COURSE GUIDE

Biotechnology (2041131)

Approval date:
Departamento de Microbiología: 20/06/2022
Departamento de Bioquímica y Biología Molecular II: 20/06/2022

Grado (Bachelor's Degree)	Grado en Farmacia	**Branch**	Health Sciences
Module	Biología	**Subject**	Biotecnología

Year of study	3º	**Semester**	1º	**ECTS Credits**	6	**Course type**	Compulsory course

PREREQUISITES AND RECOMMENDATIONS

- It is strongly recommended for the student to have passed the course of Structural and Metabolic Biochemistry, Microbiology I and Microbiology II.
- The students are also recommended to have obtained a B1 certificate at English language for non-English students. Good skills for document wreading, writing and for oral presentation are also required.

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

This course is intended to teach:

1. The basic concepts of Pharmaceutical Biotechnology for sustainable development.
2. The general techniques of DNA manipulation and transfer, cloning, mutagenesis, bioinformatics, DNA sequencing, recombinant protein synthesis and protein engineering, cell culture, transgenesis, genome editing and the essential methods of gene expression analysis.
3. The use of microorganisms for pharmaceutical drug production.
4. The characteristics of the microorganisms used in Biotechnology.

SKILLS

GENERAL SKILLS

- CG01 - Identificar, diseñar, obtener, analizar, controlar y producir fármacos y medicamentos, así como otros productos y materias primas de interés sanitario de uso humano o veterinario.
- CG13 - Desarrollar habilidades de comunicación e información, tanto orales como escritas, para tratar con pacientes y usuarios del centro donde desempeñe su actividad profesional. Promover las capacidades de trabajo y colaboración en equipos multidisciplinares y las relacionadas con otros profesionales sanitarios.
- CG15 - Reconocer las propias limitaciones y la necesidad de mantener y actualizar la

competencia profesional, prestando especial importancia al autoaprendizaje de nuevos conocimientos basándose en la evidencia científica disponible.

SUBJECT-SPECIFIC SKILLS

- CE21 - Desarrollar habilidades para identificar dianas terapéuticas y de producción biotecnológica de fármacos, así como de uso de la terapia génica.

TRANSFERABLE SKILLS

- CT02 - Capacidad de utilizar con desenvoltura las TICs

LEARNING OUTCOMES

- **MOLECULAR BIOLOGY MODULE**

The final learning outcome of this course will be the localization, analysis, assimilation, interpretation and processing of biological information for the identification and evaluation of therapeutic targets for biotechnological drug design.

1. R1- To use bioinformatics tools for extraction, analysis, interpretation and processing of biological information from biological databases
2. R2 – To analyze, interpret and process biological information of genes and their products
3. R3 – To extract and interpret biological information from scientific papers
4. R4 – To characterize the different techniques of information on genetic manipulation, amplification, cloning, modification and storage in various hosts
5. R5 – To compare techniques for controlled gene expression to produce different types of proteins in living organisms
6. R6 – To characterize and evaluate the methodology for the molecular analysis of the genetic variability and its impact in health and drug response.
7. R7 – To analyze and characterize the main techniques for the transfer of genetic information and their use in gene therapy
8. R8 – To characterize different experimental design methodologies for the development of a biotechnological product
9. R9 – To plan and develop an analytical proposal for the development of a human biotechnology product for sustainable development and its potential impact on food availability, health improvement, environmental protection, cooperation and rational development of biotechnology..
10. R10- To evaluate the bioethical implications of genetic and biotechnological manipulation of living organisms

- **MICROBIOLOGY MODULE**

1. R12 - Handle all theoretical and practical information on Culture Collections of Microorganisms / Biotechnology companies
2. R13 - Know the peculiarities / differential characteristics that make bacteria, viruses and eukaryotic microorganisms with potential biotechnological agencies
3. R14 - Designing selective media and culture conditions for the isolation of strains with biotechnological interest
4. R15 - Management and production of microbial polymers with therapeutic use
5. R16 - Develop the process of recombinant synthesis, molecular modification and

production of proteins with therapeutic use
6. R17 - Designing a recombinant vaccine
7. R18 - Commissioning of the production of a recombinant drug
8. R19 - Identify the factors in the control of mass production or industrial level of recombinant
9. R20 - Identify safety levels for handling microorganisms and quality control of recombinant products

