VNIVERSITAT DE VALÈNCIA

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	2020 - 2021

Study (s)

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

Subject-matter

Degree	Subject-matter	Character
2227 - M.U. en Ingeniería Ambiental	5 - Optatividad para Especialización	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 that the student will be able to interpret the results of the analysis carried out in order to anticipate possible problems in the facilities.

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

2172 - 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.

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 training activities will be developed according to the following distribution:

• Theoretical activities.

In the theoretical classes the topics will be developed providing a global and integrator vision, analysing in detail the key aspects and of greater complexity, encouraging, at all times, the participation of the student.

• Practical activities.

They complement the theoretical activities with the aim of applying the basic concepts and expand them with the knowledge and experience that they acquire during the realization of proposed works.

• Laboratory practices.

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

• Student's personal work.

Realization (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 tries to promote autonomous work.

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

EVALUATION

The course will be evaluated (both on first and second call), by presenting a work on a practical case (20% of the grade) and two written open-response tests (each will represent 40% of the grade).

To pass the course, the student must obtain a minimum grade of 5 points (out of 10) in each written test and also in the practical case.

The final mark will be the weighted average of the marks of each written test and the practical case. A single recovery exam may be made from each suspended written test by means of a complementary evaluation (second call) on the date and time established by the Academic Commission of the Master.

Regarding attendance requirements, the maximum allowed absence will be:

Classroom Theory: 20%

Seminar Theory: 0%

Classroom Practice: 0%

Laboratory Practice: 0%

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

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially included in the teaching guide are maintained.

Volume of work and temporary planning of teaching

Regarding the workload, the different activities described in the Teaching Guide are maintained with the planned dedication.

Regarding the temporary planning of teaching, the material for the follow-up of the theory/practical lessons allows to continue with the teaching schedule both in days and hours (synchronous teaching).

Teaching methodology

Theory and practical lessons will tend to the maximum possible attendance, always respecting the sanitary restrictions. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. In this case, the subject will be taught in classrooms with streaming teaching capacity, and there may be students attending online and in class.

A rotation system will be established once the enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

With regard to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face. (If the subject does not have L teaching, remove this paragraph).

Once the enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing the specific conditions in which it will be taught.

If there is a closure of the facilities for health reasons that totally or partially affects the classes of the subject, these will be replaced online sessions following the schedules established by synchronous video conferencing, or, if not possible, asynchronous.

Evaluation

The evaluation system described in the Teaching Guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final mark of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final mark of the subject will remain unchanged, as established in this guide.

Bibliography

The bibliography recommended in the Teaching Guide is kept as part of it is accessible on line and is complemented with notes, slides and problems uploaded to the Virtual Classroom as subject material.