

Course Unit	Environmental biotechnology		Field of study	Environmental protection techniques	
Bachelor in	Biology and Biotechnology		School	School of Agriculture	
Academic Year	2022/2023	Year of study	3	Level	1-3
Type	Semestral	Semester	1	ECTS credits	6.0
Workload (hours)		162	Contact hours	T 30 TP - PL 30 TC - S - E - OT 4 O -	
Code: 9029-510-3102-00-22					

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Marina Maria Pedrosa Meca Ferreira Castro, Paula Cristina Santos Baptista

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. know the main types of environmental pollutants and their effects in different environments
2. Relate the characteristics of environments contaminated with their ability to degrade or transform specific hazardous materials
3. know the importance of soil components in the availability of pollutants
4. know the different organisms whit ability to remediate contaminated sites and its mechanisms of detoxification
5. Know the potential of the use of plants to remediate soil and water contaminated by organic compounds, and their mechanisms of detoxification
6. know the importance of fungi in bioremediation processes, including the remediation of soils contaminated by heavy metals
7. Know different strategies for bioremediation.

Prerequisites

Before the course unit the learner is expected to be able to:
Not applied

Course contents

Main sources of air, water and soil pollution. Importance of soil components in the pollutants availability. Soil properties related to the remediation process. Environmental monitoring of contaminated areas. Biological mechanisms of detoxification. Bioremediation by microorganisms. Phytoremediation. Tolerance and resistance to heavy metals: the importance of fungi and mycorrhizae. In situ and ex situ bioremediation technologies. Biotechnological treatment of effluents and solid wastes.

Course contents (extended version)

1. The environment as a continuum. Role of soil in the environment. Soil and factors of its formation
2. Solid, Liquid and Gas Phases. Properties associated with each phase
3. Biotic activity. Main groups of organisms in the soil and their functions.
4. Environment pollution
 - Origin of water and air pollution.
 - Soil Pollution: Fertilizers, sediment, animal waste, pesticides, industrial processes.
5. Physical processes that affect the fate of contaminants. Movements in soil and water.
6. Chemical processes that affect the fate of contaminants.
 - Soil phases; Solubility of organic and inorganic pollutants; Sorption of pollutants
7. Biological processes that affect the fate of contaminants.
 - Biological effects of pollutants; The biodegradation process; Microbial activity and biodegradation
8. Environmental monitoring: Soil sampling techniques.
9. Biological mechanisms of detoxification: Bioremediation by microorganisms
 - Microbial population used in bioremediation
 - Metabolic pathways of microorganisms and their importance in bioremediation
 - Factors affecting bioremediation by microorganisms
 - Biostimulation, Bioaugmentation, Bioprecipitation, Biotransformation and Biosorption
 - Examples and case studies of bioremediation processes
10. Biological mechanisms of detoxification: Phytoremediation
 - Definition, advantages and disadvantages
 - Phytoextraction, phytostabilization, phyto- and rhizodegradation, rhizofiltration, phytovolatilization
 - Principles, target substances and mechanism of action of different phytoremediation processes
 - Properties of plants used in different phytoremediation processes
 - Examples and case studies
11. The importance of fungi in bioremediation
 - Fungal decay of wood: White-rot fungi and their enzymes in bioremediation
 - Examples and case studies
12. Tolerance and resistance to heavy metals
 - Role of mycorrhizae in heavy metal contaminated land
 - Interactions between fungi and metals. physiological mechanisms
13. In-situ and ex situ techniques of bioremediation
14. Biotechnology in the bioremediation
 - Bioreactors
 - Genetically modified microorganisms (GMOs)

Recommended reading

1. Ansari AA, Gill SS, Gill R, Lanza GR, Newman L (2016) Phytoremediation: Management of Environmental Contaminants, Volume 4. Springer
2. Das S (2014) Microbial Biodegradation and Bioremediation, 1st Ed, Elsevier
3. Mirsal IA (2008) Soil Pollution: Origin, Monitoring & Remediation. 2nd ed, Springer
4. Weil RR, Brady NC (2016) The nature and properties of soils. 15th ed, Pearson Education

Teaching and learning methods

Theoretical classes: Lectures of theoretical contents supported by audio-visual media. Practical classes: Realization of practical laboratory experiments, problem solving regarding the presence and degradation of substances in the soil, analysis of case studies. E-learning platform will also be used as an important tool in the learning process by providing study guides for students.

Assessment methods

1. Avaliação contínua - (Regular, Student Worker) (Final)
 - Intermediate Written Test - 30% (Exam of the first part of the theoretical component)
 - Final Written Exam - 30% (Exam of the second part of the theoretical component.)
 - Reports and Guides - 20% (Report about bioremediation.)
 - Presentations - 20% (Analysis of a scientific article with oral presentation.)
2. Avaliação Final - (Regular, Student Worker) (Final, Supplementary, Special)
 - Final Written Exam - 100% (Exam of the theoretical and practical component whose classification must be higher than 9.5 val.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Marina Maria Pedrosa Meca Ferreira Castro, Paula Cristina Santos Baptista	Ana Maria Antão Gerales	Altino Branco Choupina	Paula Cristina Azevedo Rodrigues
12-12-2022	19-12-2022	19-12-2022	19-12-2022