Course guide
250590 - TECPRAQSOS - Technologies for Sustainable Aquaculture Production

Last modified: 01/10/2023

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 745 - DEAB - Department of Agri-Food Engineering and Biotechnology.

Degree: BACHELOR'S DEGREE IN MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Optional subject).
BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: MARIA LOURDES REIG PUIG

Others: MARIA SARAY RAMIREZ RODRIGUEZ, MARIA LOURDES REIG PUIG

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
13390. Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.
13395. To set, evaluate and propose solutions to the different conflicts of use and exploitation in the marine and coastal environment resources based on scientific and technical criteria.
13399. Apply the state-of-the-art numerical and statisticat techniques in the coastal and marine fields for a correctly interpretation of data. (Specific competence of the Marine Technologies Mention)
13402. Use and apply indicators to assess impacts, both natural and anthropogenic, and propose corrective measures with monitoring and surveillance programs. (Specific competence of the Marine Technologies Mention)
13403. Develop a conceptual framework to address the sustainability of the marine environment and the related socio-economic activities at different scales, explaining the effects of climate change.
13404. Set, plan and execute basic and applied research in the field of Marine Sciences and Technologies.
13405. Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.
13406. Write technical reports and disseminate knowledge about the different components of the marine system, considering the applicable legal framework.
13407. Apply the necessary tools to analyze the economic and legal aspects of human actions and the related impacts on the marine environment, including technical advice and representation of companies and administrations.

Generical:
13384. Apply knowledge and academic experience to the control and monitoring of the marine environment and its coastal boundary, using the state-of-the-art tools in the Marine Sciences and Technologies.
13386. Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.
13387. Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.

TEACHING METHODOLOGY

There will be weekly theoretical classes and practical sessions including laboratory activities, bioprogramming or seminars, up to a total of 4 hours per week. All practical sessions will be evaluated and mandatory, except for reasons of force majeure justified.

The detailed calendar of the subject will be provided in the first session of the same.

Support material related to the syllabus detailed in the teaching guide will be used through the ATENEA virtual campus: contents, programming of assessment and directed learning activities and bibliography.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

To do the laboratory practices you need the following personal protective equipment (PPE):
* White lab coat UPC Chemical

LEARNING OBJECTIVES OF THE SUBJECT

In this subject, the students will be shown the technological solutions for the sustainable development of aquaculture, from an economic, social and environmental standpoint. Emphasis will be placed on the different farming systems (level of intensity, use of resources) and the particularities of the different stages of the productive cycle (hatchery, nursery, fattening), showing the large differences between groups of fish species. The technology for the production of molluscs, crustaceans and algae will also be reviewed, and the criteria for the introduction of new crop species will be analyzed. Special emphasis will be placed on the relationship between farming systems and the environment, in order to assess the environmental load associated with aquaculture activities, identifying and quantifying both the use of matter and energy and the production of waste, thus introducing strategies for environmental improvement.

1. Know the different groups of vertebrates of interest for aquaculture and its biology.
2. Understand the adaptive mechanisms of aquatic species and their implication for production.
3. Understand and know how to apply the bases and dynamics of the main environmental parameters that affect the physiology of vertebrates to production

This subject is oriented to the application of technologies of observation, remote perception and automatic exploration of the marine environment, which is essential for the motorization of the coastal water bodies and the obtaining of the necessary data for the control of practically all the activities human resources in the marine environment related to the exploitation of natural and aquacultural resources of the marine and coastal environment.

At the end of the subject Technology for Sustainable Aquaculture Production, the student must be able to describe the characteristics of the aquaculture sector and identify its various applications. The student will be able to identify the elements that make a certain species interesting for aquaculture, understand its biological characteristics and its implication in production. They will be able to understand the determinants of production in aquatic environments and define the main parameters of water quality with relevance for production, understand their dynamics as well as their interactions, understand the adaptive mechanisms of aquatic species and their implication for production . She will be able to describe the appropriate facilities for the production of aquatic organisms. Finally, you will be able to use appropriate technical management criteria for the production of aquatic organisms that take into account the well-being of the organisms and environmental sustainability. The technical management of cultivation is dealt with in two large groups, differentiating between organisms that require exogenous feeding (fish and crustaceans) and those that can feed directly on the medium (molluscs and algae).

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,0	26.67
Hours small group	20,0	13.33
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Presentation of the subject

Description:
Presentation of the basic objectives of the subject, the topics, the methodology and the evaluation system, as well as the teachers who will participate in it.

Specific objectives:
Understanding the structure of the subject and the objectives to be pursued is a basic tool to achieve the involvement of students in it.

Full-or-part-time: 2h 24m
Theory classes: 1h
Self study : 1h 24m

2. Aquaculture systems

Description:
The term aquaculture will be deepened, reviewing the groups of cultured organisms. The types of possible systems for production are defined and the pros and cons are stated at the level of economic and environmental sustainability.
Dissection of organisms of interest for aquaculture production

Specific objectives:
Recall basic concepts of aquaculture and relate the concepts of aquaculture and sustainability
Understand their physiology and commercial interest

Full-or-part-time: 14h 23m
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h 23m

3. Extensive aquaculture facilities

Description:
Description of the tools and facilities necessary for extensive aquaculture production in algae, molluscs and fish.
Determination of the physico-chemical characteristics of the aquatic environment in production conditions

Specific objectives:
Place students within extensive facilities, deepening their management and continuous innovation.
To know the quality of the water to be able to define the existing conditions of crop and situate them inside the spectrum of the sustainability and the viability

Full-or-part-time: 14h 23m
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h 23m

