

Degree programme	Type	Course
Biotechnology	OB	2

Contact lecturer

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Prerequisites

Group languages

You can consult this information at the [end](#) of the document.

No special requirements are requested. However it is highly recommended that students have been previously enrolled in several core subjects such as Biochemistry (1st year) and Molecular Biology (2nd year, 2nd semester).

Objectives

This subject is aimed to introduce the student to the wide range of methodologies that are commonly known as Recombinant DNA Technology. These methodologies, most of them developed at the end of the last century, are one of the foundations of the modern biotechnology. The general objective is to provide a solid basis allowing the student to apply these methodologies when designing biotechnological processes. In addition, it is also provided the scientific background to follow-up more specialized topics in the last courses of the degree of Biotechnology. The practical aspects of this subject are dealt in the Integrated Laboratory 5.

- Know and know how to apply the basic techniques of recombinant DNA and nucleic acid engineering: enzymatic tools (restriction enzymes, polymerases, kinases, phosphatases, ligases, topoisomerases, site-specific recombinases and non-specific nucleases), different types of PCR reactions, probe labeling and Southern and Northern blot.
- Describe the main cloning vectors, know their main characteristics and know how to use them in the different strategies for the cloning of DNA fragments.
- Understand the strategies for the construction of libraries and their use for the study of genes and genomes.
- Know the basics and main applications of the new technologies for massive sequencing of nucleic acids (Next Generation Sequencing).
- Describe the main applications to modify DNA sequences: site directed mutagenesis, random mutagenesis and methods for directed molecular evolution.
- Know the main methods to obtain synthetic genes and for the expression of recombinant proteins.

Learning outcomes

- CM13 (Interpret the basic methods of recombinant DNA technology.) Interpret the basic methods of recombinant DNA technology.

- CM15 (Work collaboratively in teams to solve problems in the field of biochemistry.) Work collaboratively in teams to solve problems in the field of biochemistry.
- KM15 (Provide a proper description of the differential regulation of gene expression in prokaryotes and eukaryotes.) Provide a proper description of the differential regulation of gene expression in prokaryotes and eukaryotes.
- SM14 (Correctly interpret data and observations in the field of biochemistry.) Correctly interpret data and observations in the field of biochemistry.

Contents

1. Basic techniques in recombinant DNA technology. What can we do with the recombinant DNA technology? Main enzymes used in recombinant DNA technology. DNA restriction. Adaptors and linker-adaptors. DNA denaturation and molecular hybridization. The PCR reaction and primer designing. Sanger reaction, Southern Blot, Northern Blot and its applications.

2. Cloning in *Escherichia coli*. Plasmids and phages as cloning vectors in *E. coli*. Main transformation methods. Phagemids and main host strains. Integration by recombination. Cloning of PCR products.

3. Cloning of cDNAs. cDNA synthesis. Strategies to create representative cDNA libraries. Main vectors used to build cDNA libraries. In vivo excision system in lambda phages. Screening cDNA libraries. Reverse Transcription PCR (RT-PCR) and Rapid Amplification of cDNA ends (RACE). Historical note about nucleic acid arrays. Next generation sequencing technologies (NGS). RNASeq strategies to discover expressed genes and characterize gene expression.

4. Genomic DNA libraries. General concept. Rules to obtain representative libraries. Strategies to build genomic DNA libraries. Cosmid and fosmids, BACS, PACS and YACS. Screening of genomic libraries. Arrangement of contigs. Application of NGS to "de novo" sequencing and resequencing of genomes.

5. *In vitro* mutagenesis. Concept and uses. Silent mutations. Site directed mutagenesis (SDM). Methods for SDM (cassette, primer extension and PCR). Random mutagenesis. Molecular directed evolution (DNA shuffling and related technologies).

6. Expression of recombinant proteins. Factors affecting the expression of cloned genes in *E. coli*. Main expression vectors. Optimization of recombinant protein expression. Synthetic genes. Fusion proteins. Phage display.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Practical sessions for problem solving	8	0.32	
Theory classes	17	0.68	
Study and individual work to prepare problems and cases	44	1.76	

The training activities consist of theory classes and practical sessions for problem and case solving. Each of them has its own specific methodologies.

Theory classes

The teacher will explain the content of the syllabus with the support of audiovisual material that will be available to students in the Virtual Campus (VC) of the subject. These lectures will be the most important part of the theory section. It is recommended that students have the material published on the VC in printed or digital form in order to be able to follow the teacher more comfortably. Under the guidance of the teacher, the study of some parts of the syllabus will have to be deepened by the students, by means of autonomous learning. In order to facilitate this task, teaching materials will be provided in the form of textbooks, scientific literature, web pages, etc.

