General Information	BACELOR DEGREE IN BIOTECHONOLOGIES
Title of the subject	Fermentation biotechnology
Degree Course (class)	Industrial and Agri-food fermentation
ECTS credits	6
Compulsory attendance	Yes
Language	Italian
Academic year	2020-2021

Subject Teacher		
Name and Surname	Isabella Pisano	
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Place and time of reception	Campus, Via Orabona 4, Palazzo di Farmacia, Friday 12:00 a.m.	
ECTS credits details	Discipline sector (SSD)	Area
	CHIM/11	---

Study plan schedule	Year of study plan	Semester
	3^	2^

Time management	Lessons	Laboratory	Exercises	Total
CFU	**5**	**1**		**6**
Total hours	**125**	**25**		**150**
In-class study hours	**40**	**12**		**52**
Out-of-class study hours	**85**	**13**		**98**

Syllabus	
Prerequisites / Requirements	
Genetics, Microbiology and Biochemistry	
Expected learning outcomes (according to Dublin descriptors)	
Knowledge and understanding	Through the use of different bibliographical sources (scientific texts, scientific literature, current affairs), the student will be encouraged to acquire essential tools for his profession, with particular reference to the following specific objectives: • Know the different types of microbial fermentation. • Know the different types of fermentation processes • Know the different types of fermentation plants • Know the development strategies of new processes and/or new products.
Applying knowledge	The course aims to provide methodological approaches and basic techniques to be applied to the needs of the profession of biotechnology, with particular emphasis on the most relevant

	aspects for entry into the labour market and professional success. In detail, the following objectives are envisaged: • Acquire the skills necessary to move safely in a fermenting laboratory and/or in a fermenting plant, the manual skills required for microbiological and process analysis and the elements necessary for the interpretation of the results. • Apply the knowledge acquired to the design and validation of new processes and products of interest in the biotechnology industry.
Making informed judgments and choices	• Recognize and describe principles and limits of fermentation processes, with particular reference to environmental sustainability and ethical-social issues. • Demonstrate judgment in specific situations of analysis of process development strategies.
Communicating knowledge	Be able to describe fermentative processes in a comparative and critical manner. This ability must be acquired both with reference to communication to professional entities and for disclosure purposes.
Capacities to continue learning	Through the lectures and laboratory experiences, the student will be stimulated to make contact with the specific problems of the profession, in order to develop problem solving strategies. The student will be encouraged to actively participate in the learning and refresher actions planned by the course of studies.
Study Program	
Content	• Part I - Microbial fermentations. Planning of a bioconversion and a fermentation. Yield, production, productivity. Strategies adopted in fermentative processes: batch, feedbatch, continuous. Trophobic and idiophase. Stirred-tank bioreactors, air-lift, in a packed bed and in a fluid bed. Analysis of critical points of an industrial fermentation process: choice of bioreactor, formulation of culture medium, agitation, gas exchange, temperature, production and dissipation of process heat, density of medium, foam production, sterility. Microorganisms of biotechnological interest: bacteria, yeasts and filamentous fungi. Strain improvement: random mutagenesis, auxotrofia, antimetaboliti, gene dosage. Effects Pauster, Clusters and Crabtree. Methods of storage of strains. • Part II - Fermentation processes Fermentation of organic compounds (ethanol, glycerol, etc.) Oxidative fermentations (acetic acid and citric acid). Production of amino acids used in the food, pharmaceutical and chemical industries. Production of β-lactam antibiotics by fermentative and semi-synthetic route (penicillins and cephalosporins). Production of biomass. Production of heterologous proteins in microorganisms (E. coli and S. cerevisiae), plants and animals (insulin, growth hormone, vaccines and antibodies). Process development of molecules produced by animal cells (monoclonal antibodies and recombinant proteins). • Part III- Process development Identification of the development path of a biodrug (hybridoma isolation and cloning). Development of the culture and purification

	method (serum vs serum free media). Increased productivity and process strategies. Choice of bioreactor (Roller, Cell Factory, Miniperm, Cell Max Hollow Fiber). Linear scale up vs modular scale up. Development of analytical tests to follow the production and characterise the finished product (mycoplasmas, pH, electrophoresis, ELISA, etc.). Quality control (protein A, BSA, HCP, product data sheet). Safety tests (fill test and media fill). • Laboratory experience Development of a fermentation process and analysis of process parameters
Bibliography and textbooks	• Donadio et al. Biotecnologie microbiche, CEA Edizioni.
Notes to textbooks	
Teaching methods	Lectures in the classroom and laboratory experiences.
Assessment methods (oral, written, ongoing assessment)	Ongoing assessment Oral
Evaluation criteria (describe criteria for each of the above expected outcomes)	Students must be able to express the concepts related to the topics of the course using an appropriate language also in the choice of scientific terms that must be consistent with the terminology of the discipline. Students must know the following topics: • Use of micro-organisms in industrial fermentations. • Knowledge of different fermentation strategies and fermentation facilities. • Knowledge of the main fermentation processes of interest in the biotechnology industry • Knowledge of key process development strategies • Acquisition of basic fermentation techniques.
Further information	