Information about the subject

Degree: Bachelor of Science Degree in Biotechnology

Faculty: Faculty of Veterinary Medicine and Experimental Sciences

Code: 1100306 **Name:** Genetic and Molecular Engineering

Credits: 6,00 **ECTS Year:** 3 **Semester:** 2

Module: Bioengineering and Biotechnological Processes

Subject Matter: Genetic Engineering **Type:** Compulsory

Field of knowledge: Ciencias de la Salud

Department: Biotechnology

Type of learning: Classroom-based learning

Languages in which it is taught: Spanish

Lecturer/-s:

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Module organization

Bioengineering and Biotechnological Processes

Subject Matter	ECTS	Subject	ECTS	Year/semester
Genetic Engineering	6,00	Genetic and Molecular Engineering	6,00	3/2
Bioreactors	6,00	Bioreactors	6,00	3/2
Biochemical Engineering	6,00	Biochemical Engineering	6,00	3/1
Plant and Animal Biotechnology	6,00	Plant and Animal Biotechnology	6,00	3/2
Cell Culture	6,00	Cell Culture	6,00	3/2
Biotechnological Processes and Products	6,00	Biotechnological Processes and Products	6,00	4/1

Recommended knowledge

Recommended previous courses: Molecular Genetics, Molecular Microbiology of Microorganisms.

Learning outcomes

At the end of the course, the student must be able to prove that he/she has acquired the following learning outcomes:

R1 The student has understood and assimilated the contents of the subject.

R2 The student is able to solve problems or case studies related to the subject contents, by using different resources (bibliographic, IT, etc.)

R3 The student is able to work in a laboratory, carrying out basic operations correctly and taking into account the corresponding safety standards. He/she understands the planning, development and purpose of the experience, and is able to contrast and validate the obtained results.

R4 The student is able to write an intelligible and organized text on different aspects of the subject.

R5 The student is able to present and defend his/her work adequately.

R6 The student seeks bibliographic information from different sources and can analyze it with a critical and constructive spirit.

R7 The student collaborates with the teacher and his/her peers throughout the learning process; he/she works in a team; treats everyone with respects, is proactive and fulfills the organization rules of the course.

Competencies

Depending on the learning outcomes, the competencies to which the subject contributes are (please score from 1 to 4, being 4 the highest score):

BASIC		Weighting			
		1	2	3	4
CB1	Students acquire and understand knowledge in their field of study based on general secondary education but usually reaching a level that, although supported on advanced text books, also includes aspects involving state-of-the-art knowledge specific to their area.		x		
CB2	Students are able to apply knowledge to their work in a professional way and have the competences enabling them to state and defend views and opinions as well as perform problem-solving tasks in their field of study.		x		
CB3	Students are able to collect and interpret relevant data (generally in their field of study) and give opinions that involve reflection on relevant social, scientific or ethical issues.			x	
CB4	Students can communicate information, ideas, problems and solutions to a specialized or non-specialized audience.			x	
CB5	Students develop the necessary learning skills to undertake further studies with a high level of autonomy.		x		

GENERAL		Weighting			
		1	2	3	4
CG01	Capacity to analyze and synthesize.				x

SPECIFIC		Weighting			
		1	2	3	4
CE22	Knowing and understanding contents, principles and theories related to biotechnology.			x	

CE23	Knowing how to use laboratory equipment and to carry out basic operations for each discipline including: safety measures, handling, waste disposal and activity register.				x
CE24	Knowing basic and instrument laboratory techniques in the different areas of biotechnology.				x
CE25	Knowing how to analyze and understand scientific data related to biotechnology.				x
CE26	To understand and identify the mechanisms that influence genetic inheritance	x			
CE27	Knowing and applying action plans and assessment criteria of biotechnology processes.		x		
CE28	Integrating life science and Engineering into processes of development of biotechnological products and applications.				x
CE29	Contrasting and checking results of biotechnological experimentation.				x
CE30	Solving and analyzing problems posed by biotechnology.			x	
CE31	Describing and calculating important variables of processes and experiments.			x	
CE32	Knowing how to use different specific operating systems and software packages designed for Biotechnology.		x		
CE33	Knowing and complying with legislation and ethics of biotechnological processes and applications.	x			
CE34	Knowing main characteristics of Molecular biosciences and biotechnology communication.	x			

