Universidad Zaragoza

Year : 2020/21

28920 - Biotechnology

Syllabus Information

Academic Year: 2020/21
Subject: 28920 - Biotechnology
Faculty / School: 201 - Escuela Politécnica Superior
Degree: 583 - Degree in Rural and Agri-Food Engineering
437 - 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

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

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 Production and industrial applications of enzymes 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 - chain reaction of polymerase
Unit 4	Tools and techniques of molecular genetics (II)	
		Electrophoresis of DNA Real time PCR, quantitative PCR DNA sequencing Purification and electrophoresis of proteins Protein sequencing
Unit 5	Genomic tools	
		Genome projects Genes and genomes Bioinformatics. Next generation sequencing. Resequencing genomes
Unit 6	Molecular diagnostic tools	
		ELISA enzyme-linked inmunosorbent assay Detection of DNA sequences - dot blot, southern blot and FISH Detection of RNA sequences - northern blot Complementary DNA

Block II	**Plant biotechnology**
Unit 7	In-vitro culture of plant tissues and organs
	Introduction - concept and conditioning factors Foundations - cell potency and development Phytohormones Somatic embryogenesis

Physiological bases of in-vitro embryogenesis
Organogenesis of stems
Physiological bases of in-vitro organogenesis

Unit 8 Applications of plant micropogation

Multiplication of plants
Plant propagation on an industrial scale
In-vitro production of plant metabolites
In-vitro conservation - cryopreservation
Applications in 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

Protocol in the laboratory of plant biotechnology

1 Tools and equipment - security and hygiene - protocols -preparation of basic solutions of molecular biology

Bacteria production

2 Preparing LB medium - cultivation methods

Isolation of tomato DNA (plasmid preparation).

3 Isolation of DNA with tomato leaves through basic CTAB protocol

Amplification of DNA through PCR

4 Design and performing of the amplification reaction for a specific locus

Electrophoresis of DNA

5 Agarose gel electrophoresis of the isolated DNA samples of practical session 3 and the

		reactions of practical session 4
6	Bioinformatics in plant genetics	Management of databases - search of microsatellite motifs with MEGA in the rice genome - design of primers with Primer3
7	In-vitro plant production - organogenesis in tomato	Preparation of culture media with different phytoregulator balances - cotyledon production - analysis of results
8	In-vitro plant production - micropropagation of potato	Potato stalk disinfection and apex cultivation in plates with different phytoregulator balances
9	Protocol in the laboratory of animal biotechnology	Tools and equipment - security and hygiene - protocols -preparation of basic solutions
10	Spermiogram (1) - classic assessment	Laboratory assessment of semen quality using classic assessment techniques
11	Spermiogram (2) - new semen analysis techniques	Laboratory assessment of semen quality using new assessment techniques
12	Oocyte extraction and in-vitro embryo production	Oocyte extraction from abattoir ovaries, classification and maturing simulation, in-vitro fertilization and production
13	Sex determination	Sperm sexing and sex determination in sperms and embryos
14	Gamete and embryo preservation	Design of means, preservation in refrigeration, slow freezing and vitrification
15	Application of ELISA technique in animal production and health	Application of ELISA technique in the diagnose of diseases and hormonal levels

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 Writen 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
Total hours	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 Sanité 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, Adrianne 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.dnaftb.org/]

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

Oracle Foundation, Thinkquest Library
[http://www.searchremagnified.com/?dn=thikquest.org&pid=9PO6B1W9X]

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

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