1. OVERVIEW

Subject Area	Molecular Genetic Engineering
Degree	Bachelor's Degree in Biotechnology
School/Faculty	School of Biomedical and Health Sciences
Year	3
ECTS	6
Type	Compulsory
Language(s)	Spanish
Delivery Mode	On campus
Semester	S1
Academic Year	24-25
Coordinating professor	Mónica Martínez Martínez
Teacher	

2. INTRODUCTION

Molecular Genetic Engineering is a compulsory subject worth 6 ECTS and is taught over the semester in the third year of the Bachelor's Degree in Biotechnology and the fifth year of the Combined Degree in Pharmaceuticals and Biotechnology. This subject area falls under Module IV: INSTRUMENTAL METHODS AND BIOCHEMICAL ENGINEERING worth a total of 36 ECTS. This subject encompasses those processes which use recombinant DNA technology to modify the genetic material of an organism. Currently, the most common strategies in genetic manipulation are: overexpression of exogenous genes (transgenic) and site-directed mutagenesis (knock-out and knock-in) or genome editing. Discoveries in genetic engineering have revolutionised medicine and biotechnology in the 21st century.

The main aim of this subject area is to teach students the basic tools and analysis techniques used in the manipulation of genetic material of organisms, as well as their most significant applications in biotechnology and medicine. Students will acquire the knowledge and skills necessary to professionally develop in the field of new genetic biotechnology. They will be able to intellectually and empirically deal with the most significant implications of genetic engineering in scientific and social development.

3. LEARNING OUTCOMES (RA, by the acronym in Spanish)

Abilities (HAB, by the acronym in Spanish)

HAB04. Design experimental procedures and protocols choosing the most suitable technique in the field of biotechnological research, all the while meeting quality and legislative standards.

• Present in public the suitability and results obtained in instrumental techniques used in a practical study of a recent scientific article.

• Design a cloning and expression system of a gene for a protein of biotechnological interest, including purification and analytical methods for its identification and activity.

Skills

COMP06. Develop the skills needed to use the most common equipment, instruments and basic techniques in biotechnology, following quality standards and current biosecurity regulations.

COMP09. Identify and apply tools and techniques used in genetic and genomic engineering, both in experiments and in silico.

4. CONTENTS

· Bases of genetic and biotechnological engineering
· Basic genetic engineering tools
· Methods for sequencing and analysing nucleic acids
· Genomic libraries. Construction and screening of genomic and DNA libraries.
· Cloning and gene expression. Techniques and strategies. Identifying cloned DNA. Biotechnological applications of genetic engineering.

Topic 1. INTRODUCTION TO GENETIC ENGINEERING
1.1. General overview.
1.2. History and regulations.

Topic 2. BASIC GENETIC ENGINEERING TOOLS
2.1. Basic techniques for treating nucleic acids: isolation, purification and analysis techniques. PCR technique. Electrophoresis. Hybridisation with probes. DNA sequencing techniques. Site-directed mutagenesis. Microarrays.
2.2. Enzymology of DNA: Restriction enzymes, kinases, polymerases, nucleases, ligases and other modifying enzymes.

Topic 3. RECOMBINANT DNA TECHNOLOGY: VECTORS AND HOSTS
3.1. Methodology for the creation of recombinant molecules: cloning vectors, inserts and adapters. Types of cloning vectors depending on origin: plasmids, viruses, cosmids and others. Characteristics of the cloning vector sequence (multiple cloning sites, expression regulation, reporter genes, and so on).
3.2. Hosts for cloning vectors. Gene transfer systems in prokaryote and eukaryote cells. Factors which affect the expression of cloned genes. Recombinant clones selection methods.

Topic 4. RECOMBINANT DNA TECHNOLOGY: CLONING STRATEGIES
4.1. Cloning strategies: PCR and chemical synthesis.
4.2. Creating genomic and cDNA libraries.

Topic 5. RECOMBINANT DNA TECHNOLOGY: IDENTIFICATION AND ANALYSIS OF CLONED DNA (SCREENING)
5.1. Structural analysis: Restriction maps, hybridisation of DNA and sequencing. Use of bioinformatics.
5.2. Functional analysis: Reporter vectors or for the study of regulating sequences. Analysis techniques for the expression of the cloned gene. Other functional analysis techniques.

Topic 6. APPLICATIONS OF GENETIC ENGINEERING
6.1. Genetic modification in animals: transgenic animals. Knock-out and Knock-in animals (gene targeting and genome editing). Methods and applications.
6.2. Genetic modification in plants: transgenic plants. Genomic editing. Methods and applications.

