COURSE DESCRIPTION

COURSE DETAILS

Title (of the course): **INGENIERÍA GENÉTICA**
Code: 100433
Degree/Master: **GRADO DE BIOLOGÍA** Year: 4
Field: OPTATIVA
Character: OPTATIVA Duration: SECOND TERM
ECTS Credits: 6.0 Classroom hours: 60
Face-to-face classroom percentage: 40.0% Study hours: 90
Online platform: Moodle

LECTURER INFORMATION

Name: PIETRO, ANTONIO C. DI (Coordinator)
Department: GENÉTICA
Area: GENÉTICA
Office location: Edificio C5, 1ª planta
E-Mail: ge2dipia@uco.es Phone: 957 218981
URL web: https://www.uco.es/FusariumLab/

Name: PALOS FERNÁNDEZ, RAFAEL
Department: GENÉTICA
Area: GENÉTICA
Office location: Edificio C5, 1ª planta
E-Mail: b42pafer@uco.es Phone: 957 212421
URL web: https://www.uco.es/FusariumLab/

Name: RODRÍGUEZ LÓPEZ, ANA
Department: GENÉTICA
Area: GENÉTICA
Office location: Edificio C5, 1ª planta
E-Mail: z92roloa@uco.es Phone: 957 212421
URL web: https://www.uco.es/FusariumLab/

Name: SÁNCHEZ LÓPEZ BERGES, MANUEL
Department: GENÉTICA
Area: GENÉTICA
Office location: Edificio C5, 1ª planta
E-Mail: ge2snlpm@uco.es Phone: 957 218981
URL web: https://www.uco.es/FusariumLab/

COURSE DESCRIPTION

PREREQUISITES AND RECOMMENDATIONS

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).
In order to obtain the certicicate of having done this course in English, students need to have a certificate B1 English level (plan de plurilingüismo de la Facultad de Ciencia).
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.

INTENDED LEARNING OUTCOMES

CE83n	Comprehension of the fundamental concepts about the flora composition, structure and dynamics of communities.
CB2v2	Ability to work in group.
CB3v2	Ability for autonomous learning.
CB3v7	Ability to self-assessment.
CB4v4	Ability for analysis and synthesis.
CB10v5	Ability to obtain and analyse information from different sources (books, magazines, Internet).
CB14v2	Ethical commitment with social problems.
CB18v2	Ability to apply theoretical knowledge in a practical way.
CB19v4	Basic concepts and specific procedures to Genetic Engineering.
CE21v5	To manipulate genetic material.
CE21v6	To carry out genetic diagnoses.
CE67n	To carry out genetic advice.
CE84n	Enzymology and techniques for in vitro recombination.
CE85n	Isolation and characterization of genes and sequences.
CE86n	Amplification and sequencing of nucleic acid molecules
CE87n	Applications of Genetic Engineering.
CE88n	To design processes for resolving biotecnological issues.

OBJECTIVES

The course provides an overview of the principal concepts and methods in Molecular Genetics, and how these are used to advance the frontiers of knowledge in biology, as well as their applications in biotechnology, agriculture and medicine.

COURSE DESCRIPTION

CONTENT

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
Restriction endonucleases. Ligation and modification of DNA ends. Reverse transcription.

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.

COURSE DESCRIPTION

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.

SUSTAINABLE DEVELOPMENT GOALS RELATED TO THE CONTENT

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

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 Professor.

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

COURSE DESCRIPTION

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. During the weeks and days before the experimental design presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor during the tutorial time periods.

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 Professor. During the weeks and days before the presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor 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

Las adaptaciones metodológicas para los alumnos a tiempo parcial se decidirán en reuniones entre el profesorado y los alumnos interesados a fin de personalizar los posibles casos que se presenten.

Face-to-face activities

Activity	Large group	Medium group	Small group	Total
Assessment activities	4	-	-	4
Case study	-	18	-	18
Group presentation	-	4	-	4
Lab practice	-	-	3	3
Lectures	24	-	-	24
Tutorials	5	2	-	7
Total hours:	***33***	***24***	***3***	***60***

Off-site activities

Activity	Total
Activities	20
Analysis	5
Exercises	10

COURSE DESCRIPTION

Activity	Total
Group work	10
Information search	10
Reference search	15
Self-study	20
Total hours	***90***

WORK MATERIALS FOR STUDENTS

Case studies
Coursebook
Exercises and activities
Lessons summary
Oral presentations
References

EVALUATION

Intended learning	Exams	Oral Presentation	Problem solving	Real and/or simulated tasks
CB10v5	X	X	X	X
CB14v2	X	X	X	X
CB18v2	X	X	X	X
CB19v4	X	X	X	X
CB2v2	X	X	X	X
CB3v2	X	X	X	X
CB3v7	X	X	X	X
CB4v4	X	X	X	X
CE21v5	X	X	X	X
CE21v6	X	X	X	X
CE67n	X	X	X	X
CE83n	X	X	X	X
CE84n	X	X	X	X
CE85n	X	X	X	X
CE86n	X	X	X	X

COURSE DESCRIPTION

Intended learning	Exams	Oral Presentation	Problem solving	Real and/or simulated tasks
CE87n	X	X	X	X
CE88n	X	X	X	X
Total (100%)	***50%***	***20%***	***15%***	***15%***
Minimum grade	***5***	***1***	***1***	***1***

(*)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.

Attendance will be assessed?:

No

General clarifications on instruments for evaluation:

General clarifications on instruments for evaluation:
It is mandatory to pass the final exam and 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.

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

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:
The methodological adaptations for the students enrolled at part-time will be agreed on in meetings between the Professors and the students, in order to allow personalized solutions for each individual case.
Enrolled students who are repeating the course will need to repeat the practical and the problem classes. Repetition of the seminars is optional. Repeating students can opt to maintain the grade from the previous year.

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

It is mandatory to pass the final exam and 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

BIBLIOGRAPHY

1. Basic Bibliography

- BROWN (2008) Genomas. Panamericana, 3ªed.
- WINK (Editor) (2011) An Introduction to Molecular Biotechnology: Fundamentals, Methods and

COURSE DESCRIPTION

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/

2. Further reading

None

COORDINATION CRITERIA

Common evaluation criteria
Joint activities: lectures, seminars, visits ...
Tasks deadlines

SCHEDULE

Period	Assessment activities	Case study	Group presentation	Lab practice	Lectures	Tutorials
1# Fortnight	0,0	0,0	0,0	0,0	3,0	0,0
2# Fortnight	0,0	4,0	0,0	0,0	4,0	1,0
3# Fortnight	0,0	4,0	0,0	0,0	4,0	1,0
4# Fortnight	0,0	4,0	0,0	3,0	3,0	1,0
5# Fortnight	0,0	4,0	1,0	0,0	4,0	1,0
6# Fortnight	0,0	2,0	2,0	0,0	3,0	1,0
7# Fortnight	4,0	0,0	1,0	0,0	3,0	1,0
8# Fortnight	0,0	0,0	0,0	0,0	0,0	1,0
Total hours:	***4,0***	***18,0***	***4,0***	***3,0***	***24,0***	***7,0***

The methodological strategies and the evaluation system contemplated in this Course Description will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required.

CONTINGENCY PLAN: CASE SCENARIO A

Case scenario A will correspond to a diminished on-site academic activity due to social distancing measures affecting the permitted capacity of classrooms.

COURSE DESCRIPTION

METHODOLOGY

General clarifications on the methodology on case scenario A

A multimodal (hybrid) teaching system will be adopted, combining both on-site and remote classes via videoconference (synchronous) that will be held in the timetable approved by the corresponding Faculty or School. The time distribution of teaching activities (both on-site and remote) will be decided by the aforementioned Faculties and Schools bearing in mind the permitted capacity of classrooms and social distancing measures as established at that time.

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 Professor.

Experimental design sets

For each chapter, an experimental design question 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. Experimental design questions should be resolved **IN ADVANCE** of the problem class. At the beginning of a class, a student team will deliver a presentation 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. During the weeks and days before the experimental design presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor during the tutorial time periods.

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 Professor. During the weeks and days before the presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor 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.

COURSE DESCRIPTION

EVALUATION

Intended learnig	Exams	Oral Presentation	Problem solving	Real and/or simulated tasks
CB10v5	X	X	X	X
CB14v2	X	X	X	X
CB18v2	X	X	X	X
CB19v4	X	X	X	X
CB2v2	X	X	X	X
CB3v2	X	X	X	X
CB3v7	X	X	X	X
CB4v4	X	X	X	X
CE21v5	X	X	X	X
CE21v6	X	X	X	X
CE67n	X	X	X	X
CE83n	X	X	X	X
CE84n	X	X	X	X
CE85n	X	X	X	X
CE86n	X	X	X	X
CE87n	X	X	X	X
CE88n	X	X	X	X
Total (100%)	***50%***	***20%***	***15%***	***15%***
Minimum grade	***4***	***1***	***1***	***1***

(*)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.

Attendance will be assessed (Scenario A)?:

No

General clarifications on instruments for evaluation (Scenario A):

General clarifications on instruments for evaluation:
It is mandatory to pass the final exam and 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.

COURSE DESCRIPTION

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

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

The methodological adaptations for the students enrolled at part-time will be agreed on in meetings between the Professors and the students, in order to allow personalized solutions for each individual case.

Enrolled students who are repeating the course will need to repeat the practical and the problem classes. Repetition of the seminars is optional. Repeating students can opt to maintain the grade from the previous year.

CONTINGENCY PLAN: CASE SCENARIO B

Case scenario B will bring about a suspension of all on-site academic activities as a consequence of health measures.

METHODOLOGY

General clarifications on the methodology on case scenario B

On-site teaching activities will be held via videoconference (synchronous) in the timetable approved by the corresponding Faculty or School. Alternative activities will be proposed for reduced groups in order to guarantee the acquisition of course competences.

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 Professor.

Experimental design sets

For each chapter, an experimental design question 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. Experimental design questions should be resolved **IN ADVANCE** of the problem class. At the beginning of a class, a student team will deliver a presentation 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

COURSE DESCRIPTION

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. During the weeks and days before the experimental design presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor during the tutorial time periods.

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 Professor. During the weeks and days before the presentation, the students are **STRONGLY RECOMMENDED** to consult and discuss the presentation with the professor 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.

EVALUATION

Intended learnig	Exams	Oral Presentation	Problem solving	Real and/or simulated tasks
CB10v5	X	X	X	X
CB14v2	X	X	X	X
CB18v2	X	X	X	X
CB19v4	X	X	X	X
CB2v2	X	X	X	X
CB3v2	X	X	X	X
CB3v7	X	X	X	X
CB4v4	X	X	X	X
CE21v5	X	X	X	X
CE21v6	X	X	X	X
CE67n	X	X	X	X
CE83n	X	X	X	X
CE84n	X	X	X	X
CE85n	X	X	X	X
CE86n	X	X	X	X
CE87n	X	X	X	X
CE88n	X	X	X	X
Total (100%)	***50%***	***20%***	***15%***	***15%***
Minimum grade	***4***	***1***	***1***	***1***

COURSE DESCRIPTION

(*)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.

Moodle Tools	Exams	Oral Presentation	Problem solving	Real and/or simulated tasks
Questionnaire	X			
Videoconference		X	X	X

Attendance will be assessed (Scenario B)?:

No

General clarifications on instruments for evaluation (Scenario B):

General clarifications on instruments for evaluation:
It is mandatory to pass the final exam and 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.

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

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:
The methodological adaptations for the students enrolled at part-time will be agreed on in meetings between the Professors and the students, in order to allow personalized solutions for each individual case.
Enrolled students who are repeating the course will need to repeat the practical and the problem classes. Repetition of the seminars is optional. Repeating students can opt to maintain the grade from the previous year.