TRANSVERSAL		Weighting			
		1	2	3	4
CT02	Capacity to organize and plan.			x	
CT03	Mastering Spanish oral and written communication.				x
CT05	Knowing and applying Basic ITC skills related to Biotechnology.		x		
CT06	Capacity to manage information (capacity to look for and analyze information coming from different types of sources).		x		

CT07	Problem solving.				x
CT09	Capacity to work in interdisciplinary and multidisciplinary team.				x
CT10	Interpersonal skills.				x
CT12	Critical and self-critical capacity.		x		
CT13	Ethics.	x			
CT14	Capacity to learn			x	
CT16	Capacity to produce new ideas (creativity)			x	
CT17	Leadership abilities			x	
CT18	Taking initiatives and enterprising spirit			x	
CT19	Capacity to apply theoretical knowledge				x
CT20	Research skills				x
CT21	Sensitivity to environmental issues	x			

Assessment system for the acquisition of competencies and grading system

Assessed learning outcomes	Granted percentage	Assessment method
R1, R2, R3, R5	50,00%	Written test
R1, R2, R3, R4, R5, R6, R7	40,00%	Submission of papers
R3, R7	10,00%	Laboratory test

Observations

According to the general evaluation and qualification regulations, the preferred evaluation system will be by means of continuous evaluation:
Notes to the assessment system:
1. The laboratory assessment test (10%) consist of weekly submission of questions related to the laboratory sessions (DU2).
2. The submission of papers (40%) is divided in:
i) Weekly assignments from the theory block (DU1) (10%)
ii) Final research paper (DU2) (30%)
3. A minimum grade of 5 over 10 is needed both the final exam and final research paper.
4. Attendance to laboratory and informatics sessions is compulsory: a maximum of 1 unjustified absence will be permitted, otherwise access to final exam will not be allowed.
5. In the case of not passing the course, the student will have to repeat all teaching activities during the following academic year.
6. Plagiarism detected in any of the course assignments will result directly in a 4/10 final mark for the course in the corresponding assessment period

MENTION OF DISTINCTION:
In accordance with the regulations governing the assessment and grading of subjects in force at UCV, the distinction of "Matrícula de Honor" (Honours with Distinction) may be awarded to students who have achieved a grade of 9.0 or higher. The number of "Matrículas de Honor" (Honours with Distinction) may not exceed five percent of the students enrolled in the group for the corresponding academic year, unless the number of enrolled students is fewer than 20, in which case a single "Matrícula de Honor" (Honours with 9 Distinction) may be awarded. Exceptionally, these distinctions may be assigned globally across different groups of the same subject. Nevertheless, the total number of distinctions awarded will be the same as if they were assigned by group, but they may be distributed among all students based on a common criterion, regardless of the group to which they belong. The criteria for awarding "Matrícula de Honor" (Honours with Distinction) will be determined according to the guidelines stipulated by the professor responsible for the course, as detailed in the "Observations" section of the evaluation system in the course guide.

Learning activities

The following methodologies will be used so that the students can achieve the learning outcomes of the subject:

M1	Teacher presentation of contents, analysis of competences, explanation and in-class display of skills, abilities and knowledge.
M2	Group work sessions supervised by the professor. Case studies, diagnostic tests, problems, field work, computer room, visits, data search, libraries, on-line, Internet, etc. Meaningful construction of knowledge through interaction and student activity.
M3	Activities carried out in spaces with specialized equipment.
M4	Supervised monographic sessions with shared participation..
M5	Application of multidisciplinary knowledge.
M6	Personalized and small group attention. Period of instruction and/or guidance carried out by a tutor to review and discuss materials and topics presented in classes, seminars, readings, papers, etc.
M7	Set of oral and/or written tests used in initial, formative or additive assessment of the student
M8	Group preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical , practical and/or small-group tutoring sessions. Work done on the university e-learning.

M9 Student's study: Individual preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical, practical and/or small-group tutoring sessions. Work done on the university e-learning platform.

