

MASTER DEGREE IN MICROBIOLOGY



ENVIRONMENTAL BIOTECHNOLOGY – Instituto Superior Técnico

Objectives:

The first part, focused on biological aspects, aims to give students an integrated overview on the impacts of different pollutants in natural ecosystems, on ecological risk assessment and risk management, and on biotechnological methods used to address environmental problems, from the monitoring of the environment to the removal of pollutants from the contaminated compartments. The second part aims to teach students the basic methods for identifying, quantifying and treat gaseous, liquid and solid effluents from municipal and industrial activities, on the basis of practical cases of bio-industries and exemplifying the design of biological treatment steps.

Program:

Ecotoxicology (part 1) -Characterization and fate of xenobiotics in the environment. Effects at the different levels of biological organization: from molecular targets to ecosystems. Environmental and biological monitoring. Toxicity testing. Ecological risk assessment and management. Biodegradation of xenobiotics and bioremediation strategies (case studies: BTEX, atrazine); role of microorganisms, and their molecular detection in the environment. Bioremediation of metals. Phytoremediation. Effluent characterisation and treatment (part 2).Quantification and characterisation of gaseous, liquid and solid effluents; flow rate and quality parameters. Strategies for treatment/elimination/valorisation of effluents. Treatment stages for gaseous, liquid and solid effluents. Design examples: anaerobic and aerobic bioreactors; pond systems; sludge/solid waste treatment through pressing and composting; gaseous effluent treatment through scrubbing and biofiltration.

Evaluation methodology

Teaching is based on lectures, and guided work; under teachers supervision, selected scientific papers illustrating diverse relevant issues are analysed and used as a basis for bibliographic search by the students (as part of the assessment), and practical case basic data are used to illustrate, evaluate and calculate environmental protection schemes in municipal and industrial contexts. References for quantitative/qualitative data are indicated to the students for calculations and critical decisions, or as further reading (books, scientific/technical journals, regulatory publications; databases and other web resources). Evaluation comprises two parts: A) written monograph and its oral presentation, as an integral part of the learning process, based on an offered scientific paper focused on part 1 of the syllabus (first half of the semester); B) final open-book exam based on the whole programme. Final classification is calculated as $= 0.4xA+0.6xB$; minimal level in A and B: 9.5/20.

Recommended bibliography:

- Environmental Biotechnology, A. Scragg, 2005, Oxford University Press, Oxford, 2nd edition.
- Fundamentals of Ecotoxicology, M. C. Newman, M. A. Unger, 2003, 2nd edition, Lewis Publishers.
- Bioremediation. Applied Microbial Solutions for Real-World Environmental Cleanup. R.M. Atlas, J. Philp (eds), 2005, ASM Press, Washington, DC.
- Biodegradation and bioremediation, Martin Alexander, 1999, Elsevier, 2nd edition.

- *Wastewater Engineering - Treatment, Disposal and Reuse*, Metcalf & Eddy, Inc. (G. Tchobanoglous, F.L. Burton, rev.), 1991, McGraw-Hill, New York, 3rd edition.
- *Wastewater Treatment - Biological and Chemical Processes*, M Henze, P Harremoes, J LaCour Jansen, E Arvin, 2002, Springer-Verlag, Heidelberg, 3rd edition.
- N. de Nevers, *Air Pollution Control Engineering*, 2nd edition, McGraw-Hill, New York, 1999.
- P. T. Williams, *Waste Treatment and Disposal*, 2nd edition, John Wiley & Sons, Ltd., Chichester, 2005.