Universitat Autònoma de Barcelona

2020/2021

Applied Biocatalysis and Biotransformations

Code: 43332
ECTS Credits: 9

Degree	Type	Year	Semester
4314579 Biological and Environmental Engineering	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Gregorio Alvaro Campos

Email: Gregorio.Alvaro@uab.cat

Use of Languages

Principal working language: spanish (spa)

Teachers

Gloria González Anadón

Marina Guillen Montalban

Prerequisites

Basic knowledge of:

- Protein structure
- Biochemistry
- Catalysis
- Kinetic enzyme
- Microbial growth
- Cell biology

Objectives and Contextualisation

The objective is to present biocatalysis and its fields of application as an alternative to classical catalysis. The knowledge of biocatalysts will be deepened as the central axis of a transformation and of the aspects of engineering of the main elements that make up biotransformation, such as the biocatalyst, the reaction medium, the bioreactor and its operation. Also the classification and study of the different biotransformations according to the biocatalyst used and different case studies. The final objective is that the student is able to define the main elements of a biotransformation and can design a biocatalytic process.

Competences

- Integrate knowledge about the state of biocatalysis, its areas of application, the different kinds of biotransformations and the design of a biocatalytic process for application in industry.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.

- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use IT tools to acquire further knowledge in the field of biological and environmental engineering.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Work in a multidisciplinary team

Learning Outcomes

1. Characterise the activity and stability of biocatalysts.
2. Describe the kinetics, design and operation of bioreactors.
3. Design a biocatalyst process.
4. Distinguish the different reaction media used in biotransformations and choose the most appropriate one.
5. Distinguish the immobilisation methods of biocatalysts and the characterisation of the immobilised biocatalyst.
6. Explain the different kinds of biotransformations in terms of the biocatalyst used.
7. Identify multienzyme processes.
8. Identify the advantages and disadvantages of biocatalysis and its potential in the chemical and pharmaceutical industry as a tool for sustainable development.
9. Identify the different types of biocatalysts and assess their characteristics used in a biotransformation.
10. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
11. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
12. Use IT tools to acquire further knowledge in the field of biological and environmental engineering.
13. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
14. Work in a multidisciplinary team

Content

Assignment program:

- Topic 1 Introduction to biocatalysis
- Topic 2 Biocatalysts
- Topic 3 Biocatalyst engineering
- Topic 4 Reaction medium engineering
- Topic 5 Bioreactor operation
- Topic 6 Biotransformations: case studies

Methodology

Directed activities:

- Theoretical lectures: Master classes on the concepts of the subject
- Seminars: Presentation to students of different cases of study of biotransformations and applied biocatalysis extracted from the bibliography
- Public presentation of the work: Students will orally and publicly present a summary of the most relevant results of the work and deliver the presentation to the professor in digital format through the virtual campus

Autonomous activities:

- Individual study: Individual study, preparation of diagrams and summaries.
- Documentation and bibliography search: Consultation of the bibliographic and documentary sources essential for the course.
- Realization of a work: work in groups of 2-4 students in which each group will elaborate a written work on a case study previously selected by the teacher. The work will be delivered to the teacher in paper

format (printed) and in digital format through the virtual campus, in order to discuss in seminars and written presentation.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Seminars and case studies	6	0.24	1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 11, 13, 14, 12
Theoretical classes	49	1.96	1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 11, 14
Type: Autonomous			
Carry out work on a case study	20	0.8	10, 11, 14, 12
Individual study	127	5.08	1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 11, 14, 12
Search for documentation and bibliography	20	0.8	12

Assessment

Scheduled evaluation process and activities

Throughout the course different evaluation activities will be carried out that will lead to the final grade of the subject obtained by continuous evaluation. Specifically, the evaluable activities will be:

- Written work on a case study that is 20% of the final grade.
- Oral and public presentation of the written work that is 10% of the final grade
- Attendance at all oral presentations is compulsory for all students
- Partial exam of topics 1, 2 and 3, which represents 35% of the final grade
- Partial examination of topics 3, 4 and 5, which represents 35% of the final grade

The written work and the oral presentation of the work are non-recoverable.

The subject is considered passed if the average of the 4 activities is 5 or higher, as long as no part is less than 4.0

If the average of the 4 activities is less than 5, the suspended activities (with less than 5) must be recovered

- If any of the following circumstances occurs, it implies a grade of Not assessable to the subject:
- Do not perform written work
- Do not perform the oral presentation of the work
- Do not perform any of the exams

Programming evaluation activities

At the beginning of the subject groups will be formed to do the written work. The delivery of written work and oral presentations will be communicated through the virtual campus.

Recovery process

The student can apply for recovery whenever he has submitted to a set of activities that represent at least two thirds of the total grade of the subject. Of these, students who have on average of all the activities of the subject a grade higher than 3.5 may be presented in the recovery.

The partial exams are eliminatory, therefore, a student who has passed a partial exam will not be able to appear for the recovery of this exam. Youwill have to compulsorily recover those partial exams where the student has obtained a grade lower than 4 regardless of the average obtained according to the calculation of the section "Process and programmed evaluation activities"

The calculation of the grade will be done in the same way as in the continuous evaluation

Procedure for review of qualifications

For each evaluation activity, a place, date and time of revision in which the student can review the activity with the teacher will be indicated. In this context, claims may be made on the activity grade, which will be evaluated by the faculty responsible for the subject. If the student does not appear in this review, this activity will not be reviewed later.

Ratings

Granting a grade of honor registration is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. You can grant up to 5% of MH of the total number of students enrolled.

