



Teaching Guide

Teaching Guide				
Identifying Data				2023/24
Subject (*)	Biochemical Foundations of Biotechnology		Code	610G02014
Study programme	Grao en Bioloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optional	6
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Bioloxía			
Coordinador	Becerra Fernandez, Manuel	E-mail	manuel.becerra@udc.es	
Lecturers	Becerra Fernandez, Manuel	E-mail	manuel.becerra@udc.es	
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Web				
General description	A materia fundamentos bioquímicos de biotecnoloxía é claramente interdisciplinar, caracterizada pola reunión de conceptos e metodoloxías procedentes de numerosas ciencias para aplicalas tanto á investigación básica como á resolución de problemas prácticos e a obtención de bens e servizos. Esta vertente práctica conecta ao alumno co mundo empresarial dándolle unha visión desas aplicacións no mundo dos negocios o que pode facilitar a súa incorporación ao mercado laboral. Ademais é unha ciencia moi dinámica en continuo crecemento e expansión o que obriga a manterse ao día consultando fontes bibliográficas e artigos de investigación actualizados en lingua inglesa.			

Study programme competences / results

Code	Study programme competences / results
A8	Illar, analizar e identificar biomoléculas.
A12	Manipular material xenético, realizar análises xenéticas e levar a cabo asesoramento xenético.
A13	Realizar o illamento e cultivo de microorganismos e virus.
A14	Desenvolver e aplicar produtos e procesos de microorganismos.
A15	Deseñar e aplicar procesos biotecnolóxicos.
B2	Resolver problemas de forma efectiva.
B5	Traballar en colaboración.
B6	Organizar e planificar o traballo.
B8	Sintetizar a información.

Learning outcomes

Learning outcomes	Study programme competences / results		
Cofecer as técnicas actuais de Bioloxía Molecular, Enxeñaría metabólica e de proteínas e as súas principais aplicacións.	A8 A12 A13	B2	
Involucrarse na problemática e oportunidades relacionadas co manexo da biotecnoloxía.	A14 A15	B5 B6 B8	
Integración dos coñecementos adquiridos en forma separada doutras materias cursadas no tres primeiros anos, con forte exercicio do pensamento crítico.	A8 A12 A13	B2 B5 B6 B8	



Amplo dominio da linguaxe, as técnicas e as aplicacións da Bioloxía molecular e da Biotecnoloxía.	A14 A15	B2 B5 B6 B8	
Desenvolvemento da percepción das oportunidades que poden derivarse da aplicación de novas estratexias biotecnolóxicas.	A14 A15	B2 B5 B6 B8	

Contents	
Topic	Sub-topic
B1T1.- INTRODUCTION	Current concept of biotechnology. History and development of biotechnology. Perspectives.
B1T2.- BIOTECHNOLOGY OF THE FERMENTATION	Classification of microbial fermentations. The traditional fermentation industries. Examples. The operating mode in fermentation processes.
B1T3.- GENES CLONATION	Purposes of the molecular cloning. Basic stages of the gene cloning. To obtain the DNA. DNA fragmentation: restriction enzymes. Union of DNA molecules. Basic techniques: electrophoresis and hybridization.
B1T4.- CLONATION VECTORS	Concept of DNA vector. Organization of the vectors and types
B1T5.- LIBRARY	Concept of library. Gene banks of genomic DNA. cDNA gene banks. Gene banks of expression. Amplification, storage and replication of gene banks. Techniques for the identification of clones. Strategies to confirm the validity of the clone. DNA microarrays.
B1T6.- TRANSFORMATION	Transformation systems. Selection of recombinants. Gene expression and its amplification.
B1T7.- POLYMERASE CHAIN REACTION	Fundamentals of the method. Automation. Components and reaction conditions. The design of primers. Fidelity of the reaction. Polymerases. Major variants and their applications
B1T8.- PRODUCTION OF HETEROLOGOUS PROTEINS IN BACTERIA AND YEASTS	Selection of micro-organisms. Vectors of expression and/or secretion. Expression in transformed cells. Secretion. Stability. The process of recovery and downstream purification. Industrial applications. Examples.
B1T9.-PRODUCTION OF HETEROLOGOUS PROTEINS IN ANIMAL CELLS	Genetic manipulation of animal cells. Vectors of expression and production of proteins in mammalian cells. Expression of proteins mediated by baculovirus in insect cell cultures. Comparison of the industrial production of heterologous proteins in cultures of bacteria, yeasts and animal cells.
B1T10.- TRANSGENIC ANIMALS	Introduction of modified genes into the genome. Pure transgenic and transgenic chimera. Homologous recombination. Specific regulation of transgenes. Gene inactivation. Antisense RNA. Ribozymes. Cell ablation. Applications as study models. Commercial applications. Cloning in mammals.
B1T11.- GENETIC ENGINEERING OF PLANTS	In vitro cultures. Techniques of manipulation. The use of markers in diagnosis, improvement and conservation of biodiversity. Resistance of plants against infections, stress and pests. Plants producing proteins of economic interest. Transgenic plant field trials.
B2T1.-APPLICATIONS OF ENZYMES IN BIOTECHNOLOGY PROCESSES	Historical perspective. The development of the enzyme industry.
B2T2.- PRODUCTION OF ENZYMES TO INDUSTRIAL SCALE	Source selection of the enzyme. New methods of screening. Extremophiles. Post-fermentation processing.
B2T3.- ENZYMATIC STABILITY	Introduction. Industrial importance of enzymatic stability. Factors influencing stability. Models of deactivation. Stabilization of enzymes.



B2T4.- IMMOBILIZATION OF BIOCATALYSTS. GENERALITIES	Immobilized biocatalyzer concept. Advantages and disadvantages of the heterogeneous catalysis versus homogeneous catalysis. Historical development. The choice of the biocatalyzer and the method. Cofactors Immobilization. Experimental determination of the enzyme activity with enzymes or immobilized cells.
B2T5.- SYSTEMS OF IMMOBILIZATION	Adsorption. Entrapment. Covalent bonding. New immobilization systems based on recombinant DNA technology. The use of enzymes in organic solvents and in two-phase aqueous systems.
B2T6.- EFFECTS OF IMMOBILIZATION ON THE ACTIVITY OF THE BIOCATALYST	Effects on the enzyme molecule. Effects of partition and dissemination. Heterogeneous Catalysis with viable cells.
B2T7.- APPLICATIONS OF IMMOBILIZED BIOCATALYSTS	Enzyme bioreactors. Use in the food industry. Enzymes immobilized as therapeutic agents. Analytical applications. Artificial organs.
B2T8.- BIOSENSORS	Concept. Functional units of a biosensor. Main fields of application. The biological reaction. Types of biosensors.
B2T9.- DESIGN OF PROTEINS	Introduction. Engineering versus protein design. Recognition of preserved areas and with important functional in protein families. From the protein sequence to the structure: prediction. Design of new protein structures. Site-directed mutagenesis techniques. Hybrid proteins.
B2T10.- ENGINEERING OF PROTEINS	The artificial evolution of proteins. Strategies. Variants of DNA shuffling. Phage and yeast display.
B2T11.- PROTEINS OF DESIGN IN THE DEVELOPMENT OF BIOSENSORS	Concept of generic biosensor. Modification of proteins to adapt them to its function in biosensors.
B3T1.- PRODUCTION OF MONOCLONAL ANTIBODIES	Fundamentals. The technique of production of monoclonal antibodies. Applications.
B3T2.- RECOMBINANT MONOCLONAL ANTIBODIES	Humanized monoclonal antibodies. Design monoclonal antibodies. Construction of catalytic antibodies (abzymes).
B3T3.- STRATEGIES AND METHODS FOR OBTAINING VACCINES	Classical systems for the production of vaccines. Antigenic determinants. Subunit vaccines. DNA vaccines. Safety of vaccines derived from biotechnology.
B3T4.- APPLICATIONS OF THE BIOTECHNOLOGY IN THE PHARMACEUTICAL INDUSTRY	Heterologous therapeutic proteins. Modified therapeutic proteins. Rational design of drugs. Pharmacogenomics.
B3T5.- MOTHER CELLS	Concept. Types. Current state of research and applications.
B3T6.- APPLICATION OF THE BIOTECHNOLOGY IN THE FORENSIC MEDICINE	Traces of DNA. Analysis of mini-satellite by Southern blotting. PCR-based methodologies.
B3T7.- BIOTECHNOLOGICAL TREATMENT OF MILK WHEY	Pollution problem and reuse of milk whey
B3T8.- THE USE OF LIGNOCELLULOSIC RESIDUES	Importance and possibilities of use.
B3T9.- ETHICAL AND LEGAL ASPECTS OF THE BIOTECHNOLOGY	Safety of the biotechnology industries. The importance of the public opinion. Socio-political guidelines. Intellectual property. Patents. Modern biotechnology regulation: a historical perspective.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student's personal work hours	Total hours
Guest lecture / keynote speech	A8 A12 A13 A14 A15	21	42	63
Seminar	A14 A15 B5 B6 B8	4	12	16
Problem solving	A15 B2	3	3	6
Objective test	A8 A12 A13 A14 A15 B8	2	20	22
Laboratory practice	B2 B5 B6	14	28	42
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				



Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Exposición oral complementada co uso de medios audiovisuais coa finalidade de transmitir coñecementos e facilitar a aprendizaxe.
Seminar	Técnica de traballo en grupo que ten como finalidade a elaboración de documentos en powerpoint e word, e expostos en clase de seminarios, sobre un tema proposto polo profesor. Os temas propostos indicaranse durante o desenvolvemento da materia.
Problem solving	Traballase coa metodoloxía de aprendizaxe baseado en problemas. Plantease un problema que pode darse na realidade e traballase cos alumnos nas clases de grupos interactivo para intentar resolvelo.
Objective test	Exame que avaliará os coñecementos teórico e prácticos adquiridos.
Laboratory practice	Metodoloxía que permite que os estudantes aprendan efectivamente a través da realización de actividades de carácter práctico.

Personalized attention	
Methodologies	Description
Seminar	A atención personalizada que se describe en relación a estas metodoloxías concíbense como momentos de traballo presencial do alumno co profesor polo que implican unha participación obrigatoria para o alumno. A forma e o momento en que se desenvolverá indicaranse en relación a cada actividade ao longo do curso segundo o plan de traballo da materia. Para o alumnado con recoñecemento de dedicación a tempo parcial e dispensa académica de exención de asistencia, o profesor adoptará as medidas que considere oportunas para non perxudicar a súa cualificación.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Seminar	A14 A15 B5 B6 B8	Avaliarase o seminario realizado polo alumno tendo en conta a capacidade para a extracción do máis relevante do total da información conseguida, a capacidade para traballar en grupo e a capacidade para expor en público.	15
Problem solving	A15 B2	Traballase coa metodoloxía de aprendizaxe baseado en problemas cos alumnos durante as clases de grupo interactivo. O alumno deberá entregar individualmente a resolución ao problema plantexado para a súa avaliación.	10
Laboratory practice	B2 B5 B6	Realizase unha proba obxectiva para avaliar os coñecementos adquiridos durante a realización das prácticas de laboratorio	15
Objective test	A8 A12 A13 A14 A15 B8	Avaliarase mediante unha proba obxectiva os coñecementos adquiridos durante as clases expositivas e as clases en grupo reducido.	60
Others			

Assessment comments



A realización das prácticas é obrigatoria. Para poder superar a materia, a calificación tanto das prácticas como da proba obxectiva deberán ser superiores a un 40% do máximo.

CONSIDERACIÓN DE ALUMNO

NON PRESENTADO (XANEIRO): Para obter a cualificación de non presentado, os alumnos non poderán participar en máis do 20% das actividades avaliadas

programadas. CONSIDERACIÓN DE ALUMNO NON PRESENTADO (XULLO): Para obter a cualificación de non presentado bastará con non presentarse ás probas

obxectivas. Para a AVALIACIÓN NA CONVOCATORIA DE XULLO manteranse os mesmos criterios que na convocatoria de Xaneiro: o alumno deberá entregar os boletíns

de problemas resolto e a presentación power point resumo do seminario así como realizar as probas obxectivas correspondentes ás sesións maxistrais e prácticas

de laboratorio. A cualificación das partes aprobadas na convocatoria de Xaneiro manterase na de Xullo.

Para o alumnado con recoñecemento de dispensa académica de exención de asistencia, o profesor adoptará as medidas que considere oportunas para non perxudicar a súa cualificación.

CUALIFICACIÓN Matrícula de Honra: Distribuirase de preferencia entre os estudantes que cumpran os requisitos na avaliación de xaneiro.

Para ós/ás estudantes que soliciten a CONVOCATORIA ADIANTADA DE DECEMBRO, aplicarase a normativa vixente, segundo a cal rixe a guía docente do curso en vigor.

Implicacións do PLAXIO na cualificación: Aplicarase a normativa vixente, segundo a cal a realización fraudulenta das probas ou actividades de avaliación implicará directamente a cualificación de suspenso.



Basic	- Ninfa, A. J. (2010). Fundamental laboratory approaches for biochemistry and biotechnology. Hoboken: John Wiley and Sons - Cerdán Villanueva, M. E., Freire Picos, M. A., González Siso, M. I. y Rodríguez Torres, A. M. (1997). Biología Molecular. Avances y Técnicas generales . A Coruña. Universidade da Coruña - Borem, A., Santos, F. R., Bowen, D. E. (2003). Understanding Biotechnology. . New Jersey: Prentice Hall PTR - Thieman, William J. (2009). Introduction to biotechnology. San Francisco: Pearson - Christof, M. Niemeyer y Chad A. Mirkin (2004). Nanobiotechnology: concepts, applications and perspectives. Weinheim, Wiley-VCH - Glick, B. R. (2003). Molecular Biotechnology: Principles and Application of Recombinant DNA. Washington: American Society Microbiology - González Siso, M. I. (1999). La Biotecnología en el tratamiento de residuos industriales . A Coruña. Universidade da Coruña. Servicio de Publicacións - Luque, J., Herráez, A. (2001). Texto Ilustrado de Biología Molecular e Ingeniería Genética . Harcourt. - Perera, J., Tormo, A., García, J. L. (2002). Ingeniería Genética. Vol II. Expresión de DNA en sistemas heterólogos.. Madrid. Síntesis - Perera, J., Tormo, A., García, J. L. (2002). Ingeniería Genética. Vol I. Preparación, análisis, manipulación y clonaje del DNA. . Madrid. Síntesis - Ratledge, C. (2002). Basic Biotechnology. Cambridge. Cambridge University Press - Schmid, R. D. (2003). Pocket guide to biotechnology and genetic engineering . Weinheim: Wiley-VCH - Smith, J. E. (2006). Biotecnología. Zaragoza: Acribia, D.L. - Thiel, T., Bissen, S. T., Lyons, E. M. (2001). Biotechnology: DNA to Protein. A Laboratory Project in Molecular Biology. . - Thieman, W. J., Palladino, M. A., Thieman, W. (2004). Introduction to Biotechnology. . Benjamin Cummings, Publisher - Walter, J. M. y Gingold. E. B (1997). Biología Molecular y Biotecnología . Zaragoza. Acribia - Wink, M. (2006). An introduction to molecular Biotechnology: from molecular biological fundamentals to methods and applications in modern biotechnology. Verlag Chemie, GmbH - Wu, W., Welsh, M. J., Kaufman, P. B., Zhang, H. H. (1997). Methods in Gene Biotechnology . CRC Press - Gerd Gellisen Ed. (2005). Production of recombinant proteins: novel microbial and eukaryotic expression systems. Weinheim: Wiley-VCH - Barnum, S.R. (2005). Biotechnology: an introduction. Belmont: Thomson - Thieman, W. J. & Palladino, M.A. (2010). Introducción a la Biotecnología. Pearson
Complementary	- Varios (2006). Guía de empresas en el sector biotecnológico español. Madrid: Genoma España

Recommendations

Subjects that it is recommended to have taken before

Biochemistry I/610G02011

Biochemistry II/610G02012

Biochemistry and Molecular Biology/610G02013

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Other comments



Full integration will be facilitated for students who, for physical, sensory, mental or sociocultural reasons, experience difficulties in having a suitable, equal and beneficial access to university life. Work will be done to identify and modify prejudices and sexist attitudes, and the environment will be influenced to modify them and promote values of respect and equality. Likewise, if adverse situations due to gender are identified, measures will be taken to correct them. Green Campus Science Faculty Program To contribute to achieving an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", the documentary work carried out in this area: a. They will be requested mainly in virtual format and computer support. B. To do on paper: - Plastics will not be used. - Double-sided prints will be made. - Recycled paper will be used. - Drafts will be avoided.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.