UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

SCHOOL "POLITECNICA E LE SCIENZE DI BASE"

DEPARTMENT OF CHEMICAL SCIENCE

Student's Guide

2nd Cycle Degree/Master

Molecular and Industrial Biotechnology

Degree programme class: LM-8

CORSO DI LAUREA MAGISTRALE IN BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI

ANNO ACCADEMICO 2022/2023

Biotecnologie Industriali Federico II

BiotecnologieindustrialiFII

Biotecnologie Biomolecolari e Industriali UNINA

Settembre 2022

The Molecular and Industrial Biotechnology Degree programme is certified ISO 9001 from the certified management system RINA.

The educational organization of Molecular and Industrial Biotechnology Degree programme (Degree programme class: LM-8).

The document includes:

- Manifesto degli Studi – due curricula
  - Curriculum "**Produzioni Biotecnologiche** (ProBio)"
  - Curriculum "**Biotechnology for Renewable Resources** (BiRRe)"
- Summary sheets of the courses/modules with full names of the Professors.

On the Professors' website it is possible to find the detailed programmes of the courses/modules.

A quick guide to the programme

The programme at a glance

The MSc programme aims to educate graduated students for high profile positions in research centres, enterprises and industries operating in industrial biotechnology field.

The programme includes activities aimed at acquiring:
(a) knowledge on the structure and function of biological systems, interpreted according to molecular and informational logics, from the cellular level to that of the organisms;
(b) fundamental knowledge and techniques in various fields of industrial biotechnology, with particular attention to multidisciplinary approaches;
(c) specialist skills in specific sectors of industrial biotechnology.

The MSc provides the opportunity of external activities (e.g. internships in companies, public or private research institutes, traineeships in Italian and European universities) to strengthen skills in specific sectors of industrial biotechnology.

The MSc programme includes - as a qualifying moment of the training - an experimental thesis carried out in academic research laboratories and/or in other public/private structures, including the results of an original scientific and technological research.

The programme includes two curricula:
“BiRRe - Biotechnology for Renewable Resources” – The curriculum is focused on molecular and industrial issues of biotechnology to prepare students to the construction of new products and services based on the exploitation of renewable resources. Lectures for 48 CFU are hold in English language. 30 CFU lectures are hold in Italian language.
“ProBio - Biotechnology productions” – The curriculum is focused on molecular and industrial aspects of biotechnology to educate students to a general integrated approach to consolidated and emerging technologies. Lectures are hold in Italian language.

Job opportunities

Potential fields of activity of MSc graduated students are biotechnological enterprises, chemical, pharmaceutical/cosmetic and nutraceutical industries, as well as the environmental technology sector.
The MSc graduated students will be able to operate covering positions of high responsibility, including technical, economic and legal implications.
The overview by AlmaLaurea reports that graduated students found positions within 4 months from the graduation ceremony. A large fraction (80%) of the interviewed graduated students works for chemical/energy enterprises. A large fraction (85%) of the interviewed graduated students works for private enterprises.
It is possible to check the positions of the graduated students by clicking at the Linkedin link reported in the “Albo” of the graduated students at page
http://www.biotecnologieindustriali.unina.it/en/yearbook/

Admission to the programme and prerequisites

The enrolment to the Master's Degree course requires that the student:
a) is BSc graduated
b) has sufficient knowledge in the disciplines listed below:

- mathematical, chemical and physical disciplines;
- biological disciplines (biochemistry, molecular biology, genetics);
- disciplines of the fermentation sector (microbiology and chemistry of fermentation);

- disciplines of process technologies (thermodynamics and transport phenomena, foundations of unitary operations for biotechnologies).

c) CFU in SSDs as reported:
30 CFU in Biological Sciences area (BIO/ 01-BIO/ 19)
6 CFU in Mathematical and Computer Sciences area (MAT/01-MAT/09)
6 CFU in Physical Sciences area (FIS/01-FIS/08)
18 CFU in Chemical Sciences area (CHIM/01-CHIM/12)

Language skills: documented competence in the correct use of the English language comparable to B2 level.

Details on the page
http://www.biotecnologieindustriali.unina.it/media/pages/1/19/attach/Regolamento_accesso_LM.pdf

Piano di Studi

Curriculum Produzioni Biotecnologiche (ProBio) *(in corsivo gli insegnamenti caratteristici del curriculum)*								
I Anno								
Denominazione Insegnamento	**SSD**	**Modulo**	**CFU**	**Ore**	**Tipologia Attività**	**TAF**	**Ambito disciplinare**	**obbligatorio /a scelta**
Industrial microbiology and fermentation chemistry (IT)	CHIM/11		6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline chimiche	Obbligatorio
System biology and bioinformatics (IT)	BIO/10	*Biologia dei sistemi*	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
	BIO/10	*Bioinformatica e modellistica molecolare*	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
Industrial biotechnologies and environment protection (IT)	BIO/11	Biotecnologie industriali	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
	AGR/07	Biotecnologie per la salvaguardia dell'ambiente	6	48	Lezione frontale	C		Obbligatorio
Transport phenomena in biological systems (IT)	ING-IND/24		9	72	Lezione frontale	B	Discipline chimiche	Obbligatorio
Biochemistry biotechnology (IT)	BIO/10	*Biotecnologie ricombinanti*	6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline biologiche	Obbligatorio
	BIO/10	*Ingegneria proteica e metabolica*	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
Bioreactors (IT)	ING-IND/25		9	48	Lezione frontale	B	Discipline chimiche	Obbligatorio
II Anno								
Denominazione Insegnamento	**SSD**	**Modulo**	**CFU**	**Ore**	**Tipologia Attività**	**TAF**	**Ambito disciplinare**	**obbligatorio /a scelta**
Biotechnological processes (IT)	ING-IND/26	*Teoria dello sviluppo dei processi biotecnologici*	6	48	Lezione frontale	B	Discipline chimiche	Obbligatorio
	ING-IND/25	*Impianti e processi biotecnologici*	6	48	Lezione frontale	B	Discipline chimiche	Obbligatorio

Hygiene background for biotechnologies (IT)	MED/42		6	48	Lezione frontale	C		Obbligatorio
Biosensors and Biochips (IT)	FIS/01		6	48	Lezione frontale	B	Discipline per le competenze professionali	Obbligatorio
Bioecomics and intellectual property (IT)	ING-IND/35		6	48	Lezione frontale	B		Obbligatorio
Free selection proposed by the student				(+)		D		Obbligatorio
Practical training				18		F		Obbligatorio
Final Exam				3		E		Obbligatorio

Curriculum Biotechnology for Renewable Resources (BiRRe) *(in corsivo gli insegnamenti caratteristici del curriculum)*								
I Anno								
Denominazione Insegnamento	**SSD**	**Modulo**	**CFU**	**Ore**	**Tipologia Attività**	**TAF**	**Ambito disciplinare**	**obbligatorio /a scelta**
Biotecnologie microbiche industriali	CHIM/11		6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline chimiche	Obbligatorio
Microalgal exploitation	BIO/18	*Genetic engineering*	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
	BIO/10	*Microalgal resources*	6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline biologiche	Obbligatorio
Biotecnologie industriali e per la salvaguardia dell'ambiente	BIO/11	Biotecnologie industriali	6	48	Lezione frontale	B	Discipline biologiche	Obbligatorio
	AGR/07	Biotecnologie per la salvaguardia dell'ambiente	6	48	Lezione frontale	C		Obbligatorio
Transport Phenomena for Biotechnological Applications	ING-IND/24		9	72	Lezione frontale	B	Discipline chimiche	Obbligatorio
Biopolymers and Bioplastics	CHIM/11	*Polyester based bioplastics*	6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline chimiche	Obbligatorio
	BIO/10	*Polysaccharide- and protein-based bioplastics*	6	52	Lezione frontale esercitazioni e laboratorio	B	Discipline biologiche	Obbligatorio
Biorefinery processes	ING-IND/25		6	48	Lezione frontale	B	Discipline chimiche	Obbligatorio

II Anno								
Denominazione Insegnamento	**SSD**	**Modulo**	**CFU**	**Ore**	**Tipologia Attività**	**TAF**	**Ambito disciplinare**	**obbligatorio /a scelta**
Design of conversion processes	ING-IND/25	*Bioreactors*	12	48	Lezione frontale	B	Discipline chimiche	Obbligatorio
	ING-IND/26	*Process simulation*	6	48	Lezione frontale	B	Discipline chimiche	Obbligatorio
Principi di igiene nelle biotecnologie	MED/42		6	48	Lezione frontale	C		Obbligatorio
Biochip e biosensori	FIS/01		6	48	Lezione frontale	B	Discipline per le competenze professionali	Obbligatorio
Environmental economics	SECS-P/02		6	48	Lezione frontale	B	Discipline per le competenze professionali	Obbligatorio
Free selection proposed by the student			(+)			D		
Practical training			18			F		
Final Exam			3			E		

(+) Insegnamenti a scelta autonoma dello studente proposti dalla Commissione Didattica (12 CFU complessivi)

Denominazione Insegnamento	**SSD**	**Modulo**	**CFU**	**Ore**	**Tipologia Attività**	**TAF**	**Ambito disciplinare**	**obbligatorio /a scelta**
II anno-I semestre								
BIO SOFT matter: microstructured fluids in biotechnologies (IT)	ING-IND/24		6	48	Lezione frontale	D		A scelta
II anno-II semestre								
Tissue engineering (IT)	ING-IND/34		6	48	Lezione frontale	D		A scelta

Legenda

Tipologia di Attività Formativa (TAF):

B = Caratterizzanti
C = Affini o integrativi
D = Attività a scelta
E = Prova finale e conoscenze linguistiche
F = Ulteriori attività formative

Additional study plan information
Students must submit a Study Plan (PdS) at the enrolment to select the curriculum.

Customizing the study plan
Students have to submit a PdS to select the free selection of courses (18 CFU). Students that move abroad for ERASMUS programme must present a PdS for the selection of courses to be followed at the final University. The PdS from ERASMUS students has to be presented to the Student Administration office, according to their rules.

Traineeship opportunities
The student must carry out internship activities at the University or at non-university structures. No-university structures must be recognized and accredited by the University and operating in the scientific sector of interest (the list of accredited structures is available on the University website).

Graduation thesis and exam
The **Master's Degree Final Exam** consists in the presentation and discussion of a written dissertation (**Master's Degree Thesis**) which deals with an experimental **subject congruent with the field of Industrial Biotechnologies**. The **thesis** consists of a written test in which are presented the premises, the development and the conclusions of an experimental work, from which the contribution of the candidate has to be evident in the various phases of the project. Short instructions for writing the thesis can be downloaded from the web site. Students are encouraged to write the thesis in English, also to favor its diffusion in the international working world. In the case of a thesis written in English, it is mandatory to insert a summary of two pages written in Italian. The Graduating student has 15 minutes for the oral presentation of the thesis project.

International exchange programmes (Erasmus programme)
ERASMUS+ Programme allows students to spend a period in a foreign European university through UE funding. During their stay, the students can follow courses, give exams and use the infrastructures of the host university just as regular students. The activity to be performed at the host university must be planned together with the own institutional organization.

The students are invited to contact the tutors of the proposals before submitting the application in order to: 1) know the activities offered by the host universities; 2) define a possible activity program at the host organization.

Orientation and Tutoring

Orientation to incoming students

Every year, incoming orientation activities are carried out for graduate and undergraduate students through a series of initiatives widely advertised on the website and on social channels.

Every year at the Monte S. Angelo, events for the presentation of the Master's Degrees are organized open to graduate and undergraduate students of the Federico II University and outside the University.

The professors of the Industrial Biotechnology Degree Courses welcome requests for clarification of the objectives of the Master's Degree.

Tutoring and counseling

A series of activities are organized aimed at orientation in-itinere. They include:
- TUTORING - the students of each year of the course are divided into groups and can contact the assigned professor.
- OBSERVATORY progression 1st year Master's Degree. The careers of students in the first year of the Degree are checked every six months: April and November of each year. The analysis is aimed at supporting students in the progression of their university career. While respecting anonymity, the results are discussed in the MSc Committee meetings and shared with the student representatives in the Working Table.

