FACULTAD DE CIENCIAS

GRADO EN BIOLOGÍA

2024/25 YEAR

INGENIERÍA GENÉTICA

Course details

Course name: INGENIERÍA GENÉTICA
Code: 100433
Degree/Master: GRADO EN BIOLOGÍA **Year:** 4
Field:
Character: OPTATIVA **Duration:** FIRST TERM
ECTS Credits: 6.0 **Classroom hours:** 60
Face-to-face classroom percentage: 40.0% **Study hours:** 90
Online platform: https://moodle.uco.es/

Coordinating teacher

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Brief description of the contents

Part 1. Structure of genes and chromosomes
Part 2. Analysis and manipulation of genes and genomes
Part 3. Applications in Biotechnology, Agriculture and Medicine
Practical course 1. Construction of a plasmid restriction map
Practical course 2. Identification of genetic mutants by PCR

Prerequisites

Prerequisites established in the study plan

Students can enrol in optional courses after having passed 60 credits of basic courses and at least an additional 60 credits of mandatory courses.
Students must hold a B1 certificate of the English language level

Recommendations

Students should have a good level of General Genetics (e.g. acquired in the second year Genetics course). Students should have a good command of English and be able to understand scientific literature. The English level will NOT be used as a criterium for evaluation.

Study programme

1. Theory contents

Part 1- GENE AND CHROMOSOME STRUCTURE

Chapter 1. Genes. DNA as the genetic material. Gene structure and regulation. Transcription factors.

Chapter 2. Chromosomes. Chromosome structure. Chromatin organization and remodeling.

Chapter 3. Genomes.. Organization of the genome. Genome mapping.

Part 2- GENE AND GENOME ANALYSIS AND MANIPULATION

Chapter 4. Restriction enzymes and DNA cloning

Chapter 5. Gene libraries and gene isolation. DNA cloning vectors. Construction and analysis of gene libraries. Nucleic acid hybridization. Southern and
northern blot analysis.

Chapter 6. DNA amplification by PCR. Principles of the PCR technology. PCR applications.

Chapter 7. Gene transfer to cells. Genetic transformation of microorganisms. Gene transfer to plants and animals.

Chapter 8. Genome editing. DNA Recombination. Gene knockout. Genome editing with CRISPR/Cas9. Gene silencing with RNAi.

Chapter 9. Genome analysis.. Genome sequencing. Bioinformatics. Metagenomics.

Chapter 10. Functional genomics. Model organisms. Genome-wide study of gene function. Transcriptomes, proteomes, interactomes.

Part 3- APPLICATIONS IN BIOTECHNOLOGY, AGRICULTURE AND MEDICINE

Chapter 11. Applications in microorganisms. Heterologous protein expression. Bioremediation. Biofuels.

Chapter 12. Applications in plants. Plant breeding and transgenic plants. Engineering plant resistance to pests. Nutritionally improved plants. Plants
as biofactories.

Chapter 13. Applications in animals. Transgenic animals. Heterologous protein expression. Animals engineered for food production.

Chapter 14. Applications in humans. Genetics of human diseases. Genetic diagnostics. Gene therapy. Applications in forensics.

Chapter 15. Synthetic biology. Principles of synthetic biology. Resurrection of extinct species. Creation of new organisms.

2. Practical contents

Laboratory class 1. Building a plasmid restriction map.

Laboratory class 2. Identification of gene knockout mutants by PCR.

Bibliography

- BROWN (2008) Genomas. Panamericana, 3ªed.
- WINK (Editor) (2011) An Introduction to Molecular Biotechnology: Fundamentals, Methods and Applications. WILEY BLACKWELL. 2nd ed.
- GLICK, PASTERNAK, PATTEN (2009) Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th ed.
- LEWIN (2004) Genes VIII. Oxford University Press.

-PERERA, TORMO, GARCÍA (2002) Ingeniería Genética. Vol. I y II. ed Síntesis.
-PRIMROSE and TWYMAN (2006) Principles of manipulations and Genomics. 7th ed. Blackwell Publishing.
-WATSON, MYERS, CAUDY and WITKOWSKI (2007) Recombinant DNA. Genes and Genomes- A Short Course. 3rd ed. Freeman and Company.
-WATSON, BAKER, BELL, GANN, LEVINE and LOSICK (2008). Biología Molecular del Gen. Panamericana. 5ª ed.
- http://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/

Methodology

General clarifications on the methodology (optional)

Lectures

The lectures present basic information on the topics, along with more in-depth treatment of one or more questions in the field. Relevant techniques will also be covered.

IMPORTANT: The pdf versions of the ppt lectures will be available in moodle. However, additional essential information and explanations are provided in the lecture class. Therefore, students are strongly advised to attend all the lecture classes.

Problem sets

For each chapter, a problem set will be provided in moodle. Resolution of the problems is essential for proper understanding of the course contents. Problems should be resolved by the students IN ADVANCE of the problem class. During the class, for each problem the Professor calls a student chosen randomly from the list to resolve the problem on the blackboard. The student will obtain a grade based on the correctness of the resolution and the clarity of the explanation. Failure of a student to resolve a problem correctly or absence of the student from the class will be penalized. During the entire course, a student will be called at least two times for problem resolution. Students can propose themselves for resolution of a specific problem, but the choice of the presenter will be at the discretion of the Instructor.

Experimental design sets

Topics for experimental design questions will be provided in moodle. At the beginning of the course, each experimental design question will be assigned to a team of 2-3 students. At the beginning of a class, a student team will deliver a presentation by powerpoint and on the blackboard on their experimental design question. All students of the group should actively participate. There is a strict time limit for the presentation. After the presentation, there will be a debate where the other students will ask questions to the team. Each student of the team will obtain a grade based on the correctness and the clarity of the experimental design presentation.

Scientific talks and discussions

Talks will be delivered on a scientific article whose topic is directly related to the contents of the course. Presentation of a scientific talk and assistance to ALL scientific talks is mandatory. The talks are grouped into different blocks, each composed of 3-4 presentations. Talks will be prepared and presented by 2-3 students. There is a strict time limit for each presentation. The topic and scientific article of the talk will be selected by the students from the list of articles placed in moodle. Additional articles related to the lecture topics can be suggested by the students, but acceptance is at the

discretion of the Instructor. During the weeks and days before the presentation, the students are STRONGLY RECOMMENDED to consult and discuss the presentation with the Instructor during the tutorial time periods.

Scientific talk discussions

After each seminar there will be time for students to ask questions to the speakers. Participation in of students the seminar discussion will be valued.

Methodological adaptations for part-time students and students with disabilities and special educational needs

The methodological adaptations for part-time students and students with disabilities and special educational needs will be decided in meetings between the Professors and the interested students to find case-to-case personalized solutions. In the case of students with disabilities and special educational needs, the Professor will meet with the students to establish the adaptations which are most adequate for each particular case, following the indications of the report elaborated by the Unit of Inclusive Education.

Face-to-face activities

Activity	Large group	Medium group	Small group	Total
Assessment activities	4	-	-	4
Information processing activities	-	18	-	18
Oral communication activities	-	4	-	4
Practical experimentation activities	-	-	3	3
Projects based on the course contents	24	-	-	24
Tutorial action activities	5	2	-	7
Total hours:	***33***	***24***	***3***	***60***

Off-site activities

Activity	Total
Exercise and problem solving activities	40
Information processing activities	25
Information search activities	25
Total hours	***90***

Results of the training and learning process

Knowledge, competencies and skills

COM03 Learn to work as a team and exercise leadership.

COM04 Learn to work independently, with a capacity for self-assessment.

COM05 Communicate and correctly discuss knowledge, ideas and opinions, orally and in writing, formulating a constructive criticism/self-criticism.

COM11 Design and interpret techniques applied to research, health or industry.

COM14 Manage knowledge; gather, organize and interpret relevant data and make judgments on issues of a scientific, social or ethical nature.

HD02 Develop critical reasoning and apply the scientific method to analyze, synthesize and solve issues in a rigorous, creative and/or intuitive way.

HD05 Obtain information, design experimental strategies to address scientific problems, and interpret the results to explain certain biological processes.

HD06 Capably use sources of scientific information and useful resources for biological study and research.

HD07 Apply theoretical knowledge to practice, planning experiments, safely handling materials and instruments related to the subject, and interpreting data from observations and measurements taken in the laboratory or field.

HD13 Analyzes and handles genetic material, identifying and diagnosing its anomalies.

Assessment methods and instruments

Intended learning outcomes	Examination	Means of practical execution	Oral means	Students assignments
COM03			X	X
COM04		X	X	X
COM05	X		X	X
COM11	X	X		X
COM14	X		X	
HD02	X	X	X	X
HD05		X		X
HD06		X	X	X
HD07	X	X		
HD13	X	X		
Total (100%)	***50%***	***15%***	***20%***	***15%***
Minimum grade (*)	***5***	***0***	***0***	***0***

(*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

General clarifications on instruments for evaluation:

It is mandatory to pass the final exam and to perform all the activities of the course, as well as to attend the laboratory classes.
The final exam is written and includes all the topics presented during the course.
Attendance of the classes is considered mandatory and does not contribute to the final grade.
For the experimental design and scientific presentations that are done in teams, each student of the team will obtain a grade based on the correctness and the clarity of the experimental design presentation, and on the answers to the questions made by the audience.
During the problem class, the Professor calls a student chosen randomly from the list to resolve a problem on the blackboard. The student will obtain a grade based on the correctness of the resolution and the clarity of the explanation.

Enrolled students who are repeating the course will not need to repeat the practical class and can opt to maintain the grade from the previous year. Repetition of the problem class is mandatory, while repetition of the experimental design and scientific presentations is optional.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

The methodological adaptations for part-time students and students with disabilities and special educational needs will be decided in meetings between the Professors and the interested students to find case-to-case personalized solutions. In the case of students with disabilities and special educational needs, the Professor will meet with the students to establish the adaptations which are most adequate for each particular case, following the indications of the report elaborated by the Unit of Inclusive Education.

Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:

It is mandatory to pass the final exam and to perform all the activities of the course, as well as to attend the laboratory classes. The final exam is written and includes all the topics presented during the course. In the three evaluation criteria "Oral presentation", "Real and/or simulated tasks" and "Problem solving" the previous grades are maintained. Attendance of the classes is considered mandatory and does not contribute to the final grade.

Qualifying criteria for obtaining honors:

Final Grade

Sustainable development goals

Zero hunger
Good health and well-being
Quality education
Gender equality
Clean water and sanitation
Affordable and clean energy
Industry, innovation and infrastructure
Responsible consumption and production
Life below water

Life on land
Partnerships for the goals

Other Faculty

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The methodological strategies and the evaluation system contemplated in this Teaching Guide will respond to the principles of equality and non-discrimination and must be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required. Students must be informed of the risks and measures that affect them, especially those that may have serious or very serious consequences (article 6 of the Safety, Health and Welfare Policy; BOUCO 23-02-23).