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

1. **EDUCATIONAL ACTIVITIES**

Classroom training activity: 60 total hours to distribute among lectures, practical classes, seminars, presentation of works and tests

Outdoor training activity: 90 total hours including preparation of work and preparation and study of theory and practice lessons

2. **PROGRAM OF THEORETICAL CLASSES**

- **MODULE BIOCHEMISTRY AND MOLECULAR BIOLOGY**
  - **THEMATIC UNIT 1. Introduction to Biotechnology.** Objectives of Biotechnology. Conceptual and historical framework. The biotechnological process. Biological systems used in biotechnology. Biotechnology Research. Social and business dimension. Public perception. Ethics and Law. Biotechnology for Sustainable Development. (1h)
    - Objectives:
    - To give an overview of the concept of Biotechnology.
    - To describe the objectives, development and general techniques of biotechnology.
    - To understand the social and ethical importance of Biotechnology for Sustainable Development.
    - To describe importance of Biotechnology in the Degree in Pharmacy. Programmed Activity: self-assessment test on acquired skills.
- **THEMATIC UNIT 2. Organization of genetic material in prokaryotes and eukaryotes.** Types of nucleic acids. Genomes, chromosomes, mitochondrial DNA, genes and operons. Epigenetics. Genetic code. Concepts of replication, transcription and translation. DNA recombination and repair. Expression and regulation. Changes post-transcriptional and post-translational. (1h)
  - Objectives:
    - To learn more about the gene organization of living things.
    - To know the importance of epigenetics in gene expression.
    - To understand the molecular basis of gene expression and regulation.
- **THEMATIC UNIT 3. Human Genetic variability in HapMap.** Haplotype and chromosomal markers. Direct and indirect molecular diagnosis of genetic mutations. Karyotype. Clinical and forensic applications. Pharmacogenetics. Genetic analysis on Hospital and business contexts. (3h)
  - Objectives:
    - To learn the basics of genetic variability in the human being.
    - To define and chromosomal marker haplotype.

        - To describe types of chromosomal markers.
        - To learn the utility or chromosomal markers in the molecular diagnosis of genetic variants.
        - To define karyotypes-genomes and their clinical utility.
        - To learn currently developed clinical, forensic and hospital analysis of genetic variability and their profits.
        - To know the current and future business environment associated with the analysis of genetic variability.
- **THEMATIC UNIT 4. Bioinformatics. Database.** NCBI, PubMed, PMC and OMIM. Extraction of biological and genetic information. Sequence analysis of nucleic acids and proteins. (3h)
    - Objectives:
        - To know the structure and utility of main bioinformatic databases.
        - To extract information on genes, molecular diseases and scientific articles.
        - To research/query the database PDB and to use data visualization and modeling software of protein structures.
        - To understand the utility of phylogenetic analysis: phylogeny, functional analysis, structural analysis.
        - To know main software for the analysis and comparison of sequences: BLAST, CLUSTALW.
- **THEMATIC UNIT 5. Systems Biology.** Involvement of -omic techniques in pharmaceutical and biotechnology research. Genomics, transcriptomics, proteomics, metabolomics. Protein sequencing. Other-omics. Uses in the molecular classification of diseases and validation of molecular targets. Massive DNA sequencing. (2h)
    - Objectives:
        - Familiarize students with the concept of systems biology, reductionism versus holism.
        - To know the main methods of omics analysis.
        - To know the use of -omics approach in the molecular classification of diseases.
        - To know the use of -omic approach in the identification and validation of molecular targets
- **THEMATIC UNIT 6. Recombinant DNA technology.** Concept of recombinant DNA and genetic engineering. Enzymes used in genetic engineering. DNA polymerases and polymerase chain reaction (PCR). PCR and semi-quantitative RT-PCR. Nucleic acid detection. DNA sequencing. (3h)
    - Objectives:
        - To know the general types of enzymes used in molecular biology: nucleases, polymerases, ligases and restriction enzymes.
        - To know the importance or nucleic acid hybridization to identify polynucleotide sequences.
        - To know the most important techniques PCR amplification of DNA by PCR.
        - To know currently used methods for sequencing nucleic acids and proteins.
- **THEMATIC UNIT 7. Strategies cloning issue.** Vectors. Introducing genetic material into the host. Libraries: utility, construction and analysis. (3h)
    - Objectives:
        - To know the characteristics of general cloning vectors: plasmids, bacteriophages and cosmids.
        - To know optimized vectors for recombinant DNA ligation.
        - To know general and specific transformation and transfection techniques.

