UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: GENETIC ENGINEERING AND BIOTECHNOLOGY
Code: 13319
Type: CORE COURSE
ECTS credits: 6
Degree: 341 - UNDERGRADUATE DEGREE PROGRAMME IN BIOCHEMISTRY
Academic year: 2021-22
Center: 501 - FACULTY OF ENVIRONMENTAL SCIENCES AND BIOCHEMISTRY
Group(s): 40
Year: 3
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **Mª CARMEN FENOLL COMES** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
Sabatini/029	CIENCIAS AMBIENTALES		carmen.fenoll@uclm.es	Tuesday, Wednesday and Thursday, 15 to 17 (prior appointment by email)

Lecturer: **MARTA CARMEN GUADAMILLAS MORA** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
Sabatini/017.2	CIENCIA Y TECNOLOGÍA AGROFORESTAL Y GENÉTICA		Marta.Guadamillas@uclm.es	Tuesday, Wednesday, Friday, 12.00h-14.00h (prior appointment by email)

Lecturer: **Mª DEL MAR MARTIN TRILLO** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
ICAM/0.20	CIENCIAS AMBIENTALES		mariamar.martin@uclm.es	Appointment by email

Lecturer: **ISABEL MARTINEZ ARGUDO** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
Sabatini/01	CIENCIA Y TECNOLOGÍA AGROFORESTAL Y GENÉTICA	925 268 800	isabel.margudo@uclm.es	

2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

Knowledge and skills developed in “Genetic Engineering” are essential in any field of modern Biochemistry. They have direct applications in professional areas as basic research, diagnosis and molecular monitoring, pharmaceutical and agro-alimentary industries, and any biotechnological activity. The acquisition of these skills enables to design different strategies to generate genetic modified organisms, applicable to several fields (health, agrofood, biotechnological industries,…)

“Genetic Engineering” is fundamental to understand the experimental basis of concepts developed in other courses related to molecular biology. Biotechnology introduces to a specific and productive application of Genetic Engineering, related to other optative courses (Biotechnology and Biomedicine itineraries).

4. Degree competences achieved in this course

Course competences

Code	Description
E01	Express themselves correctly in basic biological, physical, chemical, mathematical and computer terms.
E18	To know the principles of the manipulation of nucleic acids, as well as the techniques that allow the study of the gene function and the development of transgenic organisms with applications in biomedicine, industry, environment, agriculture, etc.
E31	To know and know how to apply the regulations on quality control and management and the legal and ethical bases involved in the development and application of the molecular life sciences.
G01	To possess and understand the knowledge in the area of Biochemistry and Molecular Biology at a level that, based on advanced textbooks, also includes cutting-edge aspects of relevance in the discipline
G02	To know how to apply the knowledge of Biochemistry and Molecular Biology to professional practice and to possess the necessary intellectual skills and abilities for this practice, including the capacity for: information management, analysis and synthesis, problem solving, organization and planning and generation of new ideas.
G03	Be able to collect and interpret relevant data, information and results, draw conclusions and issue reasoned reports on relevant social, scientific or ethical issues in connection with advances in Biochemistry and Molecular Biology.
G04	To know how to transmit information, ideas, problems and solutions in the field of Biochemistry and Molecular Biology to a specialized and non-specialized public.
G05	Develop those strategies and learning skills necessary to undertake further studies in the area of Biochemistry and Molecular Biology and other related areas with a high degree of autonomy.
G06	Acquire skills in the handling of computer programs including access to bibliographic, structural or any other type of databases useful in Biochemistry and Molecular Biology.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Become familiar with the scientific literature and with the search for and communication of scientific information.

Become familiar with experimental techniques for studying gene function.

Understand the molecular basis and applications of different methods of interrupting the specific expression of gene function.

Solve and design experiments in the field of Molecular Biology.

To know the model organisms used in biotechnology, their potential and characteristics.

To understand the potential applications of molecular biotechnology in agriculture, food, medicine, environment and industry and the main current trends and future challenges.

To know the techniques used to obtain genetically modified microorganisms, plants and animals.

Acquire the basic concepts necessary for the use of recombinant DNA technology.

Acquire the necessary scientific criteria to develop professional ethics in the application of genetic engineering and biotechnology.

Additional outcomes

To obtain an introductory training in holistic and reverse genetic experimental approaches in the fileds of genomics and genetic engineering

6. Units / Contents

Unit 1: INTRODUCTION

Unit 1.1 Genetic Engineering and modern Biotechnology. Multidisciplinary approach, current developmental fields and future perspectives. Theoretical basis, development and applications of recombinant DNA technologies.