Career orientation and job placement

Outgoing orientation and placement initiatives are organized in close coordination with the other degree programs of the Department / School / University. Every year, the Polytechnic and Basic Sciences School organizes the Career Day with meetings with companies.
Career orientation meetings are organized as an integral part of the training activities.

Calendar of educational activities'and timeline

Application timeline

Initial enrolment and successive annual enrolment is presented between September 1st and October 31st. The initial enrolment is possible until March 31st. Details are reported on the website of the University:
https://www.unina.it/didattica/sportello-studenti/guide-dello-studente

Further deadlines (presentation of study plan, ERASMUS application, etc.) are reported on the website of the MSc.

Academic Calendar: courses and exams

I Semester – From the end of September up to the beginning of Christmas holiday
II Semester – From the beginning of March up to the beginning of June
Exams – January to March. June, July, September and October

Course Timetable

The timetable of the lectures is available at the webpage
http://www.biotecnologieindustriali.unina.it/en/page/laurea-magistrale/orari-delle-lezioni-laurea-magistrale.html

Graduation dates

The timetable of the graduation exams is available at the webpage
http://www.biotecnologieindustriali.unina.it/it/page/didattica-ed-orientamento/esami-di-laurea-e-laurea-magistrale.html

Contact persons

Chairman of the MSc: Prof.ssa Daria Maria Monti – Dipartimento di Scienze Chimiche - tel. 081.679150 - e-mail: dariamaria.monti@unina.it.

Responsible for the **Orientation**: Prof.ssa Angela Arciello, Dipartimento di Scienze Chimiche - Tel. 081-679147. e-mail: angela.arciello@unina.it

Responsible for the **SOCRATES/ERASMUS** programme: Prof.ssa M. Luisa Tutino – Dipartimento di Scienze Chimiche - tel. 081.674317 - e-mail: tutino@unina.it.

Responsible for **trainings**: Prof.ssa Rachele Isticato – Dipartimento di Biologia (tel. 081-679035 - email rachele.isticato@unina.it) - e Dott. Daniele Tammaro – Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale (e-mail: daniele.tammaro@unina.it).

Segreteria didattica:
Dott. Anna Mancino anna.mancino@unina.it, Dipartimento di Scienze Chimiche
Dott. Giuseppe Rollino giuseppe.rollino@unina.it, Segreteria Studenti area Scienze della Scuola Politecnica e delle Scienze di Base
Sent cc email to ccd.biotecnologieindustriali@unina.it

Comitato di Indirizzo del MSc

Dr. **Joanna Dupont-Inglis** (Head of EU Affairs, European Bioplastics)
Dott. **Leonardo Vingiani** (Direttore di Assobiotec, IT)
Dott. **Nicola Torre** (Centrient Pharmaceuticals, Delft, NL)

Working table
The Chairman of the MSc.
Two students for each year of the MSc.
Details at page
http://www.biotecnologieindustriali.unina.it/it/page/la-struttura/tavolo-di-lavoro.html

Sites and links

Sites
Complesso Universitario di Monte Sant'Angelo
https://www.google.com/maps/place/Universit%C3%A0+Degli+Studi+di+Napoli+Federico+II+Complesso+Universitario+di+Monte+Sant'Angelo/@40.8322726,14.1824662,15z/data=!4m19!1m13!4m12!1m4!2m2!1d14.1947658!2d40.8250146!4e1!1m6!1m2!1s0x133b0ed5dc19a33b:0xb3482663d2c21f6e!2smonte+sant'angelo+napoli!2m2!1d14.1849805!2d40.8388234!3m4!1s0x133b0ed5dc19a33b:0xb3482663d2c21f6e!8m2!3d40.8388234!4d14.1849805

MSc:
http://www.biotecnologieindustriali.unina.it/it/

Department
http://www.scienzechimiche.unina.it/home

School website
http://www.scuolapsb.unina.it/

University website
http://www.unina.it/home

Social networks

Instagram
Biotecnologie IndustrialiFII
https://www.instagram.com/biotecnologieindustrialifii/?hl=it

Facebook
https://www.facebook.com/biotecnologieindustriali/

Telegram
https://t.me/biotecnologieindustriali

Twitter
BiotecnologieindustrialiFII
https://twitter.com/Biotecnologiei1

Linkedin
Biotecnologie Industriali - Università degli Studi di Napoli "Federico II"
https://www.linkedin.com/groups/6620663/

YouTube
Biotecnologie Biomolecolari e Industriali UNINA
https://www.youtube.com/channel/UCDUlubUpRIgZqeJ2xjVPp7Q

Course description

The content and objectives of the courses, the name of the professor, the methods of carrying out the lectures and checking results can be consulted at the link
http://www.biotecnologieindustriali.unina.it/it/page/didattica-ed-orientamento/laurea-magistrale.html

COURSE DESCRIPTION
INDUSTRIAL MICROBIAL BIOTECHNOLOGY

SSD: CHIMICA E BIOTECNOLOGIA DELLE FERMENTAZIONI (CHIM/11)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: TUTINO MARIA LUISA
PHONE: 081-674015 - 081-674317
EMAIL: marialuisa.tutino@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

Basic knowledge of Microbiology, Biochemistry, Molecular Biology and Genetics, Principles of fermentation chemistry

LEARNING GOALS

Ability to design, in light of the information acquired during the course, guided or random molecular approaches to strain improvement, development interventions of strains with increased properties. Ability to identify the bottlenecks and/or limitations present in industrial fermentation processes and to propose innovative solutions for their optimization.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems relating to the construction of a recombinant and / or genetically modified microbial biocatalyst with improved properties in the process. He must demonstrate that he knows how to elaborate even complex discussions concerning the strategies to be used to identify the main physiological and molecular limits that can prevent or make the use of a microorganism in an industrial process not very advantageous.

Applying knowledge and understanding

The student must demonstrate to be able to design the development of an industrial process that uses microbial biocatalysts. This objective requires that he be able to predict, address and solve the main problems concerning the application in an industrial process of a wild microorganism or its appropriate variants. The extension of the methodology described for yeasts to all industrial areas in which other types of microorganisms are handled will also be required.

COURSE CONTENT/SYLLABUS

Introduction to the yeast technology. A survey of the main molecular tools for the yeast genetic manipulation. Description of yeast cell ultra-structure. Yeast nutrition: growth media formulation and specific nutrition strategies. Yeast cell metabolism. Yeast cell replication. (2 CFU).
Primary and secondary metabolites of industrial interest. Use of screening schemes for the selection of novel organisms producing industrially relevant metabolites. Classical and innovative approaches to the development of improved strains. Antimicrobial molecules as an example of metabolites of microbial origin produced in industrial processes. Molecular bases of antimicrobial drug resistance. Ambivalent role of microbial biofilms in industrial processes: some examples (4CFU)

READINGS/BIBLIOGRAPHY

ppt presentations, selected reviews and papers regarding several topics discussed during the lessons

Books

G. M. Walker “Yeast: physiology and biotechnology” Wiley ed. 1998
B.R. Glick, J.J. Pasternak “Biotecnologia molecolare” Edizioni Zanichelli, 1999
Donadio S. e Marino G (a cura di) “Biotecnologie microbiche” Casa Editrice Ambrosiana, 2008

TEACHING METHODS OF THE COURSE (OR MODULE)

Lessons, guided study of recent and relevant scientific literature, group presentation

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☐ Written

☑ Oral

☐ Project discussion

☑ Other : group presentation containing the original analysis of a topic described over the course

In case of a written exam, questions refer to

☐ Multiple choice answers

☐ Open answers

☐ Numerical exercises

b) Evaluation pattern

The final exam grade is expressed out of thirty from 18/30 to 30/30 cum laude and takes into account the basic knowledge in microbial biotechnology and the knowledge acquired. The attribution of the vote takes place according to the criteria shown in the Table:

Grade	***Descrption***
<18 insufficiente	*Fragmentary and superficial knowledge of the contents, errors in applying the*
18 - 20	*Sufficient but general knowledge of the contents, simple exposition, uncertainties in the application of theoretical concepts*
21 - 23	*Appropriate but not in-depth knowledge of contents, ability to apply theoretical concepts, ability to present contents in a simple way*
24 - 25	*Appropriate and broad knowledge of contents, fair ability to apply knowledge, ability to present contents in an articulated way.*
26 - 27	*Precise and complete knowledge of contents, good ability to apply knowledge, analytical skills, clear and correct presentation*
28 - 29	*Broad, complete and in-depth knowledge of contents, good application of contents, good ability to analyze and synthesize, safe and correct exposure.*
30 30 e lode	*Very broad, complete, and in-depth knowledge of contents, well-established ability to apply contents, excellent ability to analyze, synthesis and interdisciplinary connections, mastery of exposure*

COURSE DESCRIPTION
BIOLOGY OF SYSTEMS

SSD: GENETICA (BIO/18)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: CALABRO' VIOLA
PHONE: 081-679069
EMAIL: viola.calabro@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U0618 - BIOLOGIA DEI SISTEMI E BIOINFORMATICA
MODULE: U0619 - BIOLOGIA DEI SISTEMI
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

Genetics

PREREQUISITES

Basic knowledge of Genetics and Molecular Biology.

LEARNING GOALS

The course aims to provide basic knowledge of genomics and transcriptomics. We will tackle the study of polygenic inheritance and human genetic variability with their implication on molecular diagnosis. We will learn advanced technologies to study genome and gene expression. Through the study of genetic and epigenetic mechanisms driving gene expression, the students will understand how environmental factors can impact on genome expression and control biological processes as metabolism, cell growth and differentiation, ageing and cancerogenesis.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student will understand the impact of genetics on physiology of living cells. The student will learn the most common approaches and technologies for studying genomes and transcriptomes. The student should be aware of human genome variability and how it can impact on diagnosis and diseases. Students must be able to evaluate and interpret experimental and literature data.

Applying knowledge and understanding

The student should be able to apply knowledge and understanding to demonstrate a professional approach to support their reasoning and should solve problems related to this field of study. They should be autonomous in making judgments. The student should be able to properly interpret and communicate scientific data. They should develop an adequate scientific language.

COURSE CONTENT/SYLLABUS

Introduction to the System biology. Molecular networks. Animal and cellular model for the study of complex biological phenomenon. Omics science **(1 CFU)**. **Transcriptome.** Transcriptome complexity. Non coding RNA. miRNAs and competing endogenous RNAs. High throughput gene expression analyses. Gene expression profiling. Transcriptional and post-transcriptional control of gene expression. Epigenetic mechanisms. EST data base. "Differential display". **(1 CFU) Genomics.** Genome structure and complexity. Genetic and physical mapping. The genome project. Gerarchic and shot-gun models. Genome data base (Ensembl, genome ucsc, ncbi. omim etc.). Ditag Genome Scanning" (DGS) e sequencing strategies "Paired-end". Next generation sequencing. Roche/454/FLX;Illumina/Solexa; Applied Biosystem SOLiDTM. Polymorfisms and their applications for diagnostic medicine and forensic science. RFLPs, STS, VNTR, STR. Genome evolution **(2 CFU**). **Protein-protein and protein-DNA interactions**. Functional domains. Chromatin immunoprecipitation and proteomic analyses. ChIP seq and RNA-IP. Protein pool down. Student's talks and seminars on specific topic of the course **(2 CFU).**

READINGS/BIBLIOGRAPHY

Human Molecular Genetics Tom Strachan e Andrew Read | 18 dic. 2018 Genetica Molecolare Umana –Tom Strachan and Andrew Read Edizione Italiana ed. Zanichelli Edizione maggio 2012. Brown Genomi 4 Edizione Edises 2018. Gibson G - A primer of Genome Science –ed. Sinauer.- dicembre 2014. Manuela Helmer Citterich - Fondamenti di bioinformatica prima edizione maggio 2018. Zanichelli.

TEACHING METHODS OF THE COURSE (OR MODULE)

Oral presentations. Scientific articles: disussion and presentation.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☐ Written

☑ Oral

- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [x] Multiple choice answers
- [x] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The student should be able to apply knowledge and understanding to demonstrate a professional approach to support their reasoning and should solve problems related to this field of study. They should be autonomous in making judgments. The student should be able to properly interpret and communicate scientific data. They should develop an adequate scientific language.

COURSE DESCRIPTION
BIOINFORMATICS AND MOLECULAR MODELING

SSD: BIOCHIMICA (BIO/10)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: NOTOMISTA EUGENIO
PHONE: 081-679208 - 081-679129
EMAIL: eugenio.notomista@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U0618 - BIOLOGIA DEI SISTEMI E BIOINFORMATICA
MODULE: 34097 - BIOINFORMATICA E MODELLISTICA MOLECOLARE
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None.

PREREQUISITES

Knowledge of Biochemistry, Molecular Biology and Genetics.

LEARNING GOALS

The aim of the course is to provide students with the skills necessary for consulting biological databases, for the analysis of sequences and three-dimensional structures of biological macromolecules (proteins and nucleic acids), and for the prediction of protein structures.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course aims to provide students with the basic knowledge necessary for consulting biological databases and for the use of bioinformatics tools, freely available on the World Wide Web, for the

analysis of nucleic acid and protein sequences and for the analysis of the structures of biological macromolecules.

Applying knowledge and understanding
The student should be able to easily access to biological databases and to use the main bioinformatics tools for the analysis of nucleic acids and proteins sequences, for the visualization and analysis of the structures of biological macromolecules and for the modeling of proteins.

COURSE CONTENT/SYLLABUS

Structure and consultation of databases. Consultation of databases of protein and nucleotide sequences, of bibliographic references, of genomes. Use of integrated biological database systems.
Use of programs and servers for the analysis of nucleotide sequences. Evolution of nucleotide and protein sequences.
Pairwise alignments. Homology searches in sequence databases. Use of Blast and FastA programs.
Multiple alignments. Use of programs for the preparation, visualization and manipulation of multiple alignments.
Phylogenetic analysis. Use of programs for the preparation and visualization of phylogenetic trees.

Use of programs and servers for the analysis of protein sequences. Prediction of the secondary structure of proteins.
Methods for the determination of the structures of biological macromolecules (X-ray and NMR crystallography). Analysis of protein structures. Use of programs for the visualization of protein structures.
Prediction of the three-dimensional structure of proteins. Homology modeling, Fold prediction, Methods from the beginning. Use of programs and servers for protein structure modeling.
Basics of computational biology.

READINGS/BIBLIOGRAPHY

RECOMMENDED TEXTBOOKS
- Fondamenti di bioinformatica M.H. Citterich; F. Ferrè; G. Pavesi; C. Romualdi; G. Pesole. (2018, Zanichelli)
- Bioinformatics: An Introduction (3° Ed.) Jeremy Ramsden (2016, Springer)
- Bioinformatica S. Pascarella, A. Paiardini (2011, Zanichelli)

OTHER MATERIAL
PowerPoint presentations of the lectures held by the teacher, software and websites available in the reserved section of the Teacher’s website (reserved for course members) and via the “Microsoft Teams” platform (upon registration to the course Team).

TEACHING METHODS OF THE COURSE (OR MODULE)

The course includes 40 hours of theoretical lessons and 8 hours of practice.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

COURSE DESCRIPTION
INDUSTRIAL BIOTECHNOLOGY

SSD: BIOLOGIA MOLECOLARE (BIO/11)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: MONTI DARIA MARIA
PHONE: 081-679150
EMAIL: dariamaria.monti@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U0620 - BIOTECNOLOGIE INDUSTRIALI E PER LA SALVAGUARDIA DELL'AMBIENTE
MODULE: U0621 - BIOTECNOLOGIE INDUSTRIALI
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The course aims are: (a) to introduce the topic of bioeconomy, circular economy and its applications; (b) to provide students with the specialized knowledge for industrial processes involving the use of biomass and on the processes related to biorefineries and the production of bio-based molecules; (c) to teach the application of different molecules in different biotechnological fields, with special emphasis on industrial applications; (d) to provide the knowledge of the main biotic and abiotic factors of the environmental pollution and the main techniques of phyto- and phyco-remediation from inorganic and organic compounds; (c) to

reduce the environmental risks of deliberate release of genetically modified plants using a innovative techniques of assisted evolution.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

At the end of the course, students will be expected to demonstrate (a) to have acquired knowledge related to industrial processes involving the use of biomass, (b) to be able to design interventions for the remediation of different environments from pollution resulting from inorganic and organic sources and from the use of GMOs; (c) to be able to develop ideas and designs leading to produce and process innovations related to biorefineries. The training aims are to provide students with the knowledge and methodological tools necessary for the production and use of new and innovative bio-based products, biomaterials and biofuels, fostering the application skills of the methodological tools acquired at laboratory or field scale.

Applying knowledge and understanding

Students should demonstrate their ability to apply the knowledge they acquired, to discuss topics pertaining to various industrial processes and environmental pollution issues. The student should demonstrate the ability to independently increase knowledge of new aspects of industrial biotechnology and to be able to integrate knowledge of Green Chemistry processes with those of the Bioeconomy and Circular Economy. The student will be expected to demonstrate scientific/experimental communication methodology in the field of Industrial Biotechnology and its applications and discuss with both colleagues and non-specialist interlocutors. The teaching will provide the student with the tools to evaluate the advantages and disadvantages of biotechnologies proposed for environmental remediation.

COURSE CONTENT/SYLLABUS

The course is structured through examples of applications of biotechnology in different industrial sectors.

Among the different topics, the course will focus in particular on:

1 CFU. Introduction to Industrial Biotechnology: Green Chemistry, Economic Sustainability and environmental sustainability, bioeconomy.

1 CFU. Biotransformation-Bioconversions: use, improvement and selection of enzymes and micro-organisms for the development of new bioprocesses and for the synthesis of high-value molecules added.

1 CFU. Bioremediation: Use of enzymes and microorganisms for the detoxification of polluted environments and/or industrial process water.

1 CFU. Biorefineries: Biofuels, bioproducts, biopolymers, biomaterials.

1 CFU. Biosensors: development and use of enzymes as sensing molecules.

1 CFU. Bioeconomy and Circular Economy: case studies.

READINGS/BIBLIOGRAPHY

“Che cosa èla Bioeconomia” Mario Bonaccorso, Edizioni Ambiente (2019).
Slides of the course, scientific articles and supporting material provided by the teacher.

TEACHING METHODS OF THE COURSE (OR MODULE)

There will be lectures and seminars by experts in the field and case studies exposed by the students. In particular: a) frontal lessons for about 85% of the total hours, b) seminars by experts in the field for 5% of total hours, c) seminars by students for 10% of total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☑ Other : The final assessment will take into account the level of knowledge and understanding of the main industrial processes, in the ability to apply the acquired knowledge to interpret case studies, as well as skills in discussing scientific topics.

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern

The final grade will be weighted on the CFUs of each teaching and thus composed as follows: "Biotechnology for Environmental Protection" module 6 CFU, 50%; "Industrial Biotechnology"
module 6 CFU, 50%.

COURSE DESCRIPTION
BIOTECHNOLOGY FOR THE PROTECTION OF 'ENVIRONMENT

SSD: GENETICA AGRARIA (AGR/07)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: FILIPPONE EDGARDO
PHONE: 081-2539103 - 081-2539100 - 081-2539224
EMAIL: edgardo.filippone@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U0620 - BIOTECNOLOGIE INDUSTRIALI E PER LA SALVAGUARDIA DELL'AMBIENTE
MODULE: U0622 - BIOTECNOLOGIE PER LA SALVAGUARDIA DELL' AMBIENTE
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The course aims are: (a) to introduce the topic of bioeconomy, circular economy and its applications; (b) to provide students with the specialized knowledge for industrial processes involving the use of biomass and on the processes related to biorefineries and the production of bio-based molecules; (c) to teach the application of different molecules in different biotechnological fields, with special emphasis on industrial applications; (d) to provide the knowledge of the main biotic and abiotic factors of the environmental pollution and the main techniques of phyto- and phyco-remediation from inorganic and organic compounds; (c) to reduce

the environmental risks of deliberate release of genetically modified plants using a innovative techniques of assisted evolution.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

At the end of the course, students will be expected to demonstrate (a) to have acquired knowledge related to industrial processes involving the use of biomass, (b) to be able to design interventions for the remediation of different environments from pollution resulting from inorganic and organic sources and from the use of GMOs; (c) to be able to develop ideas and designs leading to produce and process innovations related to biorefineries. The training aims are to provide students with the knowledge and methodological tools necessary for the production and use of new and innovative bio-based products, biomaterials and biofuels, fostering the application skills of the methodological tools acquired at laboratory or field scale.

Applying knowledge and understanding

Students should demonstrate their ability to apply the knowledge they acquired, to discuss topics pertaining to various industrial processes and environmental pollution issues. The student should demonstrate the ability to independently increase knowledge of new aspects of industrial biotechnology and to be able to integrate knowledge of Green Chemistry processes with those of the Bioeconomy and Circular Economy. The student will be expected to demonstrate scientific/experimental communication methodology in the field of Industrial Biotechnology and its applications and discuss with both colleagues and non-specialist interlocutors. The teaching will provide the student with the tools to evaluate the advantages and disadvantages of biotechnologies proposed for environmental remediation.

COURSE CONTENT/SYLLABUS

The course consists of two modules, "Biotechnology for Environmental Conservation" (SSD AGR/07) and "Industrial Biotechnology" (SSD BIO/11).

Biotechnology for Environmental Conservation.

1 CFU. The environment and recalls on organic and inorganic pollutants. Impact of modern agriculture on the environment. The "green economy" and the "circular economy".

1 CFU. Current and innovative technologies for nuclear and plastidial DNA modification of plants and microalgae.

1 CFU. Public perception and reality of the environmental risks of using plant genetic modification techniques and reducing their impact on the environment

1 CFU. Phytoremediation and phytoremediation of soil and water.

1 CFU. Plant biotechnology applied to the recycling of biomass and agro-industry wastes for the production of biofuels and new materials

1 CFU. In vitro cultures of plant and microalgae cells and tissues as bioreactors for the production of agrobiopharmaceuticals.

READINGS/BIBLIOGRAPHY

- Chrispeels e Gepts. Agricoltura sostenibile attraverso le biotecnologie, 2021, Piccin
- Rao e Leone. Biotecnologie e Genomica delle Piante. 2014, Idelson-Gnocchi
- Selected slides and scientific papers used for course lectures. These will be available online on the lecturer's restricted area.

TEACHING METHODS OF THE COURSE (OR MODULE)

Lectures for 90% of total hours; tutorials for 5 %; seminars for 5%, all conducted with multimedia and using online materials

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☑ Other : the final assessment will take into account the level of knowledge and understanding of key industrial processes, in the ability to apply the acquired knowledge to interpret case studies, and the expository and reasoning skills demonstrated in the discussion conducted on the required topics

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern

The final grade will be weighted on the CFUs of each teaching and thus composed as follows: "Biotechnology for Environmental Protection" module 6 CFU, 50%; "Industrial Biotechnology" module 6 CFU, 50%.

COURSE DESCRIPTION
TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS

SSD: PRINCIPI DI INGEGNERIA CHIMICA (ING-IND/24)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: IANNIRUBERTO GIOVANNI
PHONE: 081-7682270
EMAIL: giovanni.ianniruberto@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 9

REQUIRED PRELIMINARY COURSES

No

PREREQUISITES

No

LEARNING GOALS

The course aims at providing students with the necessary knowledge to deal with mass transfer problems of biological interest.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems related to mass transfer phenomena relevant to biotechnological processes of industrial interest. He must also demonstrate that he is able to deal with complex mass transfer problems concerning the design of

bioreactors and separation equipments.

Applying knowledge and understanding

The student must demonstrate to be able to design simple "mass transfere" equipments (for example oxygenation ones), and solve problems aimed at determining the relevant parameters in mass transfet phenomena (diffusion coefficient, mass transport coefficients, exchange surfaces, etc.). It also has to deal with complex biotechnological systems.

COURSE CONTENT/SYLLABUS

Importance of mass transport phenomena in biological systems. Transport mechanisms: diffusion and convection. (0.25 CFU)

Diffusion in dilute solutions. Fick's Law. Mass balances on differential control volumes. Differential equations with separable variables. Diffusion in variable section geometries. Diffusion through porous and non-porous membranes. Partition coefficient. Pseudo-stationary diffusion. Transient mass balances. Transport mechanisms in series and/or in parallel. Rate controlling mechanism. (2.75 CFU)

Convective mass transfer. Transport equation and transport coefficient. Non-dimensional correlations. Oxygen-balance Method and dynamic method. Mass transfer with chemical reactions in series. Reaction- and/or transport-limited processes. (3.5 CFU)

Mass transfer with chemical reactions in parallel. Immobilized enzymes. Effectiveness factor and Thiele modulus. Problems in different geometries and with different reaction kinetics. Examples with CSTR and PFR configurations. (2 CFU)

Diffusion in biological membranes. Facilitated diffusion. Diffusion of strong electrolytes. Nernst-Planck transport. Diffusion potential. Mass transfer in the presence of an electric field. (0.5 CFU)

READINGS/BIBLIOGRAPHY

Class notes and the following books:

· E.L. Cussler, “Diffusion. Mass transfer in fluid systems”, Cambridge University Press (2007).

· P. M. Doran, “Bioprocess Engineering Principles”, Academic Press (1995).

· G.A. Truskey, F. Yuan, D.E. Katz, “Transport phenomena in biological systems”, Prentice Hall (2004).

TEACHING METHODS OF THE COURSE (OR MODULE)

a) lectures for a total of 48 hours

b) exercises to practically deepen theoretical aspects for 24 hours

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☑ Written

☐ Oral

☐ Project discussion

☐ Other

In case of a written exam, questions refer to

☐ Multiple choice answers

☑ Open answers

☑ Numerical exercises

b) Evaluation pattern

The exam grade is assigned after the written test, which constitutes the substantial part of the exam. The student can ask to carry out a short oral, in order to possibly improve the grade of the written exam. The oral exam is in any case subject to passing the written one.

COURSE DESCRIPTION
RECOMBINANT BIOTECHNOLOGY

SSD: BIOCHIMICA (BIO/10)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: ARCIELLO ANGELA
PHONE: 081-679147
EMAIL: angela.arciello@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: 32166 - BIOTECNOLOGIE BIOCHIMICHE
MODULE: 32167 - BIOTECNOLOGIE RICOMBINANTI
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

None.

PREREQUISITES

Knowledge of Biochemistry, Molecular Biology, Microbiology and Microbial Biotechnology bases.

LEARNING GOALS

The course aims to provide students with specialized and in-depth knowledge on the production of recombinant proteins of biotechnological interest in different host organisms, such as prokaryotes, insect cells and mammalian cells
in culture.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student has to demonstrate knowledge and understanding of the problems related to the production of recombinant proteins in different host organisms. The student has to demonstrate to be able to elaborate complex
discussions about the production of proteins of biotechnological interest starting from the theoretical-methodological notions learned on the different production strategies. The course aims to provide students
with the knowledge and the basic methodological tools necessary to independently and critically analyze scientific works concerning the recombinant production of proteins of biotechnological interest and to
extrapolate necessary information to propose innovative experimental solutions. The course also intends to provide students with the necessary tools to independently and critically analyze the project ideas and
the achieved results. The student has to demonstrate to be able to illustrate to non-expert people the basic notions on the production of proteins of biotechnological interest in different host organisms. The
student has also to demonstrate to be able to communicate orally by using appropriate tools, and to present a paper by summarizing the most important achieved results in a complete and concise manner by using
correct technical language in both Italian and in English. The student has to demonstrate to be able to solve problems inherent the main topics of the course and to expand his/her knowledge by independently
consulting scientific texts and articles.

Applying knowledge and understanding

The student has to demonstrate to be able to properly design experiments aimed at optimizing the production of recombinant proteins in the field of industrial biotechnology. The student has also to demonstrate to be
able to design experiments aimed at screening and selecting the most efficient production strategy with respect to the specific protein to be produced. The course is aimed at providing all the skills necessary to achieve this goal.

COURSE CONTENT/SYLLABUS

- Expression of recombinant proteins in prokaryotic and eukaryotic systems
- *In silico* analyses of protein sequences to select the optimal expression system for specific protein products
- Comparison between alternative expression systems
- Gateway recombinant cloning technology
- Experimental strategies to isolate recombinant proteins
- Phagemid vectors and *phage display*
- Baculovirus and viral vectors
- Introduction to protein engineering

- Site-directed mutagenesis: mutagenesis by PCR and cassette mutagenesis
- Production of biotechnologically relevant proteins: examples from recent literature

READINGS/BIBLIOGRAPHY

Didactic material, scientific articles and bibliography references provided by the teacher.

TEACHING METHODS OF THE COURSE (OR MODULE)

Lectures will be performed by using multimedia, specialized software and online material. To practically deepen theoretical aspects, a laboratory exercise will be organized together with seminars on specific topics.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

The oral exam will consist in the formulation of three questions for each module in order to ensure that the final score will be weighted on both courses, being each of 6 credits.

COURSE DESCRIPTION
PROTEIN ENGINEERING AND METABOLIC

SSD: BIOCHIMICA (BIO/10)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: ARCIELLO ANGELA
PHONE: 081-679147
EMAIL: angela.arciello@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: 32166 - BIOTECNOLOGIE BIOCHIMICHE
MODULE: 32179 - INGEGNERIA PROTEICA E METABOLICA
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

None.

PREREQUISITES

Knowledge of Biochemistry, Molecular Biology, Microbiology and Microbial Biotechnology bases.

LEARNING GOALS

The course aims to provide students with specialist knowledge on the main methodologies currently used to modify the sequence coding for a protein in a targeted or random manner, on the theoretical principles underlying the most
recent experimental strategies of protein and metabolic engineering and on their applicability for the production of products of biotechnological interest.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student has to demonstrate knowledge and understanding of the main methodologies for the targeted or random modification of the sequences encoding protein molecules, the theoretical principles underlying the most recent
experimental strategies of protein and metabolic engineering and their applicability for the production of products of biotechnological interest. The student has to demonstrate to be able to analyze in detail the different strategies
for the targeted or random modification of a protein both through interventions on the coding DNA and on the protein itself. The student has to demonstrate to be able to independently and critically analyze published scientific works and
established methodologies and to make changes to improve their performance. The student has to demonstrate to be able to comprehend the complexity of problems in the biotechnology field, to identify the main aspects, and to propose
innovative solutions. The student has to demonstrate to be able to illustrate a concept or an experimental approach and to present a paper by using the technical language correctly. The student has to demonstrate to be able to read and
interpret scientific works and to communicate the concepts learned in written and verbal form, in Italian and English, by using multimedia systems. The student has to demonstrate to be able to autonomously developed judgments and to
broaden his/her knowledge by independently consulting texts, scientific articles, seminars, conferences, and databases. The student has to demonstrate logical reasoning skills and a critical approach to solve scientific issues.

Applying knowledge and understanding

The student has to demonstrate to be able to design mutagenesis experiments for the production of proteins of biotechnological interest and to be able to apply the main strategies for the improvement of the production yield of metabolites
of interest in living cells.

COURSE CONTENT/SYLLABUS

- Strategies for protein mutagenesis: experimental strategies to introduce specific mutations in DNA coding sequences through different protein engineering approaches, such as USE (Eliminates Unique restriction Site), ARM (Antibiotic Resistance Mutagenesis), use of phosphorothioates, Kunkel method
- Introduction of random mutations through direct evolution approaches: “shuffling” mutagenesis, cassette mutagenesis and random mutagenesis
- Protein mutagenesis by chemical modifications: description and evaluation of advantages and disadvantages of main chemical reagents to modify specific amino acid residues, and of bifunctional reagents for protein-protein cross-linking
- Metabolic engineering: principles and methods to determine and to analyze the metabolic fluxes of a pathway and to identify the “control steps” in a metabolic pathway

- Experimental approaches to modify the flux in a metabolic pathway
- Principles of analysis (MFA) and control (MCA) of metabolic fluxes
- Examples of metabolic engineering strategies to produce biotechnological products

READINGS/BIBLIOGRAPHY

Didactic material, scientific articles and bibliography references provided by the teacher.

TEACHING METHODS OF THE COURSE (OR MODULE)

Lectures will be performed by using multimedia, specialized software and online material. To practically deepen theoretical aspects, a laboratory exercise will be organized together with seminars on specific topics.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☐ Other

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern

The oral exam will consist in the formulation of three questions for each module in order to ensure that the final score will be weighted on both courses, being each of 6 credits.

COURSE DESCRIPTION
BIOREACTORS

SSD: IMPIANTI CHIMICI (ING-IND/25)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: MARZOCCHELLA ANTONIO
PHONE: 081-7682541
EMAIL: antonio.marzocchella@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

Knowledge of: fundaments of bioreactos; kinetic models of enzymatic conversion and microbial convesrion (unstructured and unsegregated).

LEARNING GOALS

Reactor systems: continuous and discontinuous ideal reactors. Reactor systems operated with confinement of the biocatalytic system. Single-phase and multi-phase reactors. Optimization of
reaction systems for different kinetics.
Applications to systems of interest and development of case studies.
Review of the types of reactors used in bioprocessing: fermentation, enzymatic bioreactors.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to know and to understand issues regarding the relationships among: enzymatic or microbial kinetics (unstructured and non-segregated); type of reactor (batch, fed-batch, CSTR, PFR with and without recycling) used; confined or free biocatalyst; process productivity; transport of matter between heterogeneous phases.
The student must demonstrate to know how to extend the systems analyzed to structured microbial kinetics.
The students must demonstrate knowledge of basic elements of economic evaluation of a biotechnological process.

Applying knowledge and understanding

The student must be able to design bioconversion units on the basis of enzymatic/microbial and productivity kinetics assigned to the type of reactor proposed.
The students must be able to select the operating conditions of the reactor to satisfy even heterogeneous reactive processes associated with transports of matter between phases.
The student must be able to provide a rough estimation of the costs of a biotechnological process.

COURSE CONTENT/SYLLABUS

Summary of fundamentals of reactor characterization: discontinuous stirred tank reactor (STR) and continuous stirred tank reactor. Design equation, productivity assessment and the pros and the cons of each system when coupled with the conversion system (conversion and kinetics).

Continuous flow systems: well mixed systems and plug flow systems. Exploring the main functional and design issues of bioreactors. Notes regarding mixing/segregation issues for homogeneous systems.

Continuous and discontinuous ideal reactors. Reactor systems based on the combination of ideal reactors. Fed-batch reactors. Optimization of reaction systems for different kinetics. Applications to systems for industrial application and development of case studies.

Reagent systems for microbic kinetic models structured and/or segregated. Analysis of simple cases.

Multiphase bioreactors. Mass transfer phenomena in bioreactors: main issues of coupling mass transport rate and chemical kinetics. Design and operation of multiphase reactors.
Review of the types of reactors (enzymatic and fermentative) used in industrial bioprocesses.

Notes on economic evaluation of biotechnological processes. Objective functions (e.g. Profit, Cost). Procedures to assess plant and operating cost of a process.

READINGS/BIBLIOGRAPHY

Villadsen J, Nielsen J, and Lidén G. (2011) BIOREACTION ENGINEERING PRINCIPLES. Springer

To consult: Levenspiel, O., Chemical Reaction Engineering, 3rd Ed., Jhon Wiley &Sons, 1999

Slides provided during the lectures

TEACHING METHODS OF THE COURSE (OR MODULE)

Frontal lectures.

Numerical training.

Some issues are presented according to the "Thinking class" modality

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [ ] Oral
- [ ] Project discussion
- [x] Other : Tests during the course

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The formulation of the problem is assessed together the correct numerical evaluation

COURSE DESCRIPTION
GENETIC ENGINEERING

SSD: GENETICA (BIO/18)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: SALVEMINI MARCO
PHONE: 081-2535009 - 081-2535004
EMAIL: marco.salvemini@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2867 - MICROALGAL EXPLOITATION
MODULE: U2868 - GENETIC ENGINEERING
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

Basic knowledge of genetics and molecular biology

LEARNING GOALS

The training objective of the course is to provide the student with the information necessary for understanding the main methods of genetic engineering of prokaryotic and eukaryotic organisms. The aim of the course will also be to allow learners to acquire in-depth biological knowledge and molecular and in silico methodologies that allow the study and development of modified or transgenic strains aimed at optimizing animal and plant species for purposes biotechnological.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student will have to demonstrate knowledge of the methods of recombinant DNA technology, both basic and advanced, and of genetic engineering of prokaryotic and eukaryotic organisms.

Applying knowledge and understanding

The student will have to demonstrate that he is able to design modified or transgenic strains aimed at optimizing animal and plant species for biotechnological purposes. The student must be able to evaluate which methodology to use and which type of strain (modified or transgenic) to implement on the basis of specific objectives. The student must be able to independently find in-depth information on the genetic pathways useful for the production of modified or transgenic strains designed by genome editing.

COURSE CONTENT/SYLLABUS

Recombinant DNA molecules: designing and production. (0,5 CFU)
Expression control of recombinant DNA molecules. (0,5 CFU)
Molecular cloning of new genes: molecular hybridization, genomic and cDNA libraries, screening of a library. (1 CFU)
DNA sequencing from Sanger sequencing to high-throughput techniques. Basic principles for genomic and transcriptomic assembly and in silico analysis. (1 CFU)
Gene transfer techniques in animal and vegetal species: methods and basic principles. Genetic transformation markers. (1 CFU)
The analysis of gene function using RNAi. (0,5 CFU)
The genome editing through the use of site-specific nucleases (ZNFs, TALENs, CRISPR-Cas9). (1 CFU)
Homologous recombination and the use of site-specific recombination systems. (0,5 CFU)

READINGS/BIBLIOGRAPHY

An introduction to genetic engineering (2008) D.S.T. Nicholl –Cambridge University Press.
Genome editing and engineering (2018) K. Appasani –Cambridge University Press.
Power point presentations on the topics of the course.
Lecture notes and scientific articles.

TEACHING METHODS OF THE COURSE (OR MODULE)

The teacher will use lectures and exercises for about 80% of the total hours. 20% of the hours will be used for in-depth seminars and case studies, with the active participation of students.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion

☐ Other

In case of a written exam, questions refer to

☐ Multiple choice answers

☐ Open answers

☐ Numerical exercises

b) Evaluation pattern

The final examination is aimed to verify and evaluate the achievement of the educational learning targets. The student will be asked to answer to questions in order to evaluate the degree of completeness of the answers, the level of integration between the different topics of the course and the appropriateness of the scientific language used. The student must also be able to simulate an algal transcriptome assembly and a differential expression analysis using data from public databases. Regular attendance to the lessons and active participation during the classroom activities will be positively considered. The final grade will be weighted on the CFUs of each course and then this module will represent 50% of the final vote.

COURSE DESCRIPTION
MICROALGAL RESOURCES

SSD: BIOCHIMICA (BIO/10)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: MONTI DARIA MARIA
PHONE: 081-679150
EMAIL: dariamaria.monti@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2867 - MICROALGAL EXPLOITATION
MODULE: U2869 - MICROALGAL RESOURCES
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The aim of the course is to introduce to the microalgae world and their applications. The course aims to provide students with the specialized notions for cultivating microalgae under different conditions. A systematic use of the biomass will be investigated in a biorefinery approach to extract as many class of molecules as possible. A focus on the industrial techniques used for the downstream process will be given to students. In addition, the aim of the course is to apply the different molecules in different biotechnology fields, with particular attention to industrial applications.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

At the end of the course, students must demonstrate that they have acquired knowledge on microalgae and the use of biomass, must prove to know how to process a biomass in a biorefinery approach by using a green approach. The course aims to provide students with the knowledge and tools methodologies necessary for the production and use of bio-based products, biomaterials and biofuels, new and innovative starting from microalgae.

Applying knowledge and understanding

The student will have to demonstrate to be able to apply the knowledge acquired with the study to discuss topics related to the upstream and downstream processes. The student will have to demonstrate to be
able to design a green approach for the extraction of molecules from the biomass. The student will demonstrate to have acquired a scientific/experimental communicative methodology to discuss about microalgae both with colleagues and non-specialist interlocutors. The training course is oriented to give skills as well as methodological and operational tools necessary to apply the knowledge of microalgae in different fields.

COURSE CONTENT/SYLLABUS

1 CFU. Classification of the main algal groups. Algae from extreme environments. Structure and metabolism of the algal cell. Photosynthesis. Pigments and reserve substances.
1 CFU. Cultivation: batch crops, semi-continuous and continuous crops; culture media in autotrophy, mixotrophy and heterotrophy. From the laboratory to industrial plants: photobioreactors and open ponds.
0.5 CFU. Physiological responses to changes in CO2, temperature and pH. Criteria for the selection of algal strains and techniques for the extraction of molecules with high added value.
1 CFU. Downstream of microalgae: harvesting, cell disruption, purification strategies
0.5 CFU. The concept of biorefinery: cascade extraction for the production of molecules of biotechnological interest.
1 CFU. Potential uses of plant biomass: production of biofuels, CO2 sequestration from exhaust gas, treatment of waste waters, production, purification and characterization of high added value molecules, to be used in nanotechnology, human and animal nutrition. Case studies and lessons from students.
1 CFU. Laboratory experience.

READINGS/BIBLIOGRAPHY

Richmond, Handbook of microalgal culture, 2013, Wiley.
Andersen, Algal culturing techniques, 2005, Elsevier.
Lecture notes provided during the course.
Scientific papers.

TEACHING METHODS OF THE COURSE (OR MODULE)

There will be lectures and seminars by experts in the field, case studies exposed by the students and Laboratory. In particular: a) frontal lessons for about 60% of the total hours, b) seminars by experts
in the field for 5% of total hours, c) seminars by students for 10% of total hours; d) laboratory for 15% of total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

The final grade will be weighted on the CFUs of each course and then this module will represent 50% of the final vote

COURSE DESCRIPTION
TRANSPORT PHENOMENA FOR BIOTECHNOLOGICAL APPLICATIONS

SSD: PRINCIPI DI INGEGNERIA CHIMICA (ING-IND/24)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: TOSCANO GIUSEPPE
PHONE: 081-7682278 - 081-7682286
EMAIL: giuseppe.toscano@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 9

REQUIRED PRELIMINARY COURSES

None.

PREREQUISITES

There are no prerequisites.

LEARNING GOALS

The course provides an advanced discussion of the application of transport phenomena concepts to the modeling of systems relevant to industrial biotechnological processes.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to know and understand mass, heat, and momentum transport phenomena occurring in industrial biotechnological processes.

Applying knowledge and understanding

The student must demonstrate to be able to solve problems relevant for the design of industrial biotechnological processes where mass, heat, and momentum transport phenomena play a significant role.

COURSE CONTENT/SYLLABUS

The mathematics of transport phenomena. Recapitulation of calculus
Mass balance quick recapitulation
The concept of conservation. Control volume. Inlet and Outlet, Generation, Accumulation
Conservation of mass. Macroscopic mass balance. Differential mass balance
Mass balance for a chemical species. Reactions and reaction rate. Ideal reactors. CSTR, Batch, PFR
Diffusive transfer of chemical species

- Molecular origins of diffusion. Brownian motion. Random walk statistics.
- Diffusion in dilute solutions. Fick's Law.
- Homogeneous steady-state diffusion. Differential mass balance. Diffusion in a slab, cylinder, sphere.
- Diffusion through porous media and membranes. Effective diffusion coefficient. Experimental determination of diffusion coefficients: diaphragm cell.
- Diffusion between phases. Phase equilibrium at the interface. Partition coefficient. Diffusion processes in series and in parallel.
- Transient mass balances. Space and time dependent concentration profiles in 1-Dimensional geometries. The pseudo- steady-state assumption.Diffusion with chemical reaction
- Diffusion with reaction in porous catalysts.
- Catalytic efficiency and Thiele modulus

Convective mass transfer

- Convective transport coefficient. Mass balance with a flowing phase
- Correlations for the determination of the mass transfer coefficients. Dimensionless parameters and their physical meaning.
- Experimental determination of gas-liquid mass transfer coefficients. OTR
- Mass transfer in aerated stirred tanks

Heat transfer

- Thermal energy balances
- Heat conduction and Fourier's law. Conduction is slab, cylinder, sphere.
- Conduction between phases. Thermal equilibrium at the interface. Conduction in series and in parallel.
- Convective transfer. Heat transfer coefficients

READINGS/BIBLIOGRAPHY

Lecture notes provided during the course.
E.L. Cussler, “Diffusion. Mass transfer in fluid systems”, Cambridge University Press (2009).
P. M. Doran, “Bioprocess Engineering Principles”, Academic Press (2012).

TEACHING METHODS OF THE COURSE (OR MODULE)

Lectures and numerical exercises, delivered by using slides and blackboard. Teaching materials will be available online (lecturer's website and/or MS Teams Class).

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The written exam is only for admission to the oral exam. If (non-mandatory) midterm and end-of-course tests are sufficient, the written exam can be skipped.

COURSE DESCRIPTION
POLYESTER BASED BIOPLASTICS

SSD: CHIMICA E BIOTECNOLOGIA DELLE FERMENTAZIONI (CHIM/11)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: PEZZELLA CINZIA
PHONE:
EMAIL: cpezzella@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2871 - BIOPOLYMERS AND BIOPLASTICS
MODULE: U2872 - POLYESTER BASED BIOPLASTICS
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The course aims at providing students with advanced notions related to the design, synthesis and application of natural polymers and bioplastics form renewable sources. At the end of the course the student should be able to autonomously draw further information on the methods of production and characterization of bioplastics from different scientific publications, and be able to follow workshops, conference reports and to attend interviews with main exponents of the industrial world.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student should be able to know the innovative processes for the production of bioplastics and to indicate the main methodologies relevant for obtaining bioplastics with improved mechanical and barrier properties, possessing specific biological activities. The student should also be able to define the impact of different bioplastics at a production level. In addition the student will be able to autonomously evaluate the different issues related to the sustainable biopolymer production and to elaborate new solutions for the optimization of the main process parameters (cost and environmental impact, yield and product recovery, etc..) and for the tailoring of polymer properties.

Applying knowledge and understanding

The course will allow students to 1) face the problems concerning the pollution caused by the over-production of traditional plastics; 2) identify the main biotechnological processes for the production of environmentally friendly packaging; 3) to hypothesize changes in the bioplastic main properties (mechanical, biological and barrier) in order to identify their industrial application. In general the student has to be able to design processes for the production and functionalization of biopolymers, through the application of biotechnological and green strategies. He/She has to be able to apply the acquired methodologies to the designing of biopolymers for specific industrial applications.

COURSE CONTENT/SYLLABUS

· Introduction to polymeric materials: physical, thermal and mechanical properties
· Bioplastics from renewable feedstocks: production processes, market and sustainability of bioplastics;
· Polyester based bioplastics: examples and applications;
· Microbial biopolymers: natural and synthetic routes for biopolymer production from bacteria
· Biopolymer biodegradation: definitions and biodegradation tests;
· Biomaterial processing and functionalization: nanoparticles and nanofibers, additives, compatibilization strategies
· Biopolymers applications to different sectors: packaging, healthcare, textile, etc.
· Laboratory activities: Synthesis and characterization of microbial polyhydroxyalkanoates based films

READINGS/BIBLIOGRAPHY

· Handbook of Biopolymers and Biodegradable Plastics- 1st Edition. Properties, Processing and Applications. Editors: Sina Ebnesajjad eBook ISBN: 9781455730032; Hardcover ISBN: 9781455728343
· Course slides, scientific papers and learning material provided by the lecturer

TEACHING METHODS OF THE COURSE (OR MODULE)

The lecturer will use: a) frontal lessons for about 70% of the total hours; b) Laboratory practises (8 hours) to deepen the applied knowledge on: (i) preparations of film-forming solutions and their

characterization; (ii) the production and characterization of different bioplastics (hydrocolloid and produced from polyesters); c) seminars on the flipped classroom model (4 hours).

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

The oral exams consist of 4 questions (4for each module). The final mark will be weighted on CFU of each module and therefore will be made up of: Module Polyester based bioplastics" 6 CFU 50%; Module "Polysaccharide-and protein-based bioplastics".

COURSE DESCRIPTION
POLYSACCHARIDE - AND PROTEIN- BASED BIOPLASTICS

SSD: BIOCHIMICA (BIO/10)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: GIOSAFATTO CONCETTA VALERIA LUCIA
PHONE:
EMAIL: giosafat@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2871 - BIOPOLYMERS AND BIOPLASTICS
MODULE: U2873 - POLYSACCHARIDE - AND PROTEIN- BASED BIOPLASTICS
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: I
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The course aims at providing students with advanced notions related to the design, synthesis and application of natural polymers and bioplastics form renewable sources. At the end of the course the student should be able to autonomously draw further information on the methods of production and characterization of bioplastics from different scientific publications, and be able to follow workshops, conference reports and to attend interviews with main exponents of the industrial world.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student should be able to know the innovative processes for the production of bioplastics and to indicate the main methodologies relevant for obtaining bioplastics with improved mechanical and barrier properties, possessing specific biological activities. The student should also be able to define the impact of different bioplastics at a production level. In addition the student will be able to autonomously evaluate the different issues related to the sustainable biopolymer production and to elaborate new solutions for the optimization of the main process parameters (cost and environmental impact, yield and product recovery, etc..) and for the tailoring of polymer properties.

Applying knowledge and understanding

The course will allow students to 1) face the problems concerning the pollution caused by the over-production of traditional plastics; 2) identify the main biotechnological processes for the production of environmentally friendly packaging; 3) to hypothesize changes in the bioplastic main properties (mechanical, biological and barrier) in order to identify their industrial application. In general the student has to be able to design processes for the production and functionalization of biopolymers, through the application of biotechnological and green strategies. He/She has to be able to apply the acquired methodologies to the designing of biopolymers for specific industrial applications.

COURSE CONTENT/SYLLABUS

- Pollution caused by the over-production of traditional plastics and possible biotechnological tools to counteract such phenomenon.
- Biodegradable plastics as eco-sustainable alternatives to plastics of petrochemical origin.
- Production and characterization of the main hydrocolloid bioplastics.
- Use of different methods (casting, dipping, spraying) for the preparation of polysaccharide- and protein-based bioplastics.
- Zeta potential analysis to study the stability of the film forming solutions. Experimental determination of the properties of hydrocolloid biomaterials: mechanical (tensile strength, elongation at break, Young's modulus) and barrier features towards gases (CO2 and O2) and against water vapour).
- Improvements of bioplastic properties through the use of enzymes, different plasticizers, various nanoparticles or by "blending" with other polymers.
- Recent industrial applications of hydrocolloid bioplastics. Case study: production by casting method of a kind of protein-based bioplastics prepared in the presence of the enzyme transglutaminase.

READINGS/BIBLIOGRAPHY

Handbook of Biopolymers and Biodegradable Plastics- 1st Edition. Properties, Processing and Applications. Editors: Sina Ebnesajjad eBook ISBN: 9781455730032; Hardcover ISBN:

9781455728343

Course slides, scientific papers and teaching material provided by the lecturer

TEACHING METHODS OF THE COURSE (OR MODULE)

The lecturer will use: a) frontal lessons for about 70% of the total hours; b) Laboratory practises (8 hours) to deepen the applied knowledge on: (i) preparations of film-forming solutions and their characterization; (ii) the production and characterization of different bioplastics (hydrocolloid and produced from polyesters); c) seminars on the flipped classroom model (4 hours).

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☐ Other

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern

The oral exams consist of 4 questions (4for each module). The final mark will be weighted on CFU of each module and therefore will be made up of Module Polyester based bioplastics” 6 CFU 50%; Module “Polysaccharide-and protein-based bioplastics”.

COURSE DESCRIPTION
BIOREFINERY PROCESSES

SSD:

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: RAGANATI FRANCESCA
PHONE:
EMAIL: francesca.raganati@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE:
MODULE:
SSD OF THE MODULE:
CHANNEL:
YEAR OF THE DEGREE PROGRAMME:
PERIOD IN WHICH THE COURSE IS DELIVERED:
CFU:

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The student must be able to select unit operations to exploit renewable resources and to design selected units.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to know and to understand the problems related to the selection and the design of units dedicated to processing industrial material and efficient utilization of renewable products.

Applying knowledge and understanding

The student must demonstrate to be able to apply concepts for designing bioprocess flowsheets for the production of products by combining: 1) operation units dedicated to the exploitation of renewable resources; 2) fermentation units; 3) recovery and purification units. The design should include assessments regarding the sustainability of the process.

·Autonomy of judgment: The student must demonstrate to be able to correctly identify the critical issues for the exploitation of renewable resources. The student must demonstrate to identify the optimal configuration and operating conditions to exploit the renewable resources protecting the (bio)features of products.

·Communication skills: The student must be able to develop a flowsheet and to discuss the main features of the flowsheet. The student must be able to present the proposed selection of operation units pointing out the role of the selected unit/operating conditions with respect the (bio)features of products.

·Learning skills: The student must be able to expand his/her knowledge by looking up documents (scientific papers, on-line courses, tutorials) related to the selection of units for the exploitation of renewable resources and the selection of the optimal operating conditions.

COURSE CONTENT/SYLLABUS

Biorefinery concept - current scenario, definition, examples. Overview of the main biorefinery concepts and platforms. **Recovery, yield, selectivity, pureness** –concepts for operation units dedicated to biotechnological processes. **Downstream processes in biotechnological industries** - Removal of insolubles (filtration and centrifugation), isolation of product, purification and polishing. **Liquid-liquid extraction**: Consolidate processes and innovative liquids. Mass balances, thermodynamic equilibrium and role of the extracting liquid for the features of the products. Extraction strategies (single/multiple stage, cross/counter current). Design of selected units.**Membrane filtration** - Mass balances, mechanical and transport phenomena. Criteria for the selection of the filtration unit. Filtration strategy.**Adsorption** - Mass balances, thermodynamic equilibrium and role of the adsorbent material for the features of the products. Adsorption strategies (batch, continuous, ...). Design of selected units. **Chromatography** - Mass balances and thermodynamic. Strategies and techniques. Industrial design: Simulated Moving Bed. **Precipitation/Crystallization** - Mass balances, kinetics and main principles. Strategies and techniques. Industrial design.**Flowsheet development** –Sequence of operation units to exploit renewable resources. Objective function of the flowsheet. **Techno-economic analysis in biorefinery processes** - CAPEX and OPEX, Lang factor method, OPEX analysis in labour, utilities, materials, waste and consumables.**Case studies** - Energy from Biomass and Waste, Bioproducts from biomass and waste and examples of biorefinery concepts

READINGS/BIBLIOGRAPHY

· Lecture notes provided during the course.

· Coulson &Richardson's Chemical Engineering: Chemical Engineering Design, Butterworth-Heinemann 1999.

· McCabe&Smith - Unit Operations of Chemical Engineering, John Wiley and Sons 1999.
· Belter, Cussler &Wei-Shou Hu - Bioseparations: Downstream Processing for Biotechnology, Wiley-Interscience 1988.
· Harrison, Separation Process Design, Wiley, 2003.

TEACHING METHODS OF THE COURSE (OR MODULE)

The course is carried out through frontal lessons and exercises (to be solved using excel).

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [ ] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The final exam evaluation is expressed as a grade from 18/30 to 30/30 cum laude.

COURSE DESCRIPTION
THEORY OF THE DEVELOPMENT PROCESS BIOTECHNOLOGY

SSD: TEORIA DELLO SVILUPPO DEI PROCESSI CHIMICI (ING-IND/26)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: D'AVINO GAETANO
PHONE: 081-7682241
EMAIL: gaetano.davino@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: 34102 - PROCESSI BIOTECNOLOGICI
MODULE: U0624 - TEORIA DELLO SVILUPPO DEI PROCESSI BIOTECNOLOGICI
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None.

PREREQUISITES

Definition of matematical models for processes of interest in industrial biotechnology (CSTR, PFR, adsorption, etc.).

LEARNING GOALS

(i) Correctly identify the simplifying assumptions and the mathematical model of a process, and the most appropriate numerical technique to solve it.
(ii) Solve through a numerical software mathematical models described by systems of linear, non-linear, and ordinary differential equations.

(iii) Estimate the parameters of mathematical models of interest in industrial biotechnology through regression statistical techniques.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to know and understand the problems related to the formulation and numerical solution of mathematical models of interest of industrial biotechnology and to the analysis of experimental data through statistical techniques.

Applying knowledge and understanding

The student must demonstrate to be able to use a software to solve complex equations modelling the dynamics of systems of interest of industrial biotechnology. He/she must also be able to carry out statistical analysis and parameter estimation from experimental data.

COURSE CONTENT/SYLLABUS

- An introduction to Matlab: variables, vectors and matrices, M-files, functions, graphics.
- Numerical solution of linear and non-linear systems of equations: method of Gaussian elimination, Newton's method, stopping criteria, problems with Newton's method.
- Numerical solution of ordinary differential equations: temporal discretization, explicit and implicit Euler's method, method of Crank-Nicolson, methods of Runge-Kutta, backward differentiation methods.
- Descriptive statistics: mean, median, mode, standard deviation, variance, quartiles, percentiles, box-plot, skewness, kurtosis.
- Random variables: the model of the experiment and the process, kinds of random variables, distributions, mean of a random variable.
- Linear and multilinear regressions: estimation and estimator, properties of estimators, least-square method, evaluation of linear and multilinear regression coefficients, evaluation of error variance.
- Adequacy of the regression: residual analysis, coefficient of determination, correlation matrix.
- Non-linear regression: minimization algorithms, model linearization, weighted least-square method, simultaneous regression of multiple models.

READINGS/BIBLIOGRAPHY

- Montgomery and Runger, *Applied Statistics and Probability for Engineers*, John Wiley &Sons, 2003
- Quarteroni, Sacco and Saleri, *Numerical Mathematics*, Springer, 2007.
- Lecture notes provided during the course.

TEACHING METHODS OF THE COURSE (OR MODULE)

Frontal lectures and exercises.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [ ] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The final score is calculated as the average (rounded up) between the score of the module "Teoria dello Sviluppo dei Processi Biotecnologici" and the module of "Impianti Biotecnologici".

COURSE DETAILS

"PROCESS BIOTECHNOLOGY"

SSD ING-IND/25*

DEGREE PROGRAMME: MASTER COURSE MOLECULAR AND INDUSTRIAL BIOTECHNOLOGY

ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MARIA ELENA RUSSO
PHONE: +390817682969
EMAIL: MARIAELENA.RUSSO@CNR.IT, MERUSSO@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE):
MODULE (IF APPLICABLE): BIOSEPARATION PROCESS DESIGN
SSD OF THE MODULE (IF APPLICABLE): ING-IND/25
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II, ANNUAL): I
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None

PREREQUISITES (IF APPLICABLE)

Basic of units and dimensional analysis
Application of mass balances to bioprocesses
Basic use of electronic spreadsheets

LEARNING GOALS

The aim of the course is introduction to advanced design of bioseparation processes and technologies up to industrial scale. In particular, the design of single unit operations applied to the recovery and purification of bio-products will be addressed. The teaching module will provide to the students methods, design criteria as well as theoretical tools for the analysis and assessment of bioprocesses performances.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student has to show his/her ability in addressing and working out issues related to the relations between chemical-physical phenomena driving the bioseparation processes and the performances of the processes themselves. The student has to understand and apply both the concepts of theoretical contact stages and effectiveness factor of a real equipment. The student has to know and describe issues related to the selection of proper processes and equipment for the separations of biomolecules obtained as products from bioconversions (microbial or enzymatic). In addition, the student has to work out relations between operating conditions and performances (e.g. yield) of bioseparation processes using the acquired concept including design and operation criteria of each unit operation.

Applying knowledge and understanding

The student has to solve design and operation problems for the unit operations of bioseparation introduced in the course module and referred to selected cases in the framework of bioconversion processes and the recovery of intra- and extra-cellular products. To this aim, the student will apply the tools and methods (including electronic spreadsheets) according to the instructions presented by the teacher during the course.