        - To understand what libraries are and to know their main types: genomic and cDNA expression.
- **THEMATIC UNIT 8. Expression vectors and recombinant proteins**. Fusion proteins. Heterologous expression. Vectors for expression in eukaryotes. Performance optimization and expression. (2h)
    - Objectives:
        - To know the essential characteristics of the expression vectors; Promoter induction in expression vectors.
        - To understand the benefits and uses of fusion proteins.
        - To know the criteria used to express proteins in homologous or heterologous systems.To know the basis to improve the expression of recombinant proteins
- **THEMATIC UNIT 9. Protein engineering.** Structure-function. Rational design and directed evolution. Altering the genetic material. Mutations and usefulness. Random mutagenesis and directed. Novo protein design. Pharmaceutical uses. (2h)
    - Objectives:
        - To understand the techniques used to study protein structure-function relationships and protein-ligand interactions.
        - To know random and site-specific protein mutagenesis basic techniques.
        - Skills in program management and modeling visualization of protein structures to design mutations.
        - To know drugs of first and second generation based on the recombinant expression and mutagenesis of recombinant proteins.
- **THEMATIC UNIT 10. The cell as biotechnology and therapeutic tool factory.** Mammalian cell culture. Recombinant protein and humanized antibodies production; use in the evaluation of molecular targets. Stem cells. Tissue engineering and organ culture. Regenerative medicine. (2h)
    - Objectives:
        - To know the differences and main characteristics of primary cultures and established cell lines.
        - To know types of mammalian cells used in biological experimentation.
        - To know the basic methods of protein expression in cells in cultures and humanized antibodies.
        - To know the molecular basis of growth, differentiation and cell death applied to regenerative medicine.
        - To know the methodological options used in to build tissues ex vivo.
- **THEMATIC UNIT 11. Gene therapy: a method for treating genetic diseases.** GM systems by vectors. Antisense RNA. Silencing. Use in gene therapy and for the study of gene expression in mammals. (2h)
    - Objectives:
        - Familiarize students with the concept of gene therapy.
        - To know the main methods of genetic modification currently used in gene therapy.
        - To Learn the basics of gene silencing and its use in validation of molecular targets and gene therapy.
        - To know the limitations and ethical constraints of gene therapy and regenerative.
- **THEMATIC UNIT 12. Animal models in Biomedicine and Biotechnology.** Embryos, clones and transgenics. Animals and genetically modified foods. (1h)
    - Objectives:
        - Understand the concepts of genetically modified food and genetically modified organisms.
        - To analyze the production techniques of transgenic foods.
        - To describe several examples of the application of genetic engineering

and cell culture techniques for the production transgenic plants resistant to herbicides, insects and drought and nutritional improvements and delayed maturation.
    - Transgenic animals: to know the improvements in production and / or nutritional composition and to understand de potential of transgenic animals as models for the study and treatment of human disease.

- **MODULE Microbiology: Fundamentals and Potential Use of microorganisms in Biotechnology**

OBJECTIVE: The student must acquire the fundamentals of essential uses of microorganisms in the evolution of biotechnology applied to health sciences.