IN-CLASS LEARNING ACTIVITIES

	LEARNING OUTCOMES	HOURS	ECTS
ON-CAMPUS CLASS M1	R1, R2, R7	20,00	0,80
PRACTICAL CLASSES M2	R1, R2, R4, R5, R6, R7	6,00	0,24
LABORATORY M3	R1, R2, R3, R7	24,00	0,96
SEMINAR M4	R1	4,00	0,16
GROUP PRESENTATION OF ASSIGNMENTS M5	R5	1,00	0,04
TUTORIAL M6	R1, R2, R3, R4, R5, R6, R7	3,00	0,12
ASSESSMENT M7	R1, R2, R3, R4, R5, R6, R7	2,00	0,08
TOTAL		**60,00**	**2,40**

LEARNING ACTIVITIES OF AUTONOMOUS WORK

	LEARNING OUTCOMES	HOURS	ECTS
AUTONOMOUS GROUP WORK M8	R2, R3, R4, R5, R6, R7	18,00	0,72
AUTONOMOUS INDIVIDUAL WORK M9	R1, R2, R4, R6	72,00	2,88
TOTAL		**90,00**	**3,60**

Description of the contents

Description of the necessary contents to acquire the learning outcomes.

Theoretical contents:

Content block	Contents
DIDACTIC UNIT 1 – FUNDAMENTS OF GENETIC ENGINEERING	1. Introduction 2. Main laboratory techniques 3. Enzymes for DNA manipulation *in vitro* 4. Molecular cloning I: Basic cloning vectors 5. Molecular cloning II: Cell systems for cloning 6. Molecular cloning III: Cloning methods 7. Advanced vectors for cloning in bacteriae and other organisms 8. Gene libraries 9. Expression of cloned genes 10. Changing genes: mutagenesis and gene editing 11. Synthetic biology
DIDACTIC UNIT 2 – LABORATORY PROJECTS	**BLOCK I: Research project: gene cloning and sequencing (14 sessions)** 1. Genomic DNA extraction 2. Nested PCR 3. Agarose electrophoresis 4. Purification of PCR products 5. Cloning 6. Transformation 7. Plasmid purification 8. Preparation of DNA samples for sequencing 9. Bioinformatic analysis **BLOCK II: Gene editing with CRISPR (1 session)**

Organization of the practical activities:

	Content	Place	Hours
PR1.	LABORATORY PROJECT	Lecture room	2,00
PR2.	LABORATORY PROJECT	Laboratory	24,00
PR3.	LABORATORY PROJECT	Computer	4,00
PR4.	VISIT TO COMPANY	Technical visit	2,00
PR5.	CASE STUDY THROUGH VIRTUAL LABORATORIO SIMULATIONS	Lecture room	5,00

Temporary organization of learning:

Block of content	Number of sessions	Hours
DIDACTIC UNIT 1 – FUNDAMENTS OF GENETIC ENGINEERING	15,00	30,00
DIDACTIC UNIT 2 – LABORATORY PROJECTS	15,00	30,00

References

Basic references for lecture sessions:
- Blázquez Ortiz, C., Navarro Llorens JM, Rodríguez Crespo, JI (2021). **142 problemas de Ingeniería Genética resueltos paso a paso.** Ed. Síntesis.
- Brown, TA (2020) **Gene Cloning and DNA Analysis: An Introduction**. 8th edition. Ed. Wiley-Blackwell
- Nicholl, D. S. T. (2023). **An Introduction to Genetic Engineering** (4th ed.). Cambridge: Cambridge University Press.
- Real-García, MD., Rausell-Segarra, C., Latorre-Castillo A., (2017). **Técnicas de ingeniería genética.** Ed. Síntesis.

Basic references for laboratory sessions:
- Bio-Rad (2020). **Cloning and Sequencing Explorer Series. Curriculum manual.**

Additional references:
- Hofmann, A., & Clokie, S. (Eds.). (2018). ***Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.).** Cambridge: Cambridge University Press.
- Glick, BR and Pattern, CL (2022) **Molecular Biotechnology: Principles and Applications of Recombinant DNA (6th Ed.)** ASM Press.
- Green, MR., Sambrook, J (2012) **Molecular Cloning**: A Laboratory Manual 4th edition. Cold Spring Harbor Laboratory Press.
- Primrose SB, Twyman RM (2006) **Principles of gene manipulation and genomics**. 7th edition. Ed. Blackwell Publishing
- Watson JD, Baket, TA, Bell, SP, Gann, A, Levine, Ml Losick, R, (2007) **Molecular Biology of the Gene**. 6th edition. Ed. Pearson-Benjamin Cummings