6.3. Genetic modification in microorganisms: transgenic microorganisms. Genomic editing. Biotechnological applications.
6.4. Genetic modification in medicine: Fundamentals of gene therapy. Genome editing in clinical investigation. Other therapeutic methods based on genetic engineering.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Lecture.
- Collaborative learning.
- Project-based learning.
- Learning based on workshop teaching

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity	Number of hours
Lectures	29
Asynchronous master lectures	10
Debates and discussions	3
Problem-solving	12
Spoken presentations	2
Written reports and essays	5
Tutorials	15
Independent working	50
Workshops and/or lab work	14
Scientific research and projects	4
On-campus knowledge tests	6
TOTAL	**150**

7. ASSESSMENT

The assessment methods, together with how much they each count towards the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
On-campus knowledge tests	60%
Spoken presentations	5%
Reports and written work	15%
Case study/problem scenario	5%
Laboratory work	15%

On the Virtual Campus, when you open the subject area, you can see all the details of your assessment activities and the deadlines and assessment procedures for each activity.

7.1. Ordinary exam period

To pass the subject area in the ordinary exam period you must obtain a mark of 5.0 or more out of 10.0 in all assessed parts of the subject. Any part you do not pass in the ordinary exam period will need to be recovered in the extraordinary exam period (resits).

Your final grade will be the average of the partial marks in each of the learning activities you have passed. The continuous assessment system for the learning activities requires attendance to at least 50% of the classes.

It is compulsory for students to accredit attendance to at least 50% of classes. This requirement is essential to the assessment process and qualifies students for the right to obtain academic counselling, support and monitoring from the professor. To this end, students must use the technological means made available by the University to accredit their daily attendance to each of their classes. This system will also serve to guarantee an objective record of the active role of the students in the classroom. Failure to accredit attendance to at least 50% of the classes by any of the means proposed by the University will mean that the professor awarding a fail to the student for that subject area in the ordinary exam period in accordance with the grading system outlined in these regulations. All of the above, without prejudice to the other requirements or higher attendance percentages that other faculties may stipulate in their learning guides or internal regulations. Regulations for the assessment of official degree programmes, Art. 1 point 4. (http://www.uem.es/myfiles/pageposts/reglamento_evaluacion_titulaciones_oficiales_grado.pdf).

7.2. Extraordinary exam period (resits)

To pass the subject area in the extraordinary exam period (resits), the students must obtain a mark equal to or above 5.0 out of 10.0 in all parts of the subject assessment they did not pass during the ordinary exam period.

The student must submit the activities not passed in the ordinary exam period taking into account the corrections or comments made by the teacher. The student must also submit any activities which were not submitted.

The final grade will be the average of the partial marks in each of the activities passed (with a mark equal to or higher than 5 out of 10). The marks for the assessable activities the student passed in the ordinary exam period will be maintained for calculating this grade.

8. TIMELINE

The timeline with delivery dates of assessable activities in the subject area is indicated in this section:

Assessable activities	Date
Delivery of solved problems	Week 3, 7 and 15
First objective knowledge test	Week 9
Submission of prior activity: PBL	Week 10
Laboratory work	Week 10, 12 and 14
Specialised seminar T6	Week 15
Objective knowledge tests (ordinary exam period)	Week 21-22

The timeline may be subject to modifications for logistical reasons of the activities. Students will be informed of any changes in due time and course.

9. BIBLIOGRAPHY

The reference work for following this subject area is:

BASIC BIBLIOGRAPHY:

• Brown, T.A., (2016), Gene cloning and DNA analysis: an introduction, 6th ed., WileyBlackwell.

• Glick, B.R., Pasternak, J.J. and Patten, C.L., (2010), Molecular biotechnology: principles and applications of recombinant DNA, 4th ed., ASM; Oxford: Blackwell [distributor].

• Izquierdo Rojo, M., (2001), Ingeniería genética y transferencia génica, Pirámide. o notas: El objetivo principal de este libro es explicar la base conceptual de las técnicas de ingeniería genética y transferencia génica y dar a conocer sus aplicaciones más inmediatas.

• Kreuzer, H. and Massey, A., (2004), ADN recombinante y biotecnología: guía para estudiantes, Acribia.

• Lewin, B., Barrrera Villa Zevallós, H. and García Roig, F., (2008), Genes IX, 1a, McGraw-Hill.