- **THEMATIC UNIT 13. Microorganisms and Biotechnology.** Features of cultivation and maintenance. Characteristics related to the synthesis of the product of interest. Genetic stability. Other properties. Search optimization and conservation of microorganisms of biotechnological interest. Cultivation, control and elimination of microorganisms. (2h)
    - Objectives:
        - To know the molecular basis for the use of the microorganism in biotechnology process
        - Develop the particular requirements to be met by microorganisms of biotechnological use
        - Describe procedures or cultivation of microorganisms of biotechnological interest
        - Learn to design search strategies, selection, optimization and conservation of microorganisms of biotechnological interest
        - Understand the strategies for managing the microorganism of use in biotechnology.
- **THEMATIC UNIT 14. Major bacteria of biotechnological interest Morphological and structural characteristics.** Growth rate and experimental cultivation. Physiological, nutritional and metabolic diversity. Major bacterial strains of biotechnological interest. (1h)
    - Objectives:
        - To know the main bacterial strains of biotechnological interest or describe the characteristics of the main bacterial strains of biotechnological interest.
- **THEMATIC UNIT 15. Main virus of biotechnological interest.** Phagotherapy and the discovery of antibiotics by phages. Phage-display for the selection of protein variants. Wild oncolytic viruses: the vaccine virus, poliovirus and adenovirus. Modified recombinant. Application of gene therapy virus. (2h)
    - Objectives:
        - Describe the main virus of interest in biotechnology; knowing or viral vectors, construction and application in purification of proteins of interest, viruses in gene therapy and virus oncogenic therapy.
- **THEMATIC UNIT 16. Main eukaryotic microorganisms of biotechnological interest Desirable and undesirable characteristics of eukaryotic microorganisms of biotechnological interest.** Morphological, structural and physiological characteristics major eukaryotic microorganisms. Methods of isolation, selection and cultivation of eukaryotic microorganisms of biotechnological interest. Yeast strains main use in biotechnology. (1h)
    - Objectives:
        - Develop the particular characteristics of the biotechnology use yeasts

        - Describe or culture procedures biotechnological utilization of yeasts.
- **THEMATIC UNIT 17. Production subject microbial biopolymers (polysaccharides and poly- beta-hydroxy-alkanoates) for use as excipients in medicaments.** Manipulating the culture conditions to produce new bacterial polyesters. Genetically engineering microorganisms to produce polysaccharides (xanthan) and poly-beta-hydroxy-alkanoates. (2 h)
    - Objectives:
        - Knowing polymers or microbial origin and biotechnology utility as an alternative to synthetic polymers
        - Know the methods of overproduction by selective and scheduled handling of microorganisms.
- **THEMATIC UNIT 18. Production of primary metabolites.** Production of organic acids and amino acids. Citric acid, glutamate and other amino acids. Production of ethanol. (2 h)
    - Objectives:
        - Know the primary and metabolites biotechnological utility
        - Identify resources and emerging industries with applicability in pharmaceutical biotechnology.
- **THEMATIC UNIT 19. Production of antibiotics and non-antibiotic secondary metabolites.** Secondary metabolites with antibiotic activity, antitumor, inhibitors of cholesterol synthesis and immune-suppressants. (2 h)
    - Objectives:
        - Know the natural function of antibiotics
        - Biosynthesis and industrial production of beta-lactam antibiotics
        - Synthetic antibiotics.
- **THEMATIC UNIT 20. Recombinant vaccines: antibacterial, antiviral and DNA.** Traditional vaccines against recombinant. (1.5 h)
    - Objectives:
        - Know the fundamental differences between vaccines made from microorganisms and genetically engineered
        - Know the main routes of administration of vaccines and their requirements in the synthesis.
        - Know bacterial vaccines: BCG, oral cholera, oral typhoid; Viral vaccines: measles, rubella, mumps, MMR, varicella; Toxoid vaccines: tetanus, diphtheria; DNA vaccines; Therapeutic vaccines.
- **THEMATIC UNIT 21. Production of proteins of pharmaceutical interest in microorganisms: insulin, growth hormone, erythropoietin, monoclonal antibodies** (2h).
    - Objectives:
        - Identify genetic traits of certain microorganisms for use in the production of specific proteins
        - Analyze the importance of the genetic background in terms of the protein to be expressed
        - Know the application or microorganisms and viruses to search for proteins of interest.
- **THEMATIC UNIT 22. Industrial Fermentations topic: Culture media (sources of C and N).** Water and minerals, vitamins, growth factors, oxygen and antifoam. Bioreactors: Design and construction. Control reagent addition, and physical conditions (agitation, heating and cooling, mass transfer, aeration). Monitoring system (electrodes, probes, translators, mass spectra and spectrophotometers). Operating modes. Sterilization. Reactors solid substrate. (2h)
    - Objectives:
        - Understanding the value or cost of finding means to economic performance
        - Recover waste as a source of nutrients to generate biotechnology

products
- Identify the critical factors during production of molecules of interest
- Recognize the role of the development of production processes.

- **THEMATIC UNIT 23. Control issue of biotechnology products and Biosafety** (2h)
  - Objectives:
    - Learn the special requirements in the manufacture of sterile products of pharmaceutical interest (antibiotics, vaccines, nutraceuticals) to minimize the risk of microbial contamination, particulate and pyrogen throughout the whole process of development and validation, as well as personnel and processing equipment
    - Understand the importance of Hazard Analysis and Critical Control Points (HACCP).

PRACTICAL SYLLABUS

PROGRAM OF PRACTICAL LESSONS

1. Expression of a recombinant protein in E. coli and in eukaryotic cells in culture: the gene for green fluorescent protein (GFP) will be amplified, cloned, transformed and expressed in Escherichia coli.
2. Isolation microorganisms from soil producing antimicrobial substances. It will be done through serial dilutions, culture in suitable media and observation of variability of microbiological samples from different sources. An overlay technique for identifying potential producers of antibiotics against potential infectious agents will be used.

RECOMMENDED READING

ESSENTIAL READING

- Herráez, A. Texto Ilustrado de Biología Molecular e Ingeniería Genética. 2ª Ed. Elsevier. Madrid. 2012.
- Martín Brieva, H. Fundamentos de Biotecnología Farmacéutica. Dextra. Madrid. 2019
- Clark D, Pazpernik N. Biotechnology – Academic Cell Update, APCell Press 2012.
- Fitzgerald-Hayes M. y Reichsman F. (eds) DNA and Biotechnology 3 rd. Elsevier, 2010.
- Glick BR, Pasternak JJ, Patten CL. Molecular Biotechnology: Principles and applications of recombinant DNA 4th. ASM Press, Washington, 2010.
- Perera J, Tormo A, García JL. Ingeniería genética, vol. I y II, Editorial Síntesis, Madrid, 2002.
- Crommelin, D.J.A., Sindelar R.D. and Meibohm B. (Eds.) Pharmaceutical Biotechnology. Fundamentals and applications (3ed). Informa Healthcare. New York. 2008
- Barnum, S.R. Biotechnology. An introduction. Thomson Brooks/Cole. Belmont. USA. 2005.
- Braun, V. and Gotz F. (Eds.). Microbial Fundamentals of Biotechnology. John Wiley & Sons, Chichester (UK) (2002).
- Gad S.C. (ed) Hanbook of Pharmaceutical Biotechnology. Wiley Interscience. 2007
- Kayser, O. y Müller, R.H. (eds). Pharmaceutical Biotechnology. Wiley Interscience. 2004
- Lewin, B. Genes IX. Jones and Bartlett publishers. Sudbury. USA. 2008.
- Simpson, R.J. Proteins and proteomics. A laboratory manual. Cold Spring Harbor Laboratory Press. New York. 2003.
- Walsh, G. Pharmaceutical Biotechnology: Concepts and Applications. Wiley. 2007

COMPLEMENTARY READING

RELEVANT LEGISLATION ON GENETICALLY MODIFIED ORGANISMS

- Directive 90/220/CE del Consejo de 23 de abril de 1990 sobre la liberación intencional en el medio ambiente de organismos modificados genéticamente. Diario Oficial de las Comunidades Europeas (DOCE). 08-05-1990
- Commission Regulation (EC) No 49/2000 of 10 January 2000 amending Council Regulation (EC) No 1139/98 concerning the compulsory indication on the labelling of certain foodstuffs produced from genetically modified organisms of particulars other than those provided for in Directive 79/112/EEC
- Commission Regulation (EC) No 50/2000 of 10 January 2000 on the labelling of foodstuffs and food ingredients containing additives and flavourings that have been genetically modified or have been produced from genetically modified organisms
- Commission Decision 2002/623/EC of 24 July 2002 establishing guidance notes supplementing Annex II to Directive 2001/18/EC of the European Parliament and of the Council on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC Official Journal L 200 of 30.7.2002.
- Opinion of the Economic and Social Committee on the "Proposal for a Regulation of the European Parliament and of the Council on genetically modified food and feed" (COM(2001) 425 final — 2001/0173 (COD)). Official Journal C 221 , 17/09/2002 P. 0114 – 0120
- Council Decision of 3 October 2002 establishing, pursuant to Directive 2001/18/EC of the European Parliament and of the Council, the summary notification information format for notifications concerning the deliberate release into the environment of genetically modified organisms for purposes other than for placing on the market Official Journal L 280 , 18/10/2002 P. 0062 – 0083
- Decisión del Consejo, de 3 de octubre de 2002, por la que se establecen unas notas de orientación complementarias al anexo VII de la Directiva 2001/18/CE del Parlamento Europeo y del Consejo sobre la liberación intencional en el medio ambiente de organismos modificados genéticamente y por la que se deroga la Directiva 90/220/CEE del Consejo. Diario Oficial de las Comunidades Europeas (DOCE). 18-10-2002
- Common Position (EC) No 17/2003 of 4 March 2003 adopted by the Council, acting in accordance with the procedure referred to in Article 251 of the Treaty establishing the European Community, with a view to adopting a Regulation of the European Parliament and of the Council on transboundary movements of genetically modified organisms
- Common Position (EC) No 22/2003 of 17 March 2003 adopted by the Council, acting in accordance with the procedure referred to in Article 251 of the Treaty establishing the European Community, with a view to adopting a regulation of the European Parliament and of the Council on genetically modified food and feed
- Common Position (EC) No 20/2003 of 17 March 2003 adopted by the Council, acting in accordance with the procedure referred to in Article 251 of the Treaty establishing the European Community, with a view to adopting a regulation of the European Parliament and of the Council on additives for use in animal nutrition (1)
- Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed
- Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC.Official Journal L 268 , 18/10/2003 P. 0024 - 0028
- Commission Regulation (EC) No 65/2004 of 14 January 2004 establishing a system for the development and assignment of unique identifiers for genetically modified organisms. Official Journal L 010 , 16/01/2004 P. 0005 – 0010

- Law 9/2003, de 25 de abril, por la que se establece el régimen jurídico de la utilización confinada, liberación voluntaria y comercialización de organismos modificados genéticamente. Jefatura del Estado (BOE:100-2003). 26-04-2003

RECOMMENDED LEARNING RESOURCES/TOOLS

- NCBI http://www.ncbi.nlm.nih.gov/
- BLAST http://blast.ncbi.nlm.nih.gov/Blast.cgi?PAGE=Nucleotides/
- GENBANKhttp://www.ncbi.nlm.nih.gov/genbank
- ExPASyhttp://expasy.org/
- GENECARDS V3 - HUMAN GENES http://www.genecards.org/
- PROTEIN DATA BANK http://www.rcsb.org/pdb/home/home.do
- OMIM ® - Online Mendelian Inheritance in Man ® http://www.ncbi.nlm.nih.gov/omim/
- PUBMED http://www.ncbi.nlm.nih.gov/pubmed/
- WATCUT https://www.genengnews.com/resources/best-of-the-web/watcut/
- NEBCUTTER http://tools.neb.com/NEBcutter2/
- VIRTUAL RIBOSOME http://www.cbs.dtu.dk/services/VirtualRibosome/
- PRIMER3 http://frodo.wi.mit.edu/primer3/
- IN SILICO PCR AMPLIFICATION http://insilico.ehu.es/PCR/
- THE SPANISH TYPE CULTURE COLLECTION: https://www.uv.es/cect
- THE GERMAN TYPE CULTURE COLLECTION: https://www.dsmz.de