Unit 2: BASIC TECHNIQUES IN GENETIC ENGINEERING

Unit 2.1 NUCLEIC ACID MANIPULATION. DNA manipulative enzymes. Modifying and restriction mechanisms. Applications of restriction enzymes. DNA polymerases. Terminal modifying enzymes.

Unit 2.2 BASIC TECHNIQUES IN GENETIC ENGINEERING I: Electrophoresis. Nucleic acid labelling. Nucleic acid and protein blotting on membranes.

Unit 2.3 PRINCIPLES OF DNA CLONING. Prokaryotic cloning vectors. Plasmids: identification, features and types. Plasmid incompatibility. Cosmids. Cloning strategies: DNA obtaining, DNA ligation, transformation. Clone selection. Protein engineering.

Unit 2.4 BASIC TECHNIQUES IN GENETIC ENGINEERING II: Polymerase chain reaction (PCR). Variations of classical techniques: RT-PCR and quantitative PCR. Applications of PCR. Nucleic acid sequencing.

Unit 2.5 GENETIC TRANSFORMATION IN PLANTS. Model species. Agrobacterium-mediated and direct transformation. Vectors. Selection and propagation of transgenic lines. Chloroplast transformation. Biotechnological applications.

Unit 2.6 GENETIC TRANSFORMATION IN ANIMALS. Model species. Vectors and methods: transfection and stable transformation. Selection and propagation of transgenic animals. Biotechnological applications.

Unit 3: STRATEGIES BASED ON GENETIC ENGINEERING FOR GENE AND FUNCTION ANALYSIS. BIOTECHNOLOGICAL APPLICATIONS.

Unit 3.1 GENE IDENTIFICATION. Construction of genomic libraries. Types and features. cDNA libraries. Screening methods.

Unit 3.2 GENE EXPRESSION: Transcript detection and quantification (Northern, RT-PCR). Reporter genes. Differential gene expression analysis. Rearrangements and RNA-seq.

Unit 3.3 GENE FUNCTION ANALYSIS BY MUTAGENESIS I: Mutagenesis. Directed mutagenesis. Directed molecular evolution.

Unit 3.4 GENE FUNCTION ANALYSIS BY MUTAGENESIS II: Reverse Genetics. Holistic (genomic) strategies. Genome-wide insertional mutations and gene trapping. Cre-Lox-based systems.

Unit 3.5 MODIFICATION OF GENE EXPRESSION: Promoter analysis. Promoter trapping. Constitutive and ectopic over-expression. RNA interference (RNAi)-based gene silencing. Conditional and inducible gene expression strategies: GAL4/UAS; XVE/Olex systems.

Unit 3.6 MACROMOLECULE INTERACTIONS. DNA-protein interactions: EMSAs. Yeast one hybrid assay (Y1H). ChIP. Transactivation by cotransfection. Protein-protein interactions: Protein complex immunoprecipitation (Co-IP). Biomolecular fluorescence complementation (BiFC). Subcellular location and protein dynamics.

Unit 3.7 PRECISION GENE AND GENOME EDITING. Designer meganucleases (TALEN, Zinc fingers). CRISP/Cas9 system. Present and future of genome editing systems.

Unit 3.8 BIOTECHNOLOGICAL APPLICATIONS. Molecular diagnosis. Recombinant vaccines. Gene therapy. Cloning. Stem cells.

Unit 4: LABORATORY PRACTICE

Unit 4.1 GMOs IDENTIFICATION BY PCR

Unit 4.2 CLONING AND IDENTIFICATION OF RECOMBINANT PLASMIDS

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E01 E18 E31 G01 G02	1.36	34	N	-	Lectures by professor (2-3h per week).
Other off-site activity [OFF-SITE]	Project/Problem Based Learning (PBL)	E18 E31 G02 G03	0.56	14	Y	N	Delivery of problems and case studies proposed by teachers. The activity is non-recoverable
Problem solving and/or case studies [ON-SITE]	Project/Problem Based Learning (PBL)	E01 E18 E31 G02 G03	0.24	6	Y	N	Problem solving by students. This activity is non-recoverable.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	E01 E18 G02 G03 G05	0.6	15	Y	Y	Realization of laboratory practices. It is a compulsory and non-reschedulable activity. Students will have to pass an exam, which is recoverable in the extraordinary and finalization exams.
Writing of reports or projects [OFF-SITE]	Group Work	E01 E18 G01 G03 G06	0.16	4	Y	N	Elaboration of a group presentation about a relevant scientific paper. Non-recoverable
Study and Exam Preparation [OFF-SITE]	Self-study	E01 E18 E31 G01 G03	2.88	72	N	-	

