

**Code: 1686    Mass and Energy Transport Phenomena****Degree:** 2<sup>nd</sup> cycle – Forestry and Natural Resources; Bioenergy Systems Engineering**Stream:** Forestry and Natural Resources – Forest Products**Curricular Year:** 2<sup>nd</sup>**Semester Course:** 1<sup>st</sup>**Credits:** 6 ECTS**Optional****Language:** Portuguese/English**Responsible:** Helena Margarida Nunes Pereira**Other lecturer(s):** Maria Suzana Leitão Ferreira Dias Vicente**Web Site:****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<sup>a</sup> 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*, 3<sup>a</sup> 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
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**7. Last Update:**

21/7/2010
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