General Information	MASTER DEGREE IN BIOTECHNOLOGIES
Title of the subject	INDUSTRIAL BIOCHEMISTRY AND BIOCHEMICAL METHODS FOR THE ENVIRONMENT
Degree Course (class)	LM-8 class INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGIES
ECTS credits	6
Compulsory attendance	Yes
Language	Italian
Academic year	2020/2021

Subject Teacher		
Name and Surname	Carlo Marya Thomas Marobbio	
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Place and time of reception	Building of the Faculty of Pharmacy, 1st floor, Room 226. Upon request via email	
ECTS credits details	Discipline sector (SSD)	Area
	BIO/10	---

Study plan schedule	Year of study plan	Semester
	1	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	
Knowledge of molecular biology, biochemistry, microbiology.	
Expected learning outcomes (according to Dublin descriptors)	
Knowledge and understanding	Acquire advanced knowledge of environmental and industrial biochemistry, with particular regard to industrial processes and products and related to bioremediation
Applying knowledge	Application of broad-spectrum biochemical methodologies for environmental and industrial research
Making informed judgments and choices	Acquisition of autonomy in areas related to the evaluation, interpretation of experimental data, and to the setting of strategies

	for the study of industrial processes and methods for bioremediation
Communicating knowledge	Acquisition of the lexicon and terminology related to cell metabolism in order to understand any further information through specific bibliography.
Capacities to continue learning	Acquisition of skills to investigate, update and critically read the evolution of the discipline, through the consultation of multimedia supports, texts and other web informations.
Study Program	
Content	Part I Environmental control and pollutants: Notes on national, European and international regulations on environmental control. Monitoring and analysis of pollutants. Remediation planning: characterization plan, preliminary remediation plan, remediation plan. Risk analysis: REBECCA procedure, "table" model. Part II ° Environmental control and elimination of pollutants: remediation and bioremediation. Main chemical-physical systems (in situ and ex situ) for the recovery of polluted environments (landfarming, composting, bioreactors, bioventing, biofilters, etc.). Biological methods of remediation (in situ and ex situ) of environments polluted by xenobiotic substances: bioattenuation, biostimulation, bioaugmentation, bio-remediation and phytoremediation. Bioavailability of xenobiotics. Part III ° Biotechnological methodologies in bioremediation processes: Identification and monitoring of microorganisms directly related to the degradation of xenobiotic substances and / or during bioremediation interventions (analysis of 16S rRNA, DGGE, TGGE, T-RFLP, SSCP, Competitive PCR, Real Time PCR); Identification of the efficiency of microbial bioremediation (increase in the number and variation of gene and protein characteristics of microorganisms through Site Directed Mutagenesis, FISH, RealTime PCR, Microarray, Differential Proteomic Analysis). Metabolism and degradation of xenobiotic pollutants. Use of plasmids in the degradation of xenobiotic substances. Part IV Biotechnological methodologies for the sustainable development of industrial production. Sustainable development and industrial production of biohydrogen (energy conversion from biomass, fuel cell). Part V ° Biotechnological industrial processes. Industrial processes for the preparation of vaccines. Industrial production of enzymes and their application. Industrial methods of lysis for the recovery of endocellular enzymes. Lysis yield and process efficiency. Industrial methods of lysate clarification. Centrifugation in industrial practice. Types of industrial centrifuges and their application. Applications of filtration in industrial biochemistry. Chromatography in industrial processes. Scaling-up of a chromatographic process. Homogeneous catalysis and heterogeneous catalysis in industrial processes. Biocatalysts. Methods of immobilization of biocatalysts. Activation of functional groups in biocatalysis. Bioreactors and biocatalysis methodologies. Immobilization kinetics. Producing microorganisms

	and metabolic pathways for the production of itaconic acid. Industrial processes for the industrial production of itaconic acid. Laboratory experiences: Bioremediation of hydrocarbons through the use of oil-degrading microorganisms. Bioadsorption of metals and organic compounds. Profile of the variation of the bacterial population by ARDRA analysis of 16SrRNA in bioremediation conditions.
Bibliography and textbooks	• **MUTAGENESI AMBIENTALE** - Migliore L. – Ed. Zanichelli. • **BIOTECNOLOGIA MOLECOLARE** - B.R. Glick & J. Pasternak - Ed. Zanichelli • Lesson notes Handouts and material in English provided by the teacher
Notes to textbooks	PDF files of the lessons are available as a support
Teaching methods	Lectures with the use of PowerPoint files
Assessment methods (oral, written, ongoing assessment)	Oral interview
Evaluation criteria (describe criteria for each of the above expected outcomes)	The assessment of the acquisition of notions is integrated with the ability to solve problems related to bioremediation and industrial processes, both from a biochemical and biotechnological point of view.
Further information	