Final test [ON-SITE]	Assessment tests	E01 E18 E31 G01 G03	0.12	3	Y	Y	Written exam to assess knowledge on the main contents of the course. The activity is recoverable in the extraordinary and the finalization exams
Project or Topic Presentations [ON-SITE]	Combination of methods	E01 E18 G01 G03 G04	0.08	2	Y	N	Group presentation about scientific papers. This activity is non-reschedulable.
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Assessment of problem solving and/or case studies	10.00%	0.00%	Problem solving and case studies delivered will be assessed. This activity is non-recoverable.
Laboratory sessions	10.00%	10.00%	Realization of laboratory practices is compulsory. A minimun mark of 4.0 is required. Recoverable in the second resit.
Oral presentations assessment	10.00%	10.00%	Synthesis ability, overall understanding and creativity will be assessed.
Final test	70.00%	80.00%	A minimum mark of 4.0 in final test is required.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

By default, the participation of the student in the continuous assessment will be assumed, unless the latter states otherwise to the teacher.
Autonomous learning capacity will be evaluated, as well as critical reasoning, through various tests as indicated in the table.

Non-continuous evaluation:

For those students who express their interest to the teacher. Autonomous learning capacity will be evaluated, as well as critical reasoning, through various tests as indicated in the table.
The final grade for the course will be calculated taking into account the percentages in the table above. The subject will be passed with a 5.
In any case, to pass the subject it will be necessary to:
Obtain a minimum score of 4 in the final test, have completed the lab practices and obtain a minimum of 4 in the laboratory exam.

Specifications for the resit/retake exam:

The same criteria will be followed as for the ordinary test.
The grades obtained in the different theoretical and practical tests, carried out throughout the course will be kept for the resit exam

Specifications for the second resit / retake exam:

To pass this call there will only be a final test that will account for 100% of the grade, as long as the laboratory practices have been carried out

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours **hours**

Unit 1 (de 4): INTRODUCTION

Group 40:

Initial date: 14/09/2018 **End date:** 14/09/2018

Unit 2 (de 4): BASIC TECHNIQUES IN GENETIC ENGINEERING

Group 40:

Initial date: 15/09/2018 **End date:** 21/10/2018

Unit 3 (de 4): STRATEGIES BASED ON GENETIC ENGINEERING FOR GENE AND FUNCTION ANALYSIS. BIOTECHNOLOGICAL APPLICATIONS.

Group 40:

Initial date: 23/10/2018 **End date:** 22/12/2018

Unit 4 (de 4): LABORATORY PRACTICE

Group 40:

Initial date: 13/10/2018 **End date:** 30/10/2018

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
MD Rausell, Carolina Latorre, Amparo real	Técnicas de Ingeniería Genética	Síntesis		9788491710714	2017	
Brown, T	Genomas. 3ª Edición	Panamericana		978-9500614481	2008	
Glick, B; Pasternak, J and Patten, C	Molecular Biotechnology. 4th Edition	ASM Press		978-1555814984	2010	
	Biología Molecular e Ingeniería					

Herráez, A	Genética. 2ª Edición	ELSEVIER	978-84-8086-647-7	2012	
Kreuzer, H y Massey A	ADN recombinante y Biotecnología	Acribia	84-200-1025-1	2004	
Nair, AJ	Introduction to Biotechnology and genetic engineering	Jones and Barlett Publishers	978-1934015162	2008	
Perera, J; Tormo, A y Garcia, JL	Ingeniería genética. Volumen I: Preparación, análisis, manipulación y clonaje de DNA.	Síntesis	84-7738-966-7	2002	
Perera, J; Tormo, A y Garcia, JL	Ingeniería genética. Volumen II: Expresión de DNA en sistemas heterólogos	Síntesis	84-7738-966-7	2002	
Primrose S and Twyman, R	Principles of Gene Manipulation and Genomics. 8th edition	Balckwell	978-1405156660	2012	Prevista su publicación
Primrose S and Twyman, R	Principles of Gene Manipulation and Genomics. 7th edition	Blackwell	978-1405135443	2006	
Renneberg, R	Biotecnología	Reverte	978-8429174830	2008	
Thiemann, W y Palladin, M	Introducción a la Biotecnología.2ª edición	Pearson education	978-8478291175	2010	