Universitat de Lleida

DEGREE CURRICULUM

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY

Coordination: CANELA GARAYOA, RAMON

Academic year 2019-20

INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2019-20

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>
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<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>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>1.2</td><td>2.4</td><td>2.4</td></tr>
<tr><td>Number of groups</td><td>4</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>CANELA GARAYOA, RAMON</td></tr>
<tr><td>Department</td><td>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>
<tr><td>Office and hour of attention</td><td>Centre: ETSEA
Departament: Química
Despatx: 0.06 Horari consulta: Dilluns i divendres 12-14
Telèfon: 973702841</td></tr>
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INDUSTRIAL APPLICATIONS OF BIOTECHNOLOGY 2019-20

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
AGUILERA OVIEDO, JOHANNA	johanna.aguilera@udl.cat	1	
CANELA GARAYOA, RAMON	ramon.canela@udl.cat	,8	
CEQUIER MANCIÑEIRAS, ENRIQUE	enrique.cequier@udl.cat	4,4	
DAGO BUSQUETS, ANGELA	angela.dago@udl.cat	2,4	
YARA VARÓN, EDINSON	edinson.yara@udl.cat	1	

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 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

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:

- To be able to search and selectively use sources of information necessary to achieve the training objectives.
- To interpret scientific-technical information with a critical sense, and to be able to make presentations based on this information.
- 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.
- 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.
- 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.
- Respect the fundamental rights of equality between men and women, the promotion of human rights and the values of a culture of peace and democratic values.
- To know and use adequately the scientific and technical vocabulary of the different fields of Biotechnology.
- To work in the laboratory applying criteria of quality and good practice.
- To be able to carry out a professional activity in accordance with safety and environmental regulations and ethical criteria.
- Acquire criteria for choosing the most appropriate analytical techniques for each specific practical case.
- To interpret the scientific-technical information with a critical sense, and to be able to make presentations based on this information.
- Be able to make understandable written and oral reports on the work carried out, with a justification based on the theoretical-practical knowledge attained.

Specific competences

- To develop biotechnological applications and protocols to obtain products of commercial value.
- Working in biotechnology companies in the research, development or production of products from biomass.
- To design innovative biotechnology projects by identifying applications, business ideas, work plans and the implementation of new techniques and equipment.
- Transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.

Subject contents

Topics

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. From design to obtaining a product: example of hydroxytyrosol and terpenic acids. Possible environmental impact of these actions. Application of biotechnology in its production.

Additives

Colorants and preservatives. Possible sources of additives. Processes for obtaining them. Application of biotechnology in its production. Glycerol as a source of some additives.

New horizons in the use of biomass: biomolds.

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

Reading and discussion of 2 selected scientific publications.

Comparison of a minimum of two scientific publications on a current topic related to the subject and public presentation of the main aspects analyzed.

Laboratory practices

Practice 1: Lignin extraction using ionic liquids.

Practice 2: Use of biocatalysts in batch reactors for the preparation of food flavourings.

Visit:

Visit to a production plant and use of microalgae.

Methodology

Tipus d'activitat	Descripció	Activitat presencial alumne		Activitat no presencial alumne		Avaluació	Temps total
		Objectius	**Hores**	**Treball alumne**	**Hores**	**Hores**	**Hores**
Lliçó magistral	Classe magistral (Aula. Grup gran)	Explicació dels principals conceptes	**24**	Estudi: Conèixer, comprendre i sintetitzar coneixements	**32**	4	**60**
Problemes i casos	Classe participativa (Aula. Grup gran)	Resolució de problemes i casos	**0**	Aprendre a resoldre problemes i casos	**0**	**0**	**0**
Seminari	Classe participativa (Grup mitjà)	Realització d'activitats de discussió o aplicació	**8**	Resoldre problemes i casos. Discutir	**15**	0	**23**
Laboratori	Pràctica de Laboratori (Grup mitjà)	Execució de la pràctica: comprendre fenòmens, mesurar...	**12**	Estudiar i realitzar Examen	**12**	0	**24**
Aula d' nformàtica	Pràctica d'aula d'informàtica (Grup mitjà)	Execució de la pràctica: comprendre fenòmens, mesurar...	**0**	Estudiar i Realitzar memòria	**0**	0	**0**
Pràctiques de camp	Pràctica de camp (Grup mitjà)	Execució de la pràctica: comprendre fenòmens, mesurar...	**0**	Estudiar i Realitzar memòria	**0**	0	**0**
Visites	Visita a explotacions o industries	Realització de la visita	**6**	Estudiar i Realitzar memòria	**9**	0	**15**

Activitats dirigides	Treball de l'alumne (individual o grup)	Orientar a l'alumne en el treball (en horari de tutories)	**6**	Realitzar un treball bibliogràfic, pràctic, etc.	**22**	0	**28**
Altres			**0**		**0**	0	**0**
Totals			**56**		**90**	4	**150**

Evaluation

Exámenes	Prácticas	Análisis de casos y problemas	Otras actividades
50	10	0	40

Tipus d'activitat	Activitat d'Avaluació		Pes qualificació
	Procediment	**Número**	
Lliçó magistral	Proves escrites sobre la teoria del programa de l'assignatura	2	**50**
Problemes i casos	Proves escrites sobre la teoria del programa de l'assignatura		
Laboratori	Lliurament de memòries, proves escrites o orals	1	**10**
Seminari	Proves escrites o orals	1	**17**
Aula informàtica	Lliurament de memòries. Proves escrites o orals.		
Pràctiques de camp	Lliurament de memòries. Proves escrites o orals		
Visites	Lliurament de memòries. Proves escrites o orals.	1	**5**
Activitats dirigides	Lliurament del treball	2	**18**
altres			
Total			**100**

Bibliography

Basic references

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).

Fern, K. **1997**Plants for a future: edible & useful plants for a healthier world, Permanent Publications : Hampshire.

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.).