Course Guide
43815 Microbiological control of wastewater treatment processes

COURSE DATA

Data Subject	
Code	43815
Name	Microbiological control of wastewater treatment processes
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
2227 - M.U. en Ingeniería Ambiental	School of Engineering	2	First term
2250 - M.D. in Environmental Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
2227 - M.U. en Ingeniería Ambiental	5 - Optatividad para Especialización	Optional
2250 - M.D. in Environmental Engineering	20 - Control microbiológico de procesos de depuración	Optional

Coordination

Name	Department
BORRAS FALOMIR, LUIS	245 - Chemical Engineering

SUMMARY

Professor UPV: Salut Botella Grau

In the course, the student is expected to acquire the ability to make microscopic observations of sludge or wastewater to identify the main microbial morphologies as well as to recognize specific groups of microorganisms based on their response to different stains. The methods and techniques for isolating and identifying certain indicator or pathogenic microorganisms are explained using methodologies that involve the cultivation of said microorganisms as well as techniques not dependent on culture. The subject aims for the student to be able to interpret the results of the analysis carried out in order to diagnose possible problems in water treatment facilities, with special emphasis on the microbiological requirements for the reuse of treated water. The contents of this subject are closely related to the Sustainable Development Goals (SDG) 6 “Clean water and sanitation”.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Relationship with other subjects of the same degree:
No enrollment restrictions have been specified with other subjects of the curriculum.

Other requirements:
No enrollment restrictions have been specified with other subjects of the curriculum.

OUTCOMES

2227 - M.U. en Ingeniería Ambiental

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Identify and apply technologies, tools and techniques in the field of environmental engineering.
- Assume with responsibility and ethics the Environmental Engineer role in a professional context.
- Adapt to changes, being able to apply the principles of Environmental Engineering to unknown cases and use new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit.
- Be able to characterize the emissions to water, coming from the anthropogenic activity.
- Be able to characterize the emissions to soils, coming from the anthropogenic activity.
- Evaluate the treatment of wastewaters emissions to assess different alternatives and obtain the required information for the design of the selected treatment processes.

2250 - M.D. in Environmental Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Identify, formulate and solve complex environmental engineering problems by applying engineering, scientific and mathematical principles.
- Work in a team effectively and with leadership, in a collaborative and inclusive environment, setting goals, planning tasks and meeting objectives.
- Conduct appropriate experimentation, analyse and interpret data and use environmental engineering knowledge to draw conclusions.
- Learn and apply new knowledge, using appropriate learning strategies.
- Characterise emissions to water.
- Characterise emissions to land.
- Manage and operate treatment and/or purification systems in the field of environmental engineering
- Interpret and apply national and international environmental legislation and adapt environmental solutions to these regulations.

LEARNING OUTCOMES

1 Ability to perform microscopic observations of sludge or water to identify the main microbial morphologies

2 Ability to recognize specific groups of microorganisms based on their response to different stains

3 Ability to isolate and identify certain indicator or pathogenic microorganisms making use of methodologies that involve cultivation

4 Ability to detect and identify certain microbial groups by techniques not dependent on cultivation

5 Ability to interpret the results of the analysis carried out in order to anticipate possible problems in the facilities

DESCRIPTION OF CONTENTS

1. Microbiota of wastewater

1. Classification of microorganisms in wastewater.
2. The floccule: biological succession.
3. Microbiological problems in the wastewater treatment process.

2. Counting microorganisms through cultural methods

Counting techniques.

3. Isolation and identification of microorganisms through cultural methods

1. Culture media.
2. Identification methods.

4. Counting microorganisms by non-cultural methods

1. Sampling for microbiological counts.
2. Direct and indirect counts.
3. Filamentous count in biological systems for wastewater treatment.
4. Quantification of microorganisms by image analysis.
5. Flow cytometry.

5. Detection and identification of microorganisms by techniques not dependent on cultivation

1. Fluorescent in situ hybridization (FISH). Principles and applications. Selection of probes.
2. Use of the fluorescence microscope. Selection of filters and fluorochromes. Limitations.
3. Polymerase chain reaction (PCR). Basic principles and selection of primers. Variations of the PCR.
4. Quantitative PCR (qPCR).

6. Identification of special characteristics of microorganisms through advanced techniques

1. Confocal Laser Microscopy.
2. Staining with DAPI. Cell viability.
3. Other techniques combined with FISH.
4. Scanning and transmission electron microscopy (SEM, TEM).
5. Denaturing gradient gel electrophoresis (DGGE).
6. High throughput sequencing techniques.

7. Laboratory practices

1. Microscopic observations of water and sludge, identifying the main microbial groups by morphology.
2. Measurements by calculating the micrometric coefficient.
3. Microorganism count.
4. Physiological stains.
5. Detection and identification of microbial groups using the FISH technique.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	14,00	100
Theory classes	14,00	100
Theoretical and practical classes	2,00	100
Development of individual work	5,00	0
Study and independent work	10,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	**75,00**	

TEACHING METHODOLOGY

The teaching sessions will be developed according to the following distribution:

• Theoretical activities.

In the theoretical classes, the topics will be developed providing a global and integrative vision, analyzing in greater detail the key and more complex aspects, encouraging, at all times, the participation of the student.

• Practical activities.

These activities complement the theoretical activities in order to apply the basic concepts and expand them with the knowledge and experience that they acquire during the completion of the proposed work.

• Laboratory practices.

The laboratory practices complement the theoretical activities, allowing the student to apply the methods studied in the theoretical activities.

• Personal work of the student.

Carrying out (outside the classroom) of monographic works, directed bibliographic search, as well as the preparation of classes and exams (study). This task will be carried out individually and aims to promote autonomous work.

The e-learning platform (Virtual Classroom of the University of Valencia and / or PoliformaT of the Polytechnic University of Valencia) will be used as a communication support with the students. Through it, students will have access to the didactic material used in class, as well as the problems and exercises to be solved.

EVALUATION

The subject will be evaluated (both in the first and second calls) by presenting a case study (20% of the grade) and two open-ended written tests (each will account for 40% of the grade).

To pass the subject, the student must obtain a minimum grade of 4 points (out of 10) in each written test of more than 30% of the final grade.

The final grade will be the weighted average of the grades of each written test and the practical case, and must be greater than or equal to 5 to pass the subject.

A single recovery may be made of each failed written test through a complementary evaluation (second call) on the date and time established by the Master's Academic Committee.

Written test: Written exam where the student must demonstrate mastery of the contents of the subject based on the questions posed by the teaching staff (total weight 80%)

Practical laboratory/field test: Evaluation instrument that allows verifying the concepts and/or skills acquired by the student in the development of their classroom, field, computer and/or laboratory practices (total weight 20%).

Regarding the attendance requirements, the maximum absence allowed will be 20% in laboratory practices.

REFERENCES

Basic

- - Seviour, R. And Nielsen, P.H. Microbial Ecology of Activated Sludge. IWA Publishing,London, 2010.
  - Ferrer Polo, J., y Seco Torrecillas, A. Tratamientos biológicos de aguas residuales. Editorial UPV (358), 2009.
  - Metcalf & Eddy. Wastewater Engineering: Treatment and reuse. 4th Ed. McGraw Hill, New York, 2003.
  - David Jenkins, Michael G. Richard, Glen T. Daigger. Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems. IWA Publishing. 2004.

- Per Halkjaer Nielsen, Holger Daims and Hilde Lemmer. FISH Handbook for Biological Wastewater Treatment. IWA Publishing. 2009.
- Duncan Mara and Nigel Horan. Handbook of Water and Wastewater Microbiology. Elsevier. 2004