

Academic Year/course: 2022/23

## 25241 - Biotechnology and resource conservation

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 25241 - Biotechnology and resource conservation

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

**Degree:** 277 - Degree in Environmental Sciences

571 - Degree in Environmental Sciences

**ECTS:** 6.0

**Year:**

**Semester:** Second Four-month period

**Subject Type:** Optional

**Module:**

## 1. General information

### 1.1. Aims of the course

The general objectives of the subject seek to know the techniques of molecular, biochemical and genetic typification of organisms, and the methods of conservation of living collections and genomic banks.

These goals are aligned with some of the Sustainable Development Goals, SDGs, of the 2030 Agenda, contributing to some extent to their achievement:

- Objective 4: Quality education.
- Objective 15: Life of terrestrial ecosystems.

## 2. Learning goals

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

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

### 4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures and practice sessions.

The method of instruction which has been designed for this course is based on a fundamentally technical and applied approach, such that the activities that have been planned endeavour to promote the knowledge and understanding of the strategies of characterization and conservation of the biodiversity, especially the biotechnologies, in order to train professionals capable of using them. The fundamentals of the technologies will be explained in lectures and the students will be able to use them in the practice sessions.

### 4.2. Learning tasks

This course is organized as follows:

- Lectures (30 hours)
- Practice sessions (30 hours)
  - Seminars
  - Laboratory sessions
  - Visits

### 4.3. Syllabus

This course will address the following topics:

#### Lectures

##### Section I: Introduction to conservation

- **BIODIVERSITY.** Diversity and biodiversity; expression of biodiversity. Why conserve biodiversity? The sixth extinction? Recorded extinctions. Threatened species. What causes extinction? Endogamy and loss of diversity. Spiral of extinction. Centers of origin, of diversity, of diversification and of dispersión. Biogeographical regions. (2 h)
- **GENETIC DIVERSITY.** Importance of genetic diversity. What is genetic diversity? Extent of genetic diversity. Polymorphism, allele frequencies, heterozygosity, heterozygosity, genetic diversity, nucleotide diversity. Extent of genetic diversity: exogamy, endogamy. (2 h)

##### Section II: Characterization of the biodiversity.

- **MOLECULAR MARKERS.** What is a molecular marker? Isoenzymes. DNA markers: markers based on hybridization of DNA: RFLP, Minisatellites or VNTR, markers based on DNA amplification: RAPD, Microsatellites or SSRs, mixed markers: AFLP. DNA sequences. (4 h)
- **DNA CHEMISTRY.** Extraction of DNA. Technology of recombinant DNA. Molecular cloning. Tools and processes. Polymerase chain reaction (PCR). DNA sequencing (2 h)
- **CYTOGENETICS.** Chromosomes, karyotype. Intra and interspecific variation in the size of the genome: evolution and adaptive significance. Molecular cytogenetics, (GISH, FISH). (1 h)
- **THE GENES OF THE POPULATIONS: HARDY-WEINBERG EQUILIBRIUM.** Description of genetic diversity. Hardy-Weinberg equilibrium. Expected heterozygosity. Deviation of the Hardy-Weinberg equilibrium. Genetic drift. (2 h)
- **QUANTITATIVE VARIATION.** Quantitative variation. Properties of the quantitative characteristics. Quantitative genetic variation. Heritability. Genetic and environmental contribution to a characteristic. Contributions to genetic variation: additive, dominant and from interaction. (2 h)

##### Section III: Strategies of conservation.

Conservation in situ: natural parks, Natura network. Conservation ex situ: botanical gardens, germoplasma banks and DNA banks. Systems of propagation of plants: sexual reproduction and vegetative multiplication. (3 h)

Techniques of plant conservation. Orthodox and recalcitrant seeds. Material of vegetative propagation: field collections, conservation of clones. Multiplication and regeneration of entries in germoplasma banks. Incident factors in conservation. Physiological and genetic deterioration. Use of natural environments. Use of controlled environments: types of installations. Selection of environment. Effect of sample size. (4 h)

##### Section IV: Biotechnology applied to the conservation of organisms.

In vitro cultivation: concept and basic requirements. Totipotency: differentiation and development. Phytohormones and phyto regulators. Explant: concept and types. Morphogenesis: somatic embryogenesis and organogenesis. Techniques of micropropagation: cultivation of apices and adventitious regeneration. Rooting and acclimatization. (4 h)

Techniques of in vitro preservation: short- and medium-term storage. Encapsulation in calcium alginate: artificial seeds. Long-term preservation: cryopreservation. Techniques of cryopreservation: dehydration and vitrification, cryoprotectants. (3 h)

Off-type plants and somaclonal variants. Methods of analysis of material regenerated in vitro: flow cytometry, molecular markers. (1 h)

**Seminars** given by persons in charge of centres devoted to the conservation of natural resources, 4 hours of attendance. In fact there will be two seminars, one concerning strategies of in situ conservation in natural parks and another about the characterization and use of phitogenetic resources of agronomic interest.

