture, lecture: plenary exercises

Extra information on the teaching methods

The course consists of lectures (44 hours), project assignment, exercises, excursion, participation in conference, a short lab demonstration and self-study. Parts of the activity will take place in two seminar weeks together with participants in a course for the industry.

Learning materials and price

PowerPoint lectures and other materials are made available on the web

References

"Aquaculture Engineering" 2nd edition 2013 by Odd-Ivar Lekang. ISBN: 978-0-470-67085-9.
"Recycling of water in hatchery production - Background Booklet for courses in recycling technology for hatchery production" 2nd edition 2017 by Fjellheim, A.J., Hess-Erga, O.-K., Attramadal, K.J.K., Vadstein, O., NIVA, NTNU, SINTEF, Marine Harvest and Scottish Sea Farms, 28 pp. ISBN: 978-82-577-6842-3.
A selection of scientific publications will be provided at the start of the course.

Course content-related study coaching

PhD students acts as course advisers in practical phase, support from 2-3 permanently employed, guiding upon request, student advice on agreement.

Evaluation methods

continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Examination methods in case of periodic evaluation during the second examination period

Examination methods in case of permanent evaluation

Written examination, assignment, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible in modified form

Extra information on the examination methods

The project assignment is approved by each group presenting their assignment and discussing it with fellow students and the teacher. For the assignment to be approved it must contain at least: an overview of the chosen order of water treatment components and the water flow in the system, limiting levels for the most important water quality variables, tank design, the amount of new water calculated, a simple production plan and a plan for logistics through the system, calculated biomass density, maximum feeding per day, correctly dimensioned biofilter and CO2 degasser, and a plan for utilizing or handling the waste streams coming from the planned production.
In case of postponed exam (continuation exam) written exam may be changed to oral exam.

Calculation of the examination mark

Written exam counts 100/100%. In case of postponed exam (continuation exam) written exam may be changed to oral exam. The normal grades are A-F and 7.5 ECTS achieved if passed (E and better, 40%)
Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner