Code: 1685 **Mass and Energy Transport Phenomena**
Degree: 1st cycle – Food Science and Engineering
Curricular Year: 2nd **Semester Course: 1st**
Credits: 6 ECTS **Compulsory**
Language: Portuguese/English
Responsible: Helena Margarida Nunes Pereira
Other lecturer(s): Maria Suzana Leitão Ferreira Dias Vicente
Web Site: http://www.isa.utl.pt/home/node/4035

1. Contact hours:
Lecture/Practicals 56 **Praticals/Laboratory** 14 **Others** 14 **Total** 84

2. Objectives:

Understanding the basic concepts of mass and energy transfer and their application to case-studies in food engineering.

3. Programme:

Mass balances in processes without and with chemical reactions. Introduction to the general concept of transfer: basic laws. *Mass transfer* and diffusion: diffusion in gases, liquids and solids. Mass transfer between phases with chemical or biochemical reaction; boundary-layer flow and turbulence in mass transfer; mass transfer in biological reactors (fermentations and systems with immobilized biocatalysts). Phase equilibrium and its application to extraction.

Heat transfer: principles of steady-state heat transfer; mechanisms of heat transfer (conduction, natural and forced convection, radiation). Principles of unsteady-state heat transfer: unsteady-state heat conduction in various geometries; heating, chilling and freezing of biological materials. Energy balances in industrial layouts.

4. Bibliography:

Main Bibliography

Bayazitoglu, Y., Ozisik, M.N. (1988), Elements of Heat Transfer, McGraw-Hill International Editions, New York.

Coulson, J.M. & J.F. Richardson, (1977) *Tecnologia Química. Vol. I. Fluxo de fluidos, transferência de calor e transferência de massa*", 3" edição, Fundação Calouste Gulbenkian.

Ferreira-Dias, S., Miranda, I, Pereira, H. (2003/2004), *Balanços de Massa: Fundamentos Teóricos e Alguns Problemas de Aplicação,* Texto de apoio da disciplina de Fenómenos de Transferência I, ISA/UTL, pp. 70, Lisboa.

Other Bibliography

Geankoplis, C.J. (1986), *Transport Processes and Unit Operations*, 3ª Edição, Prentice-Hall International, Inc.

5. Assessment:

Two tests or a final exam (80% of the final mark) and a laboratory report (20% of the final mark). A minimum of 9.5 either in the exam or in the report is required.

6. Estimated Workload: 168 Hours

7. Last Update: 12/7/2010