

## 28920 - Biotechnology

### Syllabus Information

**Academic Year:** 2021/22

**Subject:** 28920 - Biotecnología

**Faculty / School:** 201 - Escuela Politécnica Superior

**Degree:** 583 - Degree in Rural and Agri-Food Engineering

**ECTS:** 6.0

**Year:** 3

**Semester:** First semester

**Subject Type:** Compulsory

**Module:**

## 1. General information

### 1.1. Aims of the course

Main objective of this syllabus is that students will know the basis of biotechnology and also the techniques that are nowadays applied in food production and agrarian processes. Students will be able to perform basic laboratory techniques commonly employed by plant (DNA purification, amplification of molecular markers by PCR, in vitro culture, etc.) and animal (semen quality assessment, isolation and conservation of oocytes, etc.) biotechnologists.

## 2. Learning goals

## 3. Assessment (1st and 2nd call)

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The learning program designed for this course is based on studying the fundamental topics and basic tools which are needed to know, and know to use, the main biotechnologies that are nowadays applied in agronomy. To reach this, we have combined the conceptual expositions in theoretical classes and a set of practical experiences that will allow a better understanding of these techniques and also will show its applicability.

### 4.2. Learning tasks

The course includes the following learning tasks:

Participative lectures, 30 on-site hours. The program of the course encompasses 15 themes, which will be presented in 2 h sessions. These themes are grouped in three clearly differentiated main blocks: the first block deals with basic knowledge about molecular genetics and nucleic acids- based technics, which will be related to its main applications in agronomy. The second block of themes cover fundamentals of plant biotechnology and the third one topic is biotechnology for animal production.

Practical classes in laboratory/computers?room, 30 on-site hours distributed in 15 sessions of 2 h. In each class, students will perform a practical experience related to the theoretical program of the course. The practical work will consist in laboratory experiments (28 h) and computer-based technics (2 h).

Study for the written exam: professors will provide lecture notes and power-point slides with the information presented in the theoretical classes. They also will provide a list of references to support the autonomous work of the student (87 h).

To a better development of the learning process, professors will encourage students to use the individual tutorial sessions

Written and practical exams: 3 hours.

### 4.3. Syllabus

The course will address the following topics:

#### Block I. Foundations and techniques

Unit 1. Introduction and overall context

Concept and evolution of biotechnology

White biotechnology

Red biotechnology

Green biotechnology

Biotechnology as a business ? patents

Unit 2. Foundations of biotechnological progress ? biochemistry and molecular biology

Biotechnological molecules

Proteins

Nucleic acids

Molecular genetics

Unit 3. Tools and techniques of molecular genetics (I)

Isolation and purification of nucleic acids

The first tools: endonucleases

Genetic transformation

Cloned DNA and recombinant DNA

Vectors for storing DNA ? gene library

In-vitro replication ? polymerase chain reaction

Unit 4. Tools and techniques of molecular genetics (II)

Electrophoresis of DNA

Real time PCR, quantitative PCR

Isothermal amplification of DNA

Reverse transcription

DNA sequencing

Unit 5. Genomic tools

Genome projects

Genes and genomes

Bioinformatics.

Next generation sequencing. Resequencing genomes

Unit 6. Proteins and proteomics

Purification and electrophoresis of proteins

Sequencing proteins

ELISA enzyme-linked immunosorbent assay

Enzyme production and industrial applications

#### Block II. Plant biotechnology

Unit 7. In-vitro culture of plant tissues and organs

Introduction ? concept and conditioning factors

Foundations ? cell totipotency and development

Phytohormones

Somatic embryogenesis

Plant organogenesis

Unit 8. Applications of plant micropropagation

Multiplication of plants

Plant propagation on an industrial scale

In-vitro production of plant metabolites

In-vitro conservation - cryopreservation

Applications in plant genetic improvement

## Unit 9. Genetic engineering of plants

- What is a transgenic plant?
- Genetic constructs for transforming plants
- Methods of plant transformation
- Confirmation of the transformation
- Applications of transgenic plants

## **Block III. Animal biotechnology**

### Unit 10. Biotechnology of animal reproduction I ? detection and synchronization of estrus

- Estrus detection techniques
- Estrus induction and synchronization techniques

### Unit 11. Biotechnology of animal reproduction II ? artificial insemination

- Semen assembly methods
- Semen quality assessment
- Semen storage and preservation
- Insemination techniques
- Conditioning factors of the successful reproduction after insemination

### Unit 12. Biotechnology of animal reproduction III ? embryonic technologies

- MOET programs
- In-vitro production of embryos

### Unit 13. Applications of biotechnology in animal genetic improvement ? animal genetic engineering

- Imbalance of linkage and selection
- Gene and marker assisted selection
- Genomic selection
- Genome manipulation in animal genetic improvement
- Transgenesis as a tool in animal production

### Unit 14. Biotechnological applications in animal feed

- Production and use of additives (enzymes, bacteria, yeasts, etc.) for animal feed
- Production and use of synthetic amino-acids

### Unit 15. Biotechnological applications in animal diagnosis and health

- Hormonal diagnosis
- Diagnosis of diseases
- Vaccine production

## **Content of practical sessions**

1. Protocol in the laboratory of plant biotechnology. Tools and equipment ? security and hygiene ? protocols ?preparation of basic solutions of molecular biology
2. Preparation of media for bacteria culture.
3. Isolation of DNA from plant leaves.
4. Amplification of DNA through PCR.
5. Electrophoresis of DNA.
6. Bioinformatics in plant genetics- Data bases - Design of primers.
7. In-vitro plant production ? organogenesis in tomato.
8. In-vitro plant production ? micropropagation of potato.
9. Protocol in the laboratory of animal biotechnology. Tools and equipment ? security and hygiene ? protocols ?preparation of basic solutions
10. Spermogram (1) ? classic assessment.
11. Spermogram (2) ? new semen analysis techniques.
12. Oocyte extraction and in-vitro embryo production.
13. Sex determination. Sperm sexing and sex determination in sperms and embryos
14. HUMECO Journey of Animal Reproduction.
15. Preservation of gametes and embryos.