Practical sessions for problem and case solving

The class group will be divided into two subgroups (A and B). It is expected that 8 sessions will be devoted to the resolution of practical cases and experimental problems related to the contents of the theory program. Students will attend the sessions programmed for their group. At the beginning of the semester a dossier of questions, problems and cases will be available at the VC. These practical problems and cases will be solved throughout the sessions. In these sessions the problem professor will present the experimental and calculation principles necessary to work on the problems, explaining the guidelines for their resolution and reinforcing at the same time the knowledge of different parts of the subject from theory classes. It is expected the active participation of the students.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Participation in the VC forum of the subject	10%	2.5	0.1	CM13, CM15, KM15, SM14
Theory exam	50%	1	0.04	CM13, KM15, SM14
Exam of problem and case solving	40%	2.5	0.1	CM13, CM15, KM15, SM14

Continuous assessment

Two exams will be held. The first exam will have a weight of 50% in the overall qualification and will be a quiz that may also include short questions and will evaluate the contents of the theory classes. The second test, with a weight of 40% in the overall qualification, will be a classroom practice exam and the student will have to solve different exercises and/or problems similar to those carried out during practice classes. The global qualification will be completed by the contributions of the students in the subject's forum continuously throughout the course. This part will have a weight of 10% of the overall grade and the grade will be calculated based on the quantity and quality of the contributions made by the students.

Since the evaluation of the subject does not include the submission of any written work, the student is free to use applications based on artificial intelligence (AI) as an additional source for the study and monitoring of the subject. For forum of the subject on the virtual campus, the answers obtained by AI must be indicated with the following text: \"This answer has been obtained by AI (XXX application)\". For the calculation of the forum grade, only answers obtained by AI accompanied with a critical comment by the student indicating the reasons that lead him/her to think whether the answer obtained by AI is correct or not will be considered. The use of AI without giving credit for the source used will result in a grade of 0 in this section.

In the event that the student does not pass the subject, he/she might attend a second round of exams.

However, to participate in this second round, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject. The second round has the same overall distribution of tests that the first round. All students are welcome to this second exam round. Participation in this round does not imply the resignation of the previous marks. The mark obtained in the participation in the VC forum cannot be reevaluated. However, students failing the subject might chose to conserve the mark obtained in the VC forum for a maximum of one academic year.

The overall grade of the subject will be calculated as follows:

- 50% of the theory exam (in the first or the second round, if applicable). A minimum score of 3.5 is required.
- 40% of the problem solving exam (in the first or the second round, if applicable). A minimum score of 3.5 is required.
- 10% of the participation in the forum of the subject. No minimum score is required.

In order to pass the subject, the student must achieve at least a global score of 5.0 and scores equal or higher than 3,5 in the exams. The students will obtain a \"No Avaluable\" mark when the evaluation activities carried out have a weighting less than 67% in the final grade. In those cases where the overall grade is higher than 4 but the student does not reach the minimum grade of 3.5 in some of the parts of the assignment, the overall grade for the subject will be 4.0.

Single assessment

Students adhering to the single assessment mode will have to take the exams described above for continuous assessment. The same recovery system will be applied as for continuous assessment and the same non-assessable criteria will be applied as for continuous assessment.

In the case of following the single assessment, participation in the subject forum (10% of the final grade) will be replaced by a five-minute oral presentation on a current topic of the subject. The topic of this oral presentation will be arranged during the first two weeks after the start of classes. The lecturer will provide the necessary bibliography and the oral presentation will take place immediately after the classroom practice exam. Failure to arrange the topic of the oral presentation will imply a grade of 0 in this section.

Irregularities during assessments

Irregularities in an assessment (academic fraud, plagiarism or unauthorized use of AI, which could lead to a significant variation in the qualification) will result in a grade of 0 in such assessment. In addition, a disciplinary process might be instituted to the students failing in some of these irregularities

Bibliography

Textbooks:

- Molecular Biotechnology. Principles and Applications of Recombinant DNA. 5th Ed. B.R. Glick & C.L. Patten. ASM Press, 2018.
- Gene Cloning & DNA Analysis. An Introduction. 8th Ed. T.A. Brown. Wiley Blackwell, 2020.

In Campus Virtual is available a reference list about specific items of this subject

Software

No specific software is used in this subject

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	42	Catalan	second semester	afternoon
(PAUL) Classroom practices	421	Catalan	second semester	afternoon
(PAUL) Classroom practices	422	Catalan	second semester	afternoon