• Luque Cabrera, J. and Herráez Sánchez, Á., (2012), Texto ilustrado de biología molecular e ingeniería genética: conceptos, técnicas y aplicaciones en ciencias de la salud, Re-edicion 2010, Elsevier. o Obra muy novedosa por su planteamiento integral y diseño, escrita pensando en las necesidades del alumno. En ella se recogen, los conceptos básicos de la biología molecular e ingeniería genética para, posteriormente, establecer sobre estas bases sus cada vez mayores aplicaciones tecnológicas y la terapéutica del futuro. Muy visual.

• Primrose, S.B. and Twyman, R.M., (2006), Principles of gene manipulation and genomics, 7th ed., Blackwell.

• Sambrook, J. and Russell, D.W., (2006), The condensed protocols from Molecular cloning: a laboratory manual, Cold Spring Harbor Laboratory Press. o notas: Manual imprescindible para el laboratorio de biología molecular e ingeniería genética. Es el antiguo “Maniatis”.

• Julian Perera, Antonio Tormo, José Luis García. (2010) Ingeniería Genética Vol I y II. Editorial Síntesis.
• Glover, S and Crumpton, G., (2012). Handbook of Genetic Engineering. Academic Studio.
• Nicholl DST (2016) An introduction to genetic engineering. Cambridge: Cambridge University Press.

OPEN-ACCESS BIBLIOGRAPHY ON INTERNET

• http://www.ncbi.nlm.nih.gov/books/NBK7580/ (Strachan y Read (1999). Human Molecular Genetics 2. 2nd edition. BIOS Scientific Publishing Ltd. Oxford (UK).
• http://www.ncbi.nlm.nih.gov/books/NBK21128/ (Brown, T.A. (2002) Genomes. 2nd edition. BIOS Scientific Publishing Ltd. Oxford (UK).

WEBSITES

• https://www.genome.gov/genetics-glossary (Diccionario de términos genéticos en inglés).
• http://www.ncbi.nlm.nih.gov/PubMed (U.S. National Library of Medicine)
• http://www.ensembl.org/index.html (Base de datos genómica europea)
• http://www.neb.com/nebecomm/tech_reference/restriction_enzymes/cloning_gu ide.asp (New England Biolabs company web page).
• http://www.scirus.com/srsapp/ (buscador web científico)
• http://www.fao.org/docrep/006/y5160s/y5160s00.htm (biotecnología agrícola según la FAO)
• http://www.fao.org/docrep/004/y2775s/y2775s00.htm#Contents (Glossary of biotechnology and genetic engineering from FAO)
• http://www.fecyt.es/fecyt/home.do (Fundación Española para la Ciencia y la Tecnología)
• http://www.nature.com/scitable (Educational website by Nature group)
• http://www.dnalc.org/ (DNA Learning Center, Cold Spring Harbor Laboratory. Web muy útil para ver vídeos y zonas interactivas sobre las bases moleculares del ADN).
• http://ghr.nlm.nih.gov/glossary=contig (Diccionario científico del NIH)
• http://www.porquebiotecnologia.com.ar/index.php?action=cuaderno&opt=5 (Consejo Argentino para la información y el desarrollo de la biotecnología

The recommended bibliography is indicated below:

- Brown, T.A., (2016), Gene cloning and DNA analysis: an introduction, 6th ed., WileyBlackwell.
- Primrose, S.B. and Twyman, R.M., (2006), Principles of gene manipulation and genomics, 7th ed., Blackwell.
- Julian Perera, Antonio Tormo, José Luis García. (2010) Ingeniería Genética Vol I y II. Editorial Síntesis.

10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

The Educational Guidance and Diversity Unit (ODI in Spanish) offers support throughout your time at university to help you with your academic achievement. Other cornerstones of our educational policy are the inclusion of students with special educational needs, universal access in all our university campuses and equal opportunities.

This ODI unit offers students:

1. Support and monitoring through counselling and personalised student plans for those who need to improve their academic performance.

2. Curricular adaptations to uphold diversity, with assistance for those students who require specific educational support, leading to equal opportunities without significant changes to methodology or evaluation.
3. We offer students a range of extracurricular educational resources to reinforce skills which will enhance their personal and professional development.
4. Career guidance by offering tools and advice to students with doubts regarding their professional careers or those who believe they have chosen the wrong line of study.

Students who need educational support can contact us at:
orientacioneducativa@universidadeuropea.es

11. SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degree courses and the learning process.

These surveys will be available in the surveys area of your virtual campus or by email.

Your opinion is essential to improve the quality of the degree.

Many thanks for taking part.