Irregularities by the student, copy and plagiarism

Without prejudice to other disciplinary measures deemed appropriate, the irregularities committed by the student that may lead to a variation of the grade of an evaluation act will be scored with a zero. Therefore, copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending with a zero. The evaluation activities qualified in this way and by this procedure will not be recoverable. If it is necessary to pass any of these evaluation activities to pass the subject, this subject will be suspended directly, without the opportunity to recover it in the same course. In this situation the final grade that will be reflected in the minutes will be a 2.

Evaluation of repeating students

There is no provision for a different evaluation system for repeating students.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Oral and public presentation of the work	10%	1	0.04	10, 11, 13, 14, 12
Partial exam (themes 1, 2 and 3)	35%	1	0.04	1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 11, 13
Partial exam (topics 4, 5 and 6)	35%	1	0.04	1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 11, 13
Written work	20%	0	0	3, 10, 11, 13, 14, 12

Bibliography

Books:

Autor	Fersht, Alan, 1943-
Títol	Enzyme structure and mechanism / Alan Fersht

Edició	2nd. ed.
Publicació/producció	New York : W.H. Freeman, cop. 1985
Descripció	xxi, 475 p.; 24 cm
Matèria	Enzims
ISBN	0716716143
	0716716151 (pbk.)

http://cataleg.uab.cat/record=b1323065~S1*cat

Autor	Dixon, Malcolm
Títol	Enzymes / by Malcolm Dixon and Edwin C. Webb
Edició	3rd ed.
Publicació/producció	London : Longman, 1979
Descripció	XXIII + 1116 p.; 24 cm
Matèria	Enzims

http://cataleg.uab.cat/record=b1016445~S1*cat

Títol	Enzyme biocatalysis : principles and applications / Andrés Illanes, editor
Publicació/producció	[Dordrecht] : Springer, 2008
Descripció	X, 391 p. : ill. ; 25 cm.
Matèria	Enzims -- Biotecnologia

	Enzims -- Síntesi
ISBN	9781402083600

http://cataleg.uab.cat/record=b1744514~S1*cat

Títol	Ingeniería bioquímica / Francesc Gòdia Casablancas y Josep López Santín (editores) ; Carles Casas Alvero ... [et al.]
Publicació/producció	Madrid : Síntesis, DL 1998
Descripció	350 p. : il.; 24 cm
Col·lecció	Ciencias químicas (Síntesis). Tecnología bioquímica y de los alimentos
Matèria	Enginyeria bioquímica
ISBN	8477386110

http://cataleg.uab.cat/record=b1425826~S1*cat

Autor	Bommarius, A. S.
Títol	Biocatalysis : [fundamentals and applications] / A.S.Bommarius, B.R.Riebel
Publicació/producció	Weinheim : Wiley-VCH, 2004
Descripció	XXIII, 611 p.; 24 cm
Matèria	Enzims
ISBN	3527303448

http://cataleg.uab.cat/record=b1604211~S1*cat

Títol	Multi-step enzyme catalysis : biotransformations and chemoenzymatic synthesis / edited by Eduardo Garcia-Junceda
Publicació/producció	Weinheim : Wiley-VCH ; Chichester : John Wiley, 2008
Descripció	241 p. ; 25 cm
Matèria	Catàlisi
	Enzims -- Biotecnologia
ISBN	9783527319213

http://cataleg.uab.cat/record=b1747444~S1*cat

Títol	Immobilization of enzymes and cells / edited by Gordon F. Bickerstaff
Publicació/producció	Totowa : Humana Press, 1997
Descripció	XIV, 367 p.;23 cm
Col·lecció	Methods in biotechnology ; 1
Matèria	Enzims immobilitzats
	Enzims -- Biotecnologia
	Cèl·lules immobilitzades
ISBN	0896033864

http://cataleg.uab.cat/record=b1465205~S1*cat

Autor	Faber, Kurt

Títol	Biotransformations in organic chemistry : a textbook : with 37 figures, 238 schemes and 16 tables / Kurt Faber
Edició	5th revised and corrected ed.
Publicació/producció	Berlin : Springer-Verlag, cop. 2004
Descripció	XI, 453 p. : il; 24 cm
Matèria	Reaccions químiques
	Química orgànica -- Reaccions
ISBN	3540200975

http://cataleg.uab.cat/record=b1615815~S1*cat

Autor	Grunwald, Peter
Títol	Biocatalysis : biochemical fundamentals and applications / Peter Grunwald
Publicació/producció	London : Imperial College Press, 2009
Descripció	xvi, 1035 p. : il. ; 24 cm
Matèria	Enzims -- Biotecnologia
	Biotecnologia
ISBN	9781860947711
	1860947719

https://cataleg.uab.cat/record=b1778458~S1*cat

Kourist, R. (2015), Biocatalysis in Organic Synthesis. Science of Synthesis, Vol. 1-3. Edited by Kurt Faber, Wolf-Dieter Fessner and Nicholas J. Turner.. Angew. Chem. Int. Ed., 54: 12547. doi:10.1002/anie.201508130

Search engines of scientific bibliography*:*

Scholar Google: http://scholar.google.es/advanced_scholar_search?hl=en&lr=

Scopus: http://www.scopus.com/scopus/search/form.url?display=authorLookup

Scifinder: Software disponible a la UAB

Sience Direct: http://www.sciencedirect.com/science/journals

ISI Web of Knowledge: http://www.accesowok.fecyt.es/login/

Interesting web sites:

Base de dades d'enzims BRENDA: http://www.brenda-enzymes.info/

National Center for Biotechnology Information: http://www.ncbi.nlm.nih.gov/

ExPASy (Expert Protein Analysis System) Proteomic Server: http://www.expasy.ch/