**Laboratory/library sessions.** 20 hours of attendance.

**Laboratory experiments:** exercises in the characterization of plants through molecular markers, in the reproduction of plants with seeds and multiplication by cuttings, in micropropagation and in cryopreservation (16 h)

**Library sessions** on the application of bioinformatic tools to the characterization of phitogenetic resources (4 h).

**Visit** to the Horticultural Germoplasma bank in Zaragoza (6 hours of attendance).

**Study** for the written test and the preparation of reports on the practicals, a total of 87 hours of independent work by the student. For better progress in the learning process it will be beneficial for the students to use the tutorial hours, especially for the production of the laboratory/practical reports.

**Written test** 3 hours of attendance.

### 4.4. Course planning and calendar

Week	Theoretical class (2 h)	Practical class (2 h)	Homework	Horas total
------	-------------------------	-----------------------	----------	-------------

1	Lesson 1			2
2	Lesson 2		Estudio (3 h).	5
3	Lesson 3	Seminario sobre parques naturales.	Estudio (6 h).	10
4	Lesson 4	Prácticas de lab.: aislamiento de ADN.	Preparación de la práctica (0.5 h). Estudio (5.5 h).	10
5	Lesson 5	Marcadores de ADN: amplificación.	Preparación de la práctica (0.5 h). Estudio (5.5 h).	10
6	Lesson 6	Marcadores de ADN: electroforesis y codificación de alelos.	Preparación de la práctica (0.5 h). Estudio (5.5 h).	10
7	Lesson 7	Prácticas de gabinete: análisis de marcadores de ADN.	Estudio y elaboración de informe sobre la práctica (6 h).	10
8	Lesson 8	Prácticas de gabinete: análisis de polimorfismos de secuencias.	Estudio y elaboración de informe sobre la práctica (6 h).	10
9	Lesson 9	Visita al vivero forestal de Ejea de los Caballeros (6 h)	Estudio y redacción de informe de la visita (4h)	12
10	Lesson 10	Ensayos de escarificación y germinación de semillas forestales. Ensayos de estaquillado.	Preparación de la práctica (0.5 h). Elaboración de informes sobre las prácticas (5.5 h).	10
11	Lesson 11	Seminario sobre caracterización y aprovechamiento de recursos fitogenéticos	Estudio (6 h).	10
12	Lesson 12	Ensayo de micropropagación: medios de cultivo. Desinfección del material vegetal.	Preparación de la práctica (0.5 h). Estudio (5.5 h).	10
13	Lesson 13	Ensayo de micropropagación: siembra de explantos.	Preparación de la práctica (0.5 h). Estudio (5.5 h).	10
14	Lesson 14	Ensayo de criopreservación.	Preparación de la práctica (0.5). Estudio (5.5 h).	10
15	Lesson 15	Lectura de resultados de los ensayos de propagación.	Estudio y elaboración de informe sobre las prácticas (6 h).	10
			Estudio (8h)	8
	Written exam (3 h).			3
<b>Total hours</b>	33	30	87	150

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the EPS website and Moodle.

## 4.5. Bibliography and recommended resources

- BB** Avise, John C. *Phylogeography : the history and formation of species* / John C. Avise. Cambridge : Harvard University Press, 2000
- BB** *Biología de la conservación de plantas amenazadas* / coordinador Ángel Bañares Baudet. [Madrid] : Organismo Autónomo Parques Nacionales, D.L. 2002
- BB** Frankham, Richard. *Introduction to conservation genetics* / Richard Frankham, Jonathan D. Ballou and David A. Briscoe ; line drawings by Karina H. McInness. 2nd. ed. Cambridge : Cambridge University Press, 2010
- BB** Hunter, Malcolm L. *Fundamentals of conservation biology* / Malcolm L. Hunter, J. Gibbs. 3rd ed. Malden, MA : Blackwell Publishing, 2007
- BB** Pina Lorca, José Antonio. *Propagación de plantas* / José Antonio Pina Lorca. Valencia : Universidad Politécnica, 2008
- BB** Primack, Richard B. *Introducción a la biología de la conservación* / Richard B. Primack y Joandomènec Ros. Barcelona : Ariel, D.L. 2002
- BC** *Atlas y libro rojo de la flora vascular amenazada de España : Adenda 2010* / [editores y coordinación científica del proyecto, Ángel Bañares Baudet ... et al.]. Madrid : Organismo Autónomo Parques Nacionales, 2011
- BC** *Atlas y libro rojo de la flora vascular amenazada de España : taxones prioritarios* / [editores y coordinación científica del proyecto, Ángel Bañares Baudet ... (et al.)]. Madrid : Tragsa : Ministerio de Medio Ambiente, 2003
- BC** *Catálogo de especies amenazadas en Aragón : flora* / coordinación, Manuel Alcántara de la Fuente ; textos, Manuel Alcántara ... [et al.] ; fotografías, Alfredo Martínez ... [et al.]. Zaragoza : [Gobierno de Aragón, Departamento de Medio Ambiente], 2007

### LISTADO DE URLs:

Bacchetta, Gianluigi, et al. (2008). *Conservación ex situ de plantas silvestres*. Oviedo: Gobierno del Principado de Asturias "La Caixa"

[  
<https://drupal.gijon.es/sites/default/files/2020-08/Conservaci%C3%B3n%20ex%20situ%20de%20plantas%20silvestres%20>  
]

The updated recommended bibliography can be consulted in:<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=25241>