COURSE CONTENT/SYLLABUS

- **Introduction. Definitions of yields, purity, and selectivity for bioseparation and purification processes.**
- **Liquid-liquid extraction processes, design of theoretical contact unit and real equipment. Case study - 'Aqueous two-phase extraction'**
- **Ultrafiltration processes, design of hollow fibre membrane separation unit for the concentration of protein solutions in the 'gel filtration' regime**
- **Adsorption processes. Introduction to sorbents and their properties. General design criteria for fixed bed adsorption units: the 'breakthrough' curve, scale-up criteria, definition of 'Bed Volumes'. Industrial chromatography: 'simulated moving bed'**
- **Precipitation and crystallization processes for proteins separation. Design of idea units through the 'mixed-suspension mixed-product removal crystallizer' model**
- **Process cost analysis: calculation of CAPEX by the Lang factors method, analysis of OPEX (labour, energy, utilities, materials). Case study: biorefinery processes for the production of proteins, bio-fuels and bio-based-chemicals.**

READINGS/BIBLIOGRAPHY

Suggested books:
Harrison, Tudd, Rudge, Petrides – Bioseparation Science and Engineering
J. F. RICHARDSON, J. H. HARKER, J. R. BACKHURST Coulson and Richardson's - CHEMICAL ENGINEERING VOLUME 2 - FIFTH EDITION Particle Technology and Separation Processes

Additional teaching tools: slides form the course, exercises by electronic spreadsheets

TEACHING METHODS

Teacher will use: a) lectures for approx. 60% of the total hours, b) practical exercises through electronic spreadsheets to apply theoretical notions to practical case studies of unit operations design for approx. the remaining 40%.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	Intermediate exams are planned during the course. The oral exam is aimed at discussing the results of the practical test (written exam)

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

(*) multiple options are possible

b) Evaluation pattern:

Both modules provide 6 CFU, thus the final mark will be the average between those from each module evaluation.

COURSE DESCRIPTION
PRINCIPLES OF HYGIENE IN BIOTECHNOLOGY

SSD: IGIENE GENERALE E APPLICATA (MED/42)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: GUIDA MARCO
PHONE: 081-2534641 - 081-679183 - 081-679184
EMAIL: marco.guida@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES
nobody

PREREQUISITES
nobody

LEARNING GOALS
The student must be able to apply the acquired knowledge to evaluate and quantify hygienic problems related to the biotechnology field and the risk factors related to human health. The training course is aimed at transmitting the operational skills necessary to concretely apply the knowledge with reference to hygiene in biotechnologies

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)
Knowledge and understanding

Autonomy of judgment: The student must be able to critically analyze the contents relating to the principles of hygiene applied to biotechnologies in the context of different exhibition scenarios, demonstrating that he can interpret the results of the studies and be able to propose appropriate preventive interventions; he must also have achieved conscious autonomy of judgment in relation to the evaluation and interpretation of the results of the analyzes and ability to compare with existing data in the literature.

Applying knowledge and understanding
Communication skills: The student will be able to express concepts clearly using appropriate technical terminology regarding the problems of health promotion with particular reference to those relating to hygiene in biotechnology and the consequent epidemiological implications
Learning skills: The student will have acquired adequate cognitive tools and critical skills for the deepening and continuous updating of knowledge being able to correctly use databases, specialist texts, scientific articles, and to approach specialized seminars, conferences, masters in the field of hygiene applied to the biotechnological field

COURSE CONTENT/SYLLABUS

Definition of health. Factors influencing the illness state. General background about epidemiology. Definition and case studies in epidemiology. Methods in epidemiology. Data sources. Measures in epidemiology. Descriptive epidemiology. (2 CFU) Analytical epidemiology: retrospective, transversal and prospective investigations. Experimental epidemiology. Epidemiology and disease prevention. Factors depending on the physical environments: air, water, soil and climate. Factors depending on the biological environment: microorganisms and food. Risk management (HACCP). Factors depending on the biotechnological manipulation: vaccine, wastewater and food. Factors depending on the social context: urbanization, building and indoor conditions. (3 CFU) Factors depending on personal actions: eating habits. Background about prevention and biotechnologies in public heath. (1CFU)

READINGS/BIBLIOGRAPHY

Course slides, lecture notes, selected scientific works relating to the topics of the course,
G. Gilli PROFESSIONE IGIENISTA ed. CEA 2010 Isbn 978-8808-18228-9

TEACHING METHODS OF THE COURSE (OR MODULE)

lectures 4 CFU, laboratory exercises 1 CFU, problem solving 1 CFU

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [x] Oral
- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [x] Multiple choice answers
- [x] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

.

COURSE DESCRIPTION
BIOCHIP And BIOSENSORS

SSD: FISICA SPERIMENTALE (FIS/01)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: DELLA VENTURA BARTOLOMEO
PHONE:
EMAIL: bartolomeo.dellaventura@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

No

PREREQUISITES

No

LEARNING GOALS

The course aims to provide students with the specialized notions for a more in-depth study of the biosensors currently on the market and to give the student the opportunity to conceive, design or build a biosensor that can be useful for achieving some of their own objectives of the Research.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems relating to the development of biosensors.

The training course aims to provide students with the knowledge and basic methodological tools

necessary to cope with biotechnological applications of biosensors.

Applying knowledge and understanding
The training course is aimed at transmitting the skills and the methodological and operational tools necessary to concretely apply the knowledge.

COURSE CONTENT/SYLLABUS

Fundamental properties of a sensor: sensitivity, specificity and detection limit.
From sensor to biosensor: surface functionalization techniques.
Notes on the phenomenon of surface and localized plasmon resonance and fluorescence.
Optical biosensors: fluorescence biosensors, biosensors based on surface plasmon resonance and localized resonance (nanoparticles).
Piezoelectric biosensors: quartz crystal microbalances.
Basics of electrochemistry.
Biosensors based on cyclic voltammetry and impedance spectroscopy.
Elements of microfluidics.
Properties of a test: positive and negative predictive value.
Hypothesis test: probability value.

READINGS/BIBLIOGRAPHY

The teaching material will be made available during the course.

TEACHING METHODS OF THE COURSE (OR MODULE)

The teaching is organized with 40 hours of frontal teaching and 8 hours of laboratory in which some types of biosensor will be shown.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☐ Other

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern

COURSE DETAILS

BIOECOMICS AND INTELLECTUAL PROPERTY
SSD ING/IND 35

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)

ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER:
PHONE:
EMAIL:

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE):
MODULE (IF APPLICABLE):
SSD OF THE MODULE (IF APPLICABLE):
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME: II
SEMESTER: II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None

PREREQUISITES (IF APPLICABLE)

None

LEARNING GOALS

The course aims to provide students with the necessary tools to understand the fundamental concepts and models of economic actors with regard to microeconomic systems. The course aims to provide students with the knowledge and methodological tools to develop a feasibility project of a business idea as well as the main forms of intellectual property protection.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and know how to understand and use the basic tools for the analysis and description of the structural characteristics of the market and companies, the factors that determine the levels of competition and price decisions in the markets, strategies that influence business decisions.
The course aims to provide students with the basic knowledge and tools for the analysis of organizational structures and functions.

Applying knowledge and understanding

The student must be able to assess the strengths and weaknesses of a start-up project and to conduct the preliminary analysis to the drafting of a business plan. The student must be able to update or expand their knowledge by drawing independently from texts, scientific articles, by consulting the main databases available on the network, and must be able gradually to acquire the ability to follow specialist seminars, conferences, master's degrees, etc. in the fields of entrepreneurship and the protection of intellectual property. The course also provides the student with indications and suggestions necessary to allow him to address other topics similar to those scheduled, stimulating him to participate in interdisciplinary events organized with representatives of the world of work, company testimonials etc.

COURSE CONTENT/SYLLABUS

Definition of organization and entrepreneur, production factors and production function, the law of diminishing returns, costs classification, organization profit, maximization of profits, break-even analysis, principle of scarcity, rationality of the economic factor, the market, market economy, the market as a coordination mechanism for the collective action.
Demand curve, supply curve, equilibrium, economic efficiency, price elasticity of demand. Market typologies and market equilibrium.
The Bioeconomics theory of Nicholas Georgescu-Roegen.
Business planning, Business Model Canvas, internal and external environmental factors influencing organizational activities, market analysis and targeting, analysis of competitors, communication and distribution channels, Organizational Analysis (structures and functions), economic and financial planning, performance and profitability measures.
Outlines of the legal forms of companies, protection of intellectual property.

READINGS/BIBLIOGRAPHY

Readings and other materials distributed by the teacher during the course and usually available in the download area of the Professor website after registration to the course.
Sloman J., Garrat D. (2011). Elementi di Economia, il Mulino, Bologna
Cinzia Parolini (2016). Business Planning. Dall'idea al progetto imprenditoriale, 2 edizione, Pearson
H. Byers, Richard C. Dorf, Andrew J. Nelson, Roberto Vona (2011). Technology Ventures: Management dell'imprenditorialità e dell'innovazione, McGraw-Hill.
Material provided by the Professor (notes and slides of the lessons).

TEACHING METHODS

Lessons

EXAMINATION/EVALUATION CRITERIA

Knowledge of the factors determining the level of competition and market balances
Knowledge of organizational structures and the factors that determine the choice of structure
Knowledge of the main forms of intellectual property protection
Ability to analyze and describe the business model of a company

a) Exam type:

*For **integrated courses**, there should be one exam.*

Exam type	
written and oral	
only written	
only oral	X
project discussion	X
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	
	Numerical exercises	

(*) multiple options are possible

b) Evaluation pattern:

COURSE DESCRIPTION
BIOREACTORS

SSD: IMPIANTI CHIMICI (ING-IND/25)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: SALATINO PIERO
PHONE: 081-7682258
EMAIL: piero.salatino@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2875 - DESIGN OF CONVERSION PROCESSES
MODULE: U2876 - BIOREACTORS
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The aim of the course is to present the basic methodologies and problems related to the design and operation of bioreactors, taking into account the constraints posed by the nature of the feedstock and of the relevant reaction(s).

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to know and to understand the principles underlying the optimal selection and design of bioreactors taking into account the features of the proposed reactive biosystem (enzymes and/or microorganisms), of the feedstock, of the relevant reaction(s).

Applying knowledge and understanding

The student must demonstrate to be able to properly set up and solve problems related to the selection and design of bioreactors and their operating conditions taking into account the features of the feedstock, of the proposed reactive biosystem (enzymes and/or microorganisms), of the relevant reaction(s). He/she must demonstrate confidence with numerical calculation of the reactor performance.

COURSE CONTENT/SYLLABUS

Set up of the design equations governing the performance of chemical and biochemical reactive systems. Recurrent approximations and particularization to ideal flow conditions. Analysis of enzymatic and fermentation processes. Analysis and optimization of selected case studies: power-law kinetics, substrate- and product-inhibited kinetics, autocatalytic reactions.
Reactive systems in the presence of reaction networks. Definitions of yield and selectivity and their use. Analysis of simple reaction networks. Case studies development.
Introduction to non-ideal flow reactors. Residence time and age of fluid elements in continuous reactors and their distribution functions.

READINGS/BIBLIOGRAPHY

- Villadsen J, Nielsen J, and Lidén G. (2011) Bioreaction Engineering Principles, Springer.
- Levenspiel, O., Chemical Reaction Engineering, 3rd Ed. (1999) John Wiley &Sons.
- Lecture notes.

TEACHING METHODS OF THE COURSE (OR MODULE)

Teachers will use: a) lectures for about 70% of total hours; b) examples and practical exercises for about 30% of total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [x] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [x] Open answers
- [x] Numerical exercises

b) Evaluation pattern

The examiner verifies the general knowledge and understanding of the course topics, paying particular attention to the candidate's ability to develop critical reasoning and to contextualize the elements acquired during the course to selected case studies and problems.

COURSE DESCRIPTION
PROCESS SIMULATION

SSD: TEORIA DELLO SVILUPPO DEI PROCESSI CHIMICI (ING-IND/26)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: TAMMARO DANIELE
PHONE:
EMAIL: daniele.tammaro@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: U2875 - DESIGN OF CONVERSION PROCESSES
MODULE: U2877 - PROCESS SIMULATION
SSD OF THE MODULE:
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

Principles of mathematical analysis

LEARNING GOALS

The main objective of the course is to understand the problems related to the formulation and numerical solution of mathematical models of interest of industrial biotechnology and to the analysis of experimental data through statistical techniques.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to be able to correctly identify the mathematical model and the simplifying assumptions of a specific problem, as well as the correct numerical technique to solve it. He/she must be also able to correctly understand the results obtained from a numerical simulation. Furthermore, he/she must demonstrate to be able to evaluate the reliability of the parameters evaluated through a regression technique.

The student must demonstrate to be able to use a software to solve complex equations modelling the dynamics of systems of interest of industrial biotechnology. He/she must also be able to carry out statistical analysis and parameter estimation from experimental data.

Applying knowledge and understanding

COURSE CONTENT/SYLLABUS

N.a.

READINGS/BIBLIOGRAPHY

•Montgomery and Runger, Applied Statistics and Probability for Engineers, John Wiley &Sons, 2003.

•Quarteroni, Sacco and Saleri, Numerical Mathematics, Springer, 2007.

•Lecture notes provided during the course.

TEACHING METHODS OF THE COURSE (OR MODULE)

Frontal teching with alternating theory and practice.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [x] Written
- [ ] Oral
- [ ] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [x] Open answers
- [x] Numerical exercises

b) Evaluation pattern

Written exam.

COURSE DETAILS

"ENVIRONMENTAL ECONOMICS"

SSD SECSP/02

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MARCELLO D'AMATO
PHONE: ++39 320 4226743
EMAIL: MARCELLO.DAMATO@UNISOB.NA.IT; MARCELLO.DAMATO@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE):
MODULE (IF APPLICABLE):
SSD OF THE MODULE (IF APPLICABLE): SECS P02 POLITICA ECONOMICA
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II, ANNUAL): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None

PREREQUISITES (IF APPLICABLE)

None. Preliminary notions of microeconomics required for a proper study of environmental economics will be part of the course.

LEARNING GOALS

This course is designed to explore and analyze at an intermediate level the use and management of natural resources in market economies. The natural world we live in contains natural resources that both a) allow our existence on the planet and b) provide for qualities of life we enjoy. These resources range from those above the ground— air, water, trees, fish, etc. to those beneath the ground— coal, natural gas, oil, water, etc. To what extent the use of these resources by economic agents and institutions (firms and consumers) interacting through markets can be considered efficient? What is the relationship between efficiency and sustainability in the use of the resources? What is their impact on natural systems? What is the role for public policy? Which forms should such policies and interventions take according to economic theory? Which forms do they take in practice?

At the end of the course the student should be able to critically evaluate fundamental issues in the current debate on the relationship between the organization of economic activities and the environment, with a particular focus on cost benefit analysis, efficient use of renewable vs non renewable natural resources, energy transition.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

At the end of the course and after due study students endowed with an adequate background are expected to understand the basic structure of microeconomics, behavioral hypothesis about economic agents (consumers and firms) and their coordination through markets, the typical situation where market failure is expected to occur and the role of public intervention in this case. These notions will allow students to understand causal chains and main relationships between public intervention and market allocation, with a specific focus in the field of non renewable resources and energy transition.

Applying knowledge and understanding

At the end of the course and after due study and practice students should be able to apply analytic schemes and models for the analysis of real life situations. Example include: the analysis of different form of intervention in the case of externalities, cost benefit analysis and technique for the case of a public project in the energy sector, main issues typically emerging in the energy transition process, the effects of a shock in the energy market and main strategies of mitigation.

COURSE CONTENT/SYLLABUS

1. A Review of the Economic Approach. Market Allocation, Property rights, Externalities
2. Economic Foundations of Cost Benefit Analysis
3. Dynamic Efficiency and Sustainable Development
4. Non Renewable and Renewable Resources
5. Energy transition

READINGS/BIBLIOGRAPHY

Tietenberg and Lewis, Environmental and Natural Resource Economics, latest edition, Pearson (available on line). References to chapters in this textbook are indicated as TL.

TEACHING METHODS

Class on slides. Students' involvement will be favored and appreciated through class presentations and reports either in Italian or in English.

EXAMINATION/EVALUATION CRITERIA

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

(*) multiple options are possible

a) Evaluation pattern:

Class attendance (either online or in presence) and timely delivery of the assignments, although not compulsory, will be considered in the assessment (20%), quality of the exercises and assignments submitted by the student will be relevant for the 40% of the final grade, performance at the final exam will be relevant for the remaining (40%).

COURSE DESCRIPTION
BIO SOFT MATTER: FLUIDS MICROSTRUCTURED IN BIOTECHNOLOGY

SSD: PRINCIPI DI INGEGNERIA CHIMICA (ING-IND/24)

DEGREE PROGRAMME: CORSO DI LAUREA IN BIOTECNOLOGIE BIOMOLECOLARI E INDUSTRIALI (N75)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: CASERTA SERGIO
PHONE: 081-7685971
EMAIL: sergio.caserta@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: III
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER I
CFU: 6

REQUIRED PRELIMINARY COURSES

None

PREREQUISITES

None

LEARNING GOALS

The student must be able to evaluate which fluids can undergo structural changes from specific process conditions, and what consequences these changes can have on the application functionality of the aforementioned fluids.
The student must be able to interact simultaneously with different professional figures (such as process engineers, designers, industrial chemists, physicists, biologists, and doctors) to optimize the applicative aspects related to bio soft matter.

The student must be able to independently find specific information on application processes related to bio soft matter.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

During the course the biotechnological applications of microstructured fluids will be presented, with particular attention to (diluted) solutions of macromolecules and polyphasic fluids, such as suspensions (of cells), emulsions, and surfactant systems such as micelles or liposomes, known as bio -soft matter (or biological soft matter).

Applying knowledge and understanding

The student will have to know the fundamental concepts of fluid mechanics, and possible types of complex fluids and flows, with particular attention to specific applications, such as handling and mixing in industrial environments, microfluidics, the industrial formulation of drug delivery systems and foods.

COURSE CONTENT/SYLLABUS

Transport Phenomena in Industrial Biotechnologies, a brief summary. Constitutive equations of fluids, Newtonian and non-Newtonian fluids, Viscoelasticity, Rheometry. Case study: Flow of biological fluids.Complex Fluids: Macromolecules in diluted regimes, molecular modelling. Multiphase fluids: suspensions, emulsions, droplets, bubbles, flow induced microstructure. Interfacial tension, surfactants, micelles, liposomes. Interaction of micro structured fluids with cellular systems. Applications: Design and manufacturing of drug delivery systems, industrial processing of drugs, cosmetics, food. Case study: topical applications, drug delivery through skin. Case study: industrial manufacturing of low-fat food by engineered processing of biopolymers water emulsion.Complex Flows: flow around objects, mixing in vessels. Non-dimensional groups: physical meaning and use. What happens when the fluid is non-Newtonian. Turbulent and laminar flows. Reynolds number, correlations. Power required to pump or to mix.Applications: Stirred tanks, fluid pumping, mixing, microfluidics. Case study: fermentation broth mixing.Active Bio-Soft-Matter in industrial biotechnologies applications. Transport phenomena in cellular systems: motility and proliferation. Chemotaxis. Role of concentration gradient in dynamic evolution of tissues. Case Study: High throughput screening of drugs for industrial pharmacological testing. Case study: Tissue repair. Case study: Cancer growth and invasion

READINGS/BIBLIOGRAPHY

- G. A. Truskey, F. Yuan, D. F. Katz - Transport phenomena in Biological Systems - Pearson Prentice Hall, 2004.E.L.
- Cussler - Diffusion Mass Transfer in Fluid Systems - Cambridge University Press, 2009.
- R. B. Bird, W. E. Stewart, E. N. Lightfoot - Transport Phenomena –John Wiley &Sons, 2006.
- V. Cristini, E. Koay, Z. Wang - An Introduction to Physical Oncology –CRC press, 2017.

TEACHING METHODS OF THE COURSE (OR MODULE)

Teachers will use:
- Lectures for approximately 70% of total hours; this will include presentation of case studies and seminars given by partners invited from the industry, or from applied research fields.
Lectures and exercise classes will be given by using either the blackboard or Powerpoint slides.
- Practical exercises and lab sessions will cover about 20% of the total hours.
- About 10% of total hours will be dedicated to the development of a project, that will be discussed during the exam.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- [ ] Written
- [x] Oral
- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

COURSE DESCRIPTION
TISSUES ENGINEERING

SSD: BIOINGEGNERIA INDUSTRIALE (ING-IND/34)

DEGREE PROGRAMME: BIOTECNOLOGIE MOLECOLARI E INDUSTRIALI (N80)
ACADEMIC YEAR 2022/2023

COURSE DESCRIPTION

TEACHER: PANZETTA VALERIA
PHONE:
EMAIL: valeria.panzetta@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
SSD OF THE MODULE: NOT APPLICABLE
CHANNEL: A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

There are no required preliminary courses.

PREREQUISITES

Basic knowledge of chemistry and materials science.

LEARNING GOALS

The course aims at providing students with knowledge about the principles of tissue and organ regeneration in vitro. The student will acquire knowledge on the biosynthetic and metabolic activity of cells *in vitro* context, on cell-material interactions and, more generally, on the mechanisms by which exogenous stimuli can define biological activities. Finally, the student will acquire knowledge on the most advanced technologies to control regeneration processes of three-dimensional biological tissues *in vitro*.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student will acquire advanced information (i) necessary to identify the most influential chemical-physical parameters that control tissue regeneration processes in *in vitro* context and (ii) on the most advanced technologies currently available to produce *in vitro* three-dimensional biological tissues.

Applying knowledge and understanding

The student will be able to define the most suitable combination of cells-materials-culture process for the regeneration in vitro of biological tissues. In this context, the student will be able (i) to identify the chemical-physical characteristics of the materials that mostly influence cellular behavior in vitro, (ii) to establish the chemical and micro- or nano-fabrication strategies aimed at modifying these characteristics. Furthermore, the student will be able to apply the knowledge of biochemistry and transport phenomena to define the optimal conditions of the cell culture process.

COURSE CONTENT/SYLLABUS

1. Course overview
2. Fundamentals of biology and 2D cell cultures:
 2.1. Cells and cellular sources
 2.2. ECM and Biological Tissues
 2.3. Cell/native microenvironment/growth factors interaction
 2.4. Cell growth in 2D context (flat surfaces and suspension cell culture).
3. Materials and Scaffold fabrication technologies for tissue engineering:
 3.1. Macro-porous materials (various fabrication technologies)
 3.2. Polymeric hydrogels (characteristics, reticulation processes and introduction to the kinetics of reticulation).
4. Cell-material Interaction:
 4.1. Cell adhesion and migration
 4.2. Strategies of functionalization of 2D surfaces
 4.3. Strategies of functionalization of 3D matrices
 4.4. Examples of cell behavior in 2D/3D environments / Application examples *in vitro* and *in vivo* contexts.
5. Fabrication technologies of engineered biological tissues:
 5.1. Top-Down Tissue Engineering
 5.2. Bottom up Tissue Engineering (scaffold-free: spheroids; cell sheets; scaffold-based: fabrication of microscaffolds (batch and continuous process) / cell-laden microgels, bioprinting; cell-seeded microcarriers.
6. Processes of engineered biological tissues:
 6.1. Responses of 3D cell culture to process parameters (fluid-dynamic, mechanical, biochemical stimuli)
 6.2. Introduction to transport phenomena of fluids and nutrients in continuous and porous media

6.3. Oxygen consumption models
6.4. Introduction to swelling dynamics of macromolecular systems
6.5. Bioreactors in tissue engineering (spinner flasks, rotating wall bioreactors, mechanical-stimulation bioreactors)
6.6. Design of processes for the fabrication of engineered tissues.
7. Tecniques for the characterization of engineered tissues:
7.1. Molecular investigations
7.2. Morphological investigations (histology, multiphoton microscopy).
8. Tissue regeneration:
8.1. Bone and Cartilage
8.2. Vasculat Tissue
8.3. Cardiac Tissue
8.4. Derma-Skin Complex
8.5. Tendons and Ligaments.
9. Tissue Engineering: The Alternative to Animal Testing
9.1. Industrial panorama
9.2. Tissue on chip / Organ on chip
9.3. Applications and validated tissue models
9.4. Emerging strategies.

READINGS/BIBLIOGRAPHY

Lecture notes
Scientific papers

TEACHING METHODS OF THE COURSE (OR MODULE)

Teacher will use a) lectures for approximatively 90% of total hours; b) laboratories to further elaborate on applied knowledge for 10% of total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type

- ☐ Written
- ☑ Oral
- ☐ Project discussion
- ☐ Other

In case of a written exam, questions refer to

- ☐ Multiple choice answers
- ☐ Open answers
- ☐ Numerical exercises

b) Evaluation pattern