4. Intensive aquaculture facilities

Description:
Description of the tools and facilities necessary for intensive aquaculture production in algae and fish.
Design of a facility suitable for extensive or intensive aquaculture

Specific objectives:
Place students within intensive facilities, deepening their management, sustainability and continuous innovation.
Know the equipment and design criteria of an aquaculture company

Full-or-part-time: 16h 48m
Theory classes: 5h
Practical classes: 2h
Self study : 9h 48m

5. Nutrition and feeding in aquaculture

Description:
Aquatic animal nutrition concepts, nutritional requirements. Types of existing feed in aquaculture according to the organism cultivated, feed formulation, machinery associated with the production and administration of feed. Sustainable alternatives in food.
Simple formulation of aquaculture feed according to the nutritional, organoleptic and technological requirements of the species
Programming of an aquaculture installation taking into account the productive, environmental and economic parameters

Specific objectives:
Introduce food into aquaculture as the main economic cost within production and an element with the greatest environmental impact. This requires introducing basic concepts of nutrition and food production technology. Look for sustainable alternatives and arouse interest in students about the importance of innovating in this area.
Apply the knowledge of nutrition and food in the practical definition of a feed for aquaculture
Apply the acquired knowledge of production technology developing a case study

Full-or-part-time: 31h 12m
Theory classes: 5h
Practical classes: 8h
Self study : 18h 12m

6. Reproduction technology: algae, mollusks, crustacean

Description:
Introduction to the life cycle of different organisms (plants and invertebrates) of aquaculture interest and how these organisms reproduce under production conditions.

Specific objectives:
To deepen the biological knowledge of the students and place them within the initial phases of aquaculture production.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

7. Reproduction technology: fish

Description:
Introduction to the life cycle of different organisms (vertebrates) of aquaculture interest and how these organisms reproduce under production conditions

Specific objectives:
To deepen the biological knowledge of the students and place them within the initial phases of aquaculture production.

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

8. Health and disease management

Description:
Health concept in production facilities. Well-being and stress as prevention elements. Health and pathology indicators in aquaculture. Main diseases in aquaculture, losses caused by pathologies and proper management of these (mollusks, algae, crustaceans and fish).
Bibliographic search for diseases that have caused losses in aquaculture. Choosing the most appropriate treatment

Specific objectives:
Know the elements that contribute to maintaining health in aquaculture. Knowing the diseases that produce the greatest economic losses in aquaculture, learning how to diagnose and remedy them correctly.
Practical application in a case study of the knowledge acquired on health and disease in aquaculture

Full-or-part-time: 19h 12m
Theory classes: 6h
Laboratory classes: 2h
Self study : 11h 12m

9. Environmental impact: types and actions

Description:
List the factors of aquaculture production that have an impact on the environment, delve into the consequences of the productive activity and the possible current and future improvements within the sector to increase sustainability
Discussion seminar on the fishing vs. aquaculture paradigm

Specific objectives:
Make students aware of the impacts caused by aquaculture and the importance of correct production management
Collect and value all the knowledge acquired in the subject

Full-or-part-time: 14h 23m
Theory classes: 3h
Practical classes: 3h
Self study : 8h 23m

10. Evaluation

Full-or-part-time: 9h 36m
Laboratory classes: 4h
Self study : 5h 36m

GRADING SYSTEM

The qualification of the subject is obtained from the continuous evaluation qualifications, the evaluation tests (midterm and final) and the corresponding laboratory, seminars and/or computer classroom.

Continuous assessment includes performing different activities, both individual and group, of an additive and formative nature, carried out during the course (within the classroom and outside of it).

The qualification of practical activities is the average of the laboratory activities, seminars and computer room.

The evaluation tests consist of two exams (partial and final), the laboratory practices, the seminars and the bioprogramming. The characteristics of the assessment tests are explained in the classroom. In general, they consist of a part with short questions on concepts associated with the learning objectives of the subject in terms of knowledge or understanding, and, depending on the syllabus to be evaluated, a set of application exercises.

The final grade for the course is obtained as follows:
Midterm exam (20%) + Final exam (30%) + Practices (30%) + Supervised activities (20%).

Qualification and admission criteria for reevaluation: Students suspended in the ordinary evaluation who have regularly taken the failed evaluation tests will have the option to take a reevaluation test in the period set in the academic calendar, those who have already passed it or have not taken any of the assessable tests. Extraordinary evaluations will be carried out for students who due to justified force majeure have not been able to take any of the continuous evaluation tests.

These tests will be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding academic period.

BIBLIOGRAPHY

Basic:

- Barnabé, G.. Aquaculture: biology and ecology of cultured species [on line]. Boca Raton, FL: Taylor & Francis, 1994 [Consultation: 21/03/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=179014. ISBN 9780429217654.
- Beveridge, M. Cage aquaculture [on line]. 3rd ed. Oxford: Blackwell, 2007 [Consultation: 04/04/2023]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9780470995761. ISBN 9780470995761.
- Belaud, A. Oxygénation de l'eau: en aquaculture intensive. Toulouse: Cépaduès-Éditions, 1995. ISBN 2854283503.
- Lawson, T.B. Fundamentals of aquacultural engineering [on line]. New York: Chapman & Hall, 1995 [Consultation: 05/04/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6494347. ISBN 0412065118.
- Midlen, A.B.. Environmental management for aquaculture. London, UK: Chapman & Hall, 1998. ISBN 0412595001.
- Timmons, M.B. Aquaculture water reuse systems: engineering design and management. Amsterdam, The Netherlands: Elsevier, 1994. ISBN 044489585X.