#### 4.4. Course planning and calendar

##### Calendar of on-site sessions.

Week	Lectures (2 h)	Practice Sessions (2 h)	Autonomous work	Total
1	Theme 1	Practice 1		4
2	Theme 2	Practice 2	Study (3 h)	7
3	Theme 3	Practice 3	Study (4 h)	8
4	Theme 4	Practice 4	Study (4 h)	8
5	Theme 5	Practice 5	Study (4 h)	8
6	Theme 6	Practice 6	Study (4 h)	8
7	Theme 7	Practice 7	Study (4 h)	8
8	Theme 8 Written partial exam (2h)	Practice 8	Study (2 h)	8
9	Theme 9	Practice 9	Study (4 h)	8
10	Theme 10	Practice10	Study (4 h)	8
11	Theme 11	Practice 11	Study (4 h)	8
12	Theme 12	Practice 12	Study (4 h)	8
13	Theme 13	Practice 13	Study(4 h)	8
14	Theme 14	Practice 14	Study (4 h)	8
15	-		Study (8 h)	8
16	-	-	Study (8 h)	8
17	-	-	Study (8 h)	8
18	Theme 15	Practice 15	Study (4 h)	8
19	-		Study (8 h)	8
20	Theory Exam (2h)	Practical Exam (1h)		3
<b>Total hours</b>	34	31	85	150

#### 4.5. Bibliography and recommended resources

- BB** Abecia Martínez, Alfonso. Manejo reproductivo en ganado ovino / Alfonso Abecia Martínez, Fernando Forcada Miranda . Zaragoza : Servet, [2010]
- BB** Chawla, H. S.. Introduction to plant biotechnology / H. S. Chawla . 3rd. ed. Enfield (NH) [etc.] : Science Publishers, cop. 2009
- BB** Fundamentos de las técnicas de biología molecular / Denis Tagu, Christian Moussard, editores ; traducción realizada por Josep M. Casacuberta . Zaragoza : Acribia, 2006

- BB** Luque Cabrera, José. Texto ilustrado de biología molecular e ingeniería genética : conceptos, técnicas y aplicaciones en Ciencias de la Salud / José Luque Cabrera, Ángel Herráez Sánchez . Barcelona [etc.] : Elsevier , D.L. 2008
- BB** Reprology : Controlar la reproducción es controlar el futuro[Archivo de ordenador] / M. Ennuyer... [et al.] . Libourne : CEVA Santé Animale, 2001
- BC** Benítez Burraco, Antonio. Avances recientes en biotecnología vegetal e ingeniería genética de plantas / Antonio Benítez Burraco . Barcelona [etc.] : Reverté, D. L. 2005
- BC** Ingeniería genética, laboratorio virtual de identificación de transgénicos. CD-Rom. UNED, 2010
- BC** Klug, William S.. Conceptos de genética / William S. Klug, Michael R. Cummings, Charlotte A. Spencer ; traducción y revisión técnica, José Luis Ménsua, David Bueno i Torrens . 8ª ed. Madrid [ etc.] : Pearson, D.L. 2006
- BC** Kreuzer, Helen. ADN recombinante y biotecnología : guía para estudiantes / Helen Kreuzer, Adrienne Massey ; [traducción a cargo de María Isabel Mora y María Jesús Arrizubieta Balardi] . Zaragoza : Acribia, 2004
- BC** McKee, Trudy. Bioquímica : la base molecular de la vida / Trudy McKee, James R. McKee; [traducción : José Manuel González de Buitrago] . 1ª ed. en español, traducción de la 3ª ed. en inglés Madrid [etc.] : McGraw-Hill Interamericana, 2003
- BC** Razdan, M.K.. Introduction to plant tissue culture / M.K. Razdan . 2nd ed. Enfield : Science Publishers, cop. 2003
- BC** Smith, John E.. Biotecnología / John E. Smith ; traducción a cargo de Fernando Escrivá Pons... [et al.] . [1a. ed.] Zaragoza : Acribia, D.L. 2006

#### LISTADO DE URLs:

DNA from the Beginning is organized around key concepts  
[\[http://www.dnafb.org/\]](http://www.dnafb.org/)

Dna Learning Center - Biology Animation Library  
[\[http://www.dnalc.org/resources/animations/\]](http://www.dnalc.org/resources/animations/)

Oracle Foundation, Thinkquest Library  
[\[http://www.searchmagnified.com/?dn=thinkquest.org&pid=9PO6B1W9X\]](http://www.searchmagnified.com/?dn=thinkquest.org&pid=9PO6B1W9X)

Organización Mundial de Sanidad Animal, OIE  
[\[http://www.oie.int/es/\]](http://www.oie.int/es/)

The updated recommended bibliography can be consulted in:  
<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28920>