TEACHING METHODS

- MD01 - Lección magistral/expositiva
- MD02 - Sesiones de discusión y debate
- MD03 - Resolución de problemas y estudio de casos prácticos
- MD04 - Prácticas de laboratorio y/o clínicas y/o oficinas de Farmacia
- MD07 - Seminarios
- MD09 - Realización de trabajos en grupo
- MD10 - Realización de trabajos individuales
- MD12 - Tutorías
- MD13 - Participación en plataformas docentes

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

- According to the rules of evaluation and qualification of students of the University of Granada, adopted on 20 May 2013, the evaluation will be continuous. These rules contemplate the exception of an only final written test for students that apply to this type of evaluation.
- It is necessary to have all the approved practices to pass the subject.
- None of the approved partials is saved for the next course.
- To pass the course, a balance in the knowledge of Biochemistry and Microbiology is necessary.
    - **CONTINUOUS EVALUATION**
        - General evaluation criteria: The assessment will be integrated in the

learning process through the implementation and execution of units of evaluation.

In the evaluation, the Professor could assess:

- Systematic assistance to the sessions planned
- Attendance at the presentation or oral autonomous work and other activities (seminars, etc....)
- Involvement and active participation of students
- Individual and group work of students
- Degree of resolution of the tests
- Continuous monitoring and planned activities and tasks according to the requirements, deadlines and criteria

1. **GROUP A, D and E EVALUATION PROCEDURE**

The evaluation of the subject in both modules should contemplate classroom and non-attendance student activities. Therefore, the relative weight in the final qualification of the different sections, once the limitations indicated above have been overcome, will be:

- Biochemistry and Molecular Biology II Department:
  - Practices: 5%; Several activities: 5 %; multiple-choice test: 40%.
- Microbiology Department:
  - Practices: 5%; Several activities: 5%, multiple-choice test and written test of knowledge: 40%.
  - Regarding the practical training, the evaluation will be carried out using a test to assess the acquired knowledge in solving practical problems. The daily monitoring of the experimental and technical work as well as student motivation will be also evaluated.
  - The calculation of the final grade will depend on the following conditions:
  - It is compulsory to overcome the practical requirement and individual written tests with a minimum rating of 5. For the Microbiology part it is a requirement to pass the written exam with a minimum rating of 5.
  - The student must attend at least 80% of the theoretical lessons to compute non-attendance activities delivered.
  - The final grade for the course will be between 0 and 10 points and will correspond to the average of the final marks obtained in Biochemistry and Microbiology modules. They are offset provided the minimum score in some or both modules that should be equal to or greater than 5.
  - Students with the practices approved in a previous call and as long as there has been no change in the practical teaching program, may choose not to do them in subsequent academic years, appearing with its corresponding note. In the event that they would like to qualify for a higher note, they must indicate this to the Secretary of the Department so that they can be called again.

2. **GROUP B and C EVALUATION PROCEDURE**

- THEORY

There will be a written partial exam in the middle of the semester, where the contents will be evaluated of the Biochemistry block. At the end of the semester there will be an exam on the contents of the block of Microbiology. These exams will be carried out on the dates established in the teaching guide of the School. The theory exams may consist of multiple choice, short and development questions on knowledge and general understanding of the subject.

- PRACTICAL TRAINING
  - Biochemistry: Immediately after carrying out the practices, the students will have to carry out a written exam to demonstrate achievement of objectives. In case they did not pass this exam, they will be called to a make-up exam. If they do not overcome it either, they will be summoned again to a last practical exam next to the final exam of the subject or at a close date.
  - In the event that a student does not do the practical training, they must take a theoretical-practical exam about it in the laboratory on an agreed date. In all cases, it will be necessary to obtain a minimum grade of 5 out of 10 points to be included in the calculation of the final grade.
  - Microbiology: The practices are compulsory except for those students with a Single Assessment. The practices are evaluated during their completion and by means of a written exam to demonstrate achievement of objectives. If they do not pass them, they will be summoned to a practical exam together with the final exam of the subject. In all cases, it will be necessary to obtain a qualification minimum of 5 out of 10 points to be included in the calculation of the final grade.
- TEACHING ACTIVITIES
  - Bioinformatics skills, autonomous work will be evaluated face-to-face and not face-to-face, attendance and active participation in theoretical classes and seminars. In order to compute the activities, at least 50% of them must have been carried out and passed.
- FINAL SCORE
  - The calculation of the final score will depend on the following conditions:
  - It is compulsory to overcome the practical requirement and an individual written tests with a minimum rating of 5.
  - The student must attend at least 75% of the theoretical lessons to compute non-attendance activities delivered.
  - The final grade for the course will be between 0 and 10 points and will correspond to the average of the final marks obtained in Biochemistry and Microbiology modules. They are offset provided the minimum score in some or both modules that should be equal to or greater than 4.
  - The relative weight of the activities and tests developed in the independent final grade for each block will be calculated for Biochemistry part: Practices: 10%; Teaching activities: 15%; Theory: 75%, and for the Microbiology part: Practices: 10%; Teaching activities: 15%; Theory: 75%.

EXTRAORDINARY EXAMINATION DIET

- **Extraordinary call**
  - There will be a single exam similar to the second exam of the ordinary call that will include all the subject matter. Theoretical exam (90% of the qualification) and a practical exam (10% of the qualification). The grade of any theory exam will not be saved, although the practical grade will be saved.

SINGLE FINAL ASSESSMENT (evaluación única final)

- **NON-CONTINUOUS EVALUATION**
  - According to the Students Assessment and Qualification Policy of the University of Granada (adopted by the Governing Council on Oct 26, 2016), those students who cannot follow the continuous assessment system due to working, health or disability issues (or any other reason appropriately justified) can apply for a Single Final Assessment. For this purpose, the student will submit a formal request to the Director (Head) of the Department, arguing and proving (with

documented evidence) the reason for not being able to follow the continuous system. The submission deadline will be 2 weeks after the beginning of the lectures. In extraordinary circumstances, the starting date for counting the 2-week period will be the enrolment date (policy NCG78/9) and, in this case, the student will have to include the proof of enrolment date when making the request. After ten days without the student receiving a written reply from the Director of the Department, it will be understood that the request has been deemed. In case of denial, the student may file, within one month, an appeal to the Rector, who may delegate this task to the Dean or Director of the Centre, exhausting the administrative proceedings.
  - Students who have chosen this system, and in order to evaluate the theoretical knowledge, will have to make and pass a multiple-choice and /or development questions test format similar to continuous assessment on the entire agenda (80 % of score) test, and proof of practical training (20 % of score). For the calculation, it is a prerequisite pass both tests with a minimum rating of 5.
  - The student may be required by the teaching staff in order to assess their grade. Besides, teachers will be able to take complementary oral exams whenever necessary to better weigh the grade or when in doubt about the authenticity of written exercises. Any contrary action with the use of not permitted means, even if detected after the evaluation process of the test, shall be subject to numerical final rating 0. Besides, the fact shall be communicated to the academic authorities. When appropriate, a final evaluation will be carried out by means of an individual oral test examination of the student with the professor of the subject or with a tribunal made up of 3 professors from the Department.

ADDITIONAL INFORMATION

- **STUDENTS WITH SPECIFIC EDUCATIONAL SUPPORT NEEDS (SSESN)**
  - The teaching methodology and evaluation will be tailored to students with specific educational support needs (SSESN), in accordance with Article 11 of the Evaluation and Qualification Regulations for Students of the University of Granada, published in the Official Gazette of the University of Granada No. 112, of 9 November 2016.