Transport Phenomena II

Calendