Universitat de Lleida

DEGREE CURRICULUM

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY

Coordination: VILLORBINA NOGUERA, GEMMA

Academic year 2023-24

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY</td></tr>
<tr><td>Code</td><td>101635</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Biotechnology</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
</table>
</td></tr>
<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRACAMP</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>0.6</td><td>1.2</td><td>1.8</td><td>2.4</td></tr>
<tr><td>Number of groups</td><td>1</td><td>2</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>Coordination</td><td>VILLORBINA NOGUERA, GEMMA</td></tr>
<tr><td>Department</td><td>ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>56 teaching hours
94 student dedication</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Català 95%
English 5%</td></tr>
</table>

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MORATO-ARAGONES IBAÑEZ, GUILLEM	guillem.morato-aragones@udl.cat	1,2	
OSORIO VIANA, WILMAR	wilmar.osorio@udl.cat	1,2	
VILLORBINA NOGUERA, GEMMA	gemma.villorbina@udl.cat	4,8	

Subject's extra information

Students must bring the following individual protection items (EPI) in the course of laboratory works:

White lab coat UdL unisex
Safety glasses
Chemical protection gloves

The EPI can be purchased at UdL's ÚDELS store

Center for Cultures and Cross-Border Cooperation - Cappont Campus

Carrer de Jaume II, 67 low

25001 Lleida

http://www.publicacions.udl.cat/

In any case, the Department of Chemistry, Physics, Ambiental and Soil Sciences will try to put at the disposal of the students glasses and gloves of protection of general use.

GENERAL SAFETY RULES IN LABORATORY PRACTICES

Maintain the place of performance of clean and tidy practices. The work table must be free of backpacks, folders, coats ...
In the laboratory you can not come with shorts or short skirts.
Bring closed and covered shoes during the performance of the practices.
Bring long hair always collected
Keep the gowns cords to protect against spills and spills of chemical substances.
Do not carry wide bracelets, pendants or sleeves that can be trapped by the equipment, assemblies ...
Avoid wearing contact lenses, since the effect of chemicals is much greater if they are introduced between the contact lens and the cornea.
Do not eat or drink in the laboratory
Smoking is prohibited within laboratories
Wash your hands whenever you have contact with a chemical and before leaving the laboratory.
Follow the teacher's instructions and consult any questions about security.

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2023-24

Learning objectives

The student who passes the subject must know: (Knowledge Objectives)

- What does the concept of biorefinery imply?
- Possible sources of renewable materials
- Type of most important applications
- Methodologies for its transformation into products with economic interest.
- Environmental aspects linked to these processes
- Opportunities and limitations of biomass-based products.

The student who passes the course must be able to: (Capacity Objectives)

- Make decisions about the opportunity and possibility of obtaining a product based on biomass.
- To be able to advise on possible new opportunities in obtaining products based on biomass.
- To be able to join research groups working in this field.
- To be able to integrate in companies dedicated to the obtaining of products related to the subject matter of the course.
- Understand and be able to analyze scientific articles related to the subject matter.

Competences

General competences

The graduate in Biotechnology has to:

- CG1. To be able to search and selectively use sources of information necessary to achieve the training objectives.
- CG2. To interpret scientific-technical information with a critical sense, and to be able to make presentations based on this information.
- CG3. To work as a team, with a multidisciplinary vision and the ability to make a rational and effective distribution of tasks among the members of the team.
- CG4. To know and use adequately the scientific and technical vocabulary of the different fields of Biotechnology.
- CG5. To work in the laboratory applying criteria of quality and good practice.
- CG9. To be able to carry out a professional activity in accordance with safety and environmental regulations and ethical criteria.
- CG11. To acquire criteria for choosing the most appropriate analytical techniques for each specific practical case.

Specific competences

- CE34. To know the main areas of application of Biotechnology and acquire basic expertise in some of them.
- CE44. To be able to design the protocol of a specific biotechnological process. Fulfil the practical requirements necessary to carry it out and the parameters for its evaluation.

Transversal competences

- CT1. To be able to make understandable written and oral reports on the work carried out, with a justification based on the theoretical-practical knowledge reached.
- CT3. To use tools and techniques of information and communication for the analysis of data and the elaboration of oral and written reports and other formative and professional activities.

Subject contents

--Topics--

Introduction

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2023-24

Presentation of the subject: evaluation criteria, dates to take into account, introduction to the Horizon Europe program and the bioeconomy (or circular economy).

Historical perspective of industries based on the use and transformation of biomass to obtain products and materials.

From the 19th to the 21st century. Fossil reserves and their depletion. Environmental aspects. Parameters for measuring the impact of a process (the E factor; atomic savings and life cycle analyses). Need to use renewable sources. The three main areas of human consumption of products and materials: as a source of energy, as a source of materials, as a source of bioactive products. Biomass as the main renewable source: problems and challenges. The exploitation of microalgae as an example.

Possibilities of using biotechnological tools in the transformation of biomass.

Traditional fermentation processes. Current tools to improve processes. Biocatalysts. Cellular machines. Applications in the preparation of chemical products. The use of a product such as glycerol.

Biofuels

Main types of biofuels. Distribution of renewable resources. Capacity of biomass to supply us with energy. Second and third generation biofuels. Processes for obtaining them. Market possibilities for biofuels. Environmental aspects to be taken into account.

Biopolymers and bioplastics

Monomers and biopolymers. Characteristics of plastics. Biodegradable plastics. Processes to obtain them. Application of biotechnology in their production. Applications of biopolymers and bioplastics and possible problems.

Secondary metabolites as a source of new products.

Agronomic and pharmaceutical uses of secondary metabolites. The study of ancestral customs for the development of useful products. Medicinal plants as a source of active principles. Isolation and structural modification of secondary metabolites. The search for new secondary bioactive metabolites.

Additives

Flavouring dyes and preservatives. Possible sources of additives. Processes for obtaining them. Application of biotechnology in its production. Glycerol as a source of some additives: mono- and diglycerides. Unicellular proteins: fungus, yeasts and bacteria.

New horizons in the use of biomass: biotemplates.

Biomass as a source of inspiration in the design and preparation of new materials and new technologies. Photocatalytic production of hydrogen. CO_2 reduction. Solar cells. Lithium ion batteries. Photocatalytic degradation. Gas / steam sensors.

--Practical activities--
Seminar

Elaborate two writing work about 2 scientific publications proposed by the professors.

Presentation related to the subject within the framework of the Horizon Europe Program. The action must be based

on a minimum of two scientific publications and must be defended in public with a duration of 10 min explaining the motivation, rationale and conclusions.

Laboratory practices

Practice 1: Treatment of biomass by applying sustainable processes.
Practice 2: Applications of biocatalysts for the preparation of compounds with industrial interest.

Visit:

Visit to industial plant devoted to recover natural products from algae.

Methodology

Type of activity	Description	Semi-attendance activity student		Non-face-to-face activity student		Evaluation	Total time
		Objectives	**Hours**	**Student work**	**Hores**	**Hours**	**Hours**
Lecture	Lecture (Classroom. Large group)	Explanation of the main concepts	**28**	Study: Know, understand and synthesise knowledge	**32**	4	**64**
Seminar	Participative class (Medium group)	Conducting discussion or application	**4**	Solve problems and cases. Dicuss.	**15**	0	**19**
Laboratory	Laboratory practicals (Medium group)	Execution of the practical: understanding phenomena, measuring...	**12**	Carry out practical exercises and memory. Drawing conclusions.	**12**	0	**24**
Visits	Industry visit	Carrying out the visit	**6**	carrying out the report	**9**	0	**15**
Activities directed	Student work (individual or group)	Guiding the student in the work (in tutoring hours)	**10**	Carry out a bibliographic work, practical, etc.	**20**	0	**30**
Total			**60**		**90**	4	**150**

Evaluation

Tests	Practices	Other activities
50	15	35

Activity	Description	Number	%
Theory	Written tests (true/false) on the theory of the subject	2	**50**
Laboratory	Delivery of memory	1	**15**
Seminar	Oral presentation	1	**15**

Visit	Delivery of memory	1	**5**
Written activity	critical review of an article. Delivery of memory	2	**15 (5+10)**
Total			**100**

Alternative assessment

If alternative assessment is used, the following activities must be carried out in order to pass the course:

- Carry out the practical laboratory sessions and submit the report 20%
- Present the work report of the chosen article 20%
- Take the final exam on the last day of the course 60%.

Bibliography

Basic references

Bell, J.; Paula, L.; Dodd, T.; Németh, S.; Nanou, C.; Mega, V.; Campos, P. **2018** "EU ambition to build the world's leading bioeconomy—Uncertain times demand innovative and sustainable solutions" New Biotechnology 40, 25–30.

BIOPLAT/SUSCHEM **2017** "Manual sobre las Biorrefinerías en España" pp.92 http://www.suschem-es.org/docum/pb/2017/publicaciones/Manual_de_Biorrefinerias_en_Espana_feb_2017.pdf (setembre 2020).

Carus, M.; Dammer, L.; **2018** "The "Circular Bioeconomy" –Concepts, Opportunities and Limitations" Hürth 2018-01. www.bio-based.eu/nova-papers (setembre 2020).

Dominguez de Maria, P. (ed.) **2016** Industrial Biorenewables: A Practical Viewpoint. John Wiley & Sons, Inc., Hoboken, New Jersey.

Feliu Jofre, A.; Flotats Ripoll, X. **2020** Renewable gases. An emerging energy vector Naturgy Foundation Avda. San Luís:Madrid ISBN: 978-84-09-20931-6.

Illanes, A. (ed.) **2008** Enzyme Biocatalysis. Principles and Applications Springer Science + Business Media B.V

Kamm, B.; Gruber, P.R.; Kamm, M. (eds.) **2006** Biorefineries-Industrial Processes and Products Wiley-VCH Verlag & Co. KGaA: Weinheim (Alemanya).

Kauffman, G.B. **2008** Introduction to Chemicals from biomass Jonh Wiley & Sons: Chichester (UK).

Klass. D.L., **1998** Biomass for Renewable Energy, Fuels, and Chemicals Academic Press. San Diego (California-USA).

MINECO **2021**. *Estrategia Española de Bioeconomía: Horizonte 2030.* https://mercadosbiotecnologicos.com/media/wakekng2/bioeconomía-estrategia-española.pdf

Spelman, C. A. **1994** Non-food uses of agricultural raw materials : economics, biotechnology and politics, CAB International: Wallingford, U.K.

Zhou, H. Tongxiang, F. Zhang D. Biotemplated Materials for Sustainable Energy and Environment: Current Status and Challenges *ChemSusChem* **2011**, 4, 1344 – 1387.

Complementari references

Bullard, M.J. (ed.) Biomass and energy crops II, **2001** Association of Applied Biologists: Wellesbourne.

Cheda, J.; Huber, G.; Dumesic, J., Liquid-Phase Catalytic Processing of Biomass- Derived Oxygenated Hydrocarbons to Fuels and Chemicals. *Ang. Chem. Int. Ed.* **2007**, 46, 7164–7183.

Coplin, L. G. (ed.) **2012** Sustainable Development of Algal Biofuels in the United States National Academies Press, Washington: DC. de Wit, M.; Faaij, A.P.C.

European biomass resource potential and costs *Biomass Bioener.* **2010**, 34, 188–202. EBTP 2010 Strategic Research Agenda Update 2010 European Biofuels Technology Platform.

Euromot, Biomass, renewable fuels, peak oil and the end of cheap energy? *Diesel Progress, Intern. Ed.* **2006**, 60-64.

EuropaBio **2008** How industrial biotechnology can tackle climate change. The European Association for Bioinsdustries: Brussels.

Dam, J.; Hanefeld, U. Renewable Chemicals: Dehydroxylation of Glycerol an Polyols *ChemSusChem* **2011**, 4, 1017 – 1034.

Maity, S. K. Opportunities, recent trends and challenges of integrated biorefinery: Part I *Renewable and Sustainable Energy Reviews* **2015**, 43, 1427–1445.

Maity, S. K. Opportunities, recent trends and challenges of integrated biorefinery: Part II *Renewable and Sustainable Energy Reviews* **2015**, 43, 1446–1466.

MINECO Estrategia Española de Bioeconomía 2030, http://bioeconomia.agripa.org/download-doc/102163, 21/07/2016.

Smeets, E.M.W.; Faaij, A.P.C. The impact of sustainability criteria on the costs and potentials of bioenergy production – Applied for case studies in Brazil and Ukraine *Biomass Bioener.* **2010**, 34, 319–333.

Walsh, M.; Jones, M. B.; Walsh, M. (ed.) *Miscanthus* : for energy and fibre ; edited by **2001** James and James: London.

Wood, W. A.; Scott, T.; Kellogg, B. (eds.) Biomass Methods in Enzymology; 160-161, **1988** Academic Press: San Diego (Calif.).