IPS Instituto Politécnico de Setúbal
Escola Superior de Tecnologia do Barreiro

Curriculum Unit Sheet

Enzymatic Engineering

Academic Year:

2018/2019

Course	Master's degree on Chemical and Biological Engineering						
Scientific Area	Biotechnology						
ECTS Credits	6	**Curriculum Unit code**	MEBQ001	**Year**	1	**Semester**	1	**Type**	Compulsory
Prerequisites							

Contact Hours

Lecture Sessions		**Lecture-Practical Sessions**	30	**Practical and Laboratory Sessions**	22,5
Tutorial		**Placement**		**Seminar**	
Fieldwork		**Other**		**Autonomous Study**	109,5

Responsible	Natália Maria Ferreira Rebelo de Melo Osório	**Position**	Invited Assistant Professor
Lecturers	Natália Maria Ferreira Rebelo de Melo Osório	**Position**	Invited Assistant Professor

Learning Outcomes

It is intended that students acquire skills in the engineering area applied to biological processes with enzymes. Thus, it is expected that at the end of the semester, students are able to choose and understand the mechanisms involved in enzyme catalysis and perform techniques for random and directed mutagenesis as well as for protein modification. In this curricular unit it is also expected that students learn the methodologies employed in the production of enzymes in bioreactors and downstream purification.

Syllabus

- Applications of enzymes: General properties of enzymes; Classification and nomenclature of enzymes; Structure and function of enzymes;
- Protein engineering: "protein design". Directed and random mutagenesis. Molecular evolution.
- Mechanisms of enzyme catalysis; Kinetics of free and immobilized enzymes; Reactions with one or more substrates; Inhibition of enzyme activity. Effects of immobilization on the kinetics and properties of enzymes; stability and "folding" of proteins.
- Enzyme kinetics in multiphase systems. Steric and conformational effects. Partition effects. Mass transfer effect. Unconventional multiphase systems.
- Production of enzymes. Strategy for obtaining and purification of intracellular and extracellular enzymes.
- Immobilization of enzymes. Immobilization methods.
- Enzymatic phase and multiphase reactors: types and classification of enzyme reactors. Modeling of ideal and non-ideal enzymatic reactors; enzyme deactivation.

Teaching Methodologies

This curricular unit comprises a theoretical / practical component. Theoretical contents are taught via PowerPoint presentations. Intercalating theory with practical applications focusing on problem solving will be done. There is still a component of experimental classes for holding a small number of activities for better knowledge consolidation.

Evaluation

The evaluation of the curricular unit may be continuous, by performing two tests during the semester (1st test, 30%, 2nd test 45%) and two reports within the scope of the experimental activities (2x 7.5%) with an oral presentation of the work in English (10%), with a PowerPoint support. These reports can also be performed to reduce the burden of the final exam (in 1st and 2nd season) to 75%. Finally, the evaluation may be composed entirely by the final exam in 1st or 2nd season (as 100%).

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes	The content of this curricular unit seeks to deepen some of the fundamental concepts related to enzymes, including their properties, enzyme kinetics and protein engineering methodologies, taught especially in the early chapters. The mass and energy balances are addressed in modeling and design of enzyme reactors. The contents are discussed based on an exposure of subjects and exercise solving with examples of laboratory and industry, in order that the curricular unit's objectives are met.
Evidence of the teaching methodologies coherence with the curricular unit's intended learning outcomes	The teaching methods include lectures with the goal of passing concepts, definitions and mechanisms for the problems/exercises interpretation. Lectures are intended to transmit the student the knowledge to pursuit the aims of the curricular unit. The teaching methods include practical classes that use an exercise resolution strategy under the professor supervision. Practical classes are intended to give the student the competences to understand, describe and relate knowledge. Laboratory classes allow the application of knowledge in a real context, consolidating knowledge and improving the perception of the presented contents. The evaluation with reports and tests was established for continuous evaluation throughout the semester of the acquired skills. The evaluation with a final exam also allows to assess whether the skills for knowledge integration were achieved.
Bibliography	• Cabral, J.M.S., Gama M., Aires-Barros, M.R.M., Engenharia Enzimática, Edição/reimpressão: 2003, Pages: 260, Editor: Lidel, ISBN: 9789727572724. • Teixeira, J.A., Fonseca, M.M., Reatores Biológicos, fundamentos e aplicações, Edição/reimpressão: 2006, Pages: 520, Editor: Lidel, ISBN: 9789727573660. • Samuelson, J.C., Enzyme Engineering, Methods and Protocols; Edition: 2013; Series: Methods on Molecular Biology, Vol. 978, Humana Press, ISBN 978-1-62703-292-6. • Buchholz, K., Kasche, V., Bornscheuer, U.T., Biocatalysts and Enzyme Technology; Edition: 2012; Pages: 626, John Wiley & Sons. • Lutz, S., Bornscheuer, U.T., Protein Engineering Handbook, Edition: 2012; Pages: 1015, John Wiley & Sons.
Observations	