

MASTER DEGREE IN MICROBIOLOGY



MICROBIAL CELL FACTORIES – Instituto Superior Técnico

Objectives:

This discipline is focused on the exploitation of microorganisms and their biochemical pathways for the synthesis, catabolism or modification into products of industrial and economic value, in a Systems and Synthetic Biology perspective. This course lies on the interface between biochemistry, cellular and molecular microbiology and the new approaches of metabolic engineering at a genome-wide scale, empowering the application of microorganisms in Biotechnology.

Program:

1. Organization of the metabolism in prokaryotes and eukaryotes:
 - Cell structures and compartmentalization;
 - Transport systems;
 - Carbon and energy flux;
 - Lipid metabolism;
 - Exceptional metabolic pathways (polylactic acids, alginate, cellulose);
2. Metabolic engineering using global metabolic and transcriptional regulatory network models;
3. Strain optimization
 - Mechanisms of resistance and response to stresses relevant in fermentation processes;
 - Directed evolution of industrial strains;
 - Synthetic Biology;
4. Case-studies:
 - Production of biomaterials: organic acids, extracellular polysaccharides, tensioactives, antibiotics, drugs, bioplastics, biofuels
5. Modeling the metabolism of microbes based on the Dynamic Energy Budget Theory:
 - Equations of assimilation, dissipation and growth;
 - The chemical composition of structure and reserve;
 - The heat dissipation;
 - Parameter estimation.

Evaluation methodology

Teaching methodologies include lectures and practical classes. The final grade results from the balance between the contributions of two evaluation elements:

- 1 – Final exam - 60% - The exam is mandatory. A minimal grade of 9,5 values is required.
- 2 – Project presentation - 40% - The students are expected to propose an experimental strategy to obtain an engineered microorganism to produce a given biomolecule. This project, to be carried out in groups of 3, will be evaluated based on its oral and written presentation.

Recommended bibliography:

- * D. Voet, J.G. Voet, Biochemistry, 1995, John Wiley & Sons, Inc, New York, USA.
- * B. Christensen, J. Nielsen, Metabolic Network Analysis - A Powerful Tool in Metabolic Engineering, In: Advances in Biochemical Engineering/Biotechnology (Th. Scheper, Ed.), Vol. 66, Springer-Verlag Berlin Heidelberg, 1999.

* E. Klipp, R. Herwig, A. Kowald, C. Wierling, H. Lehrach, Systems Biology in Practice, Wiley-VCH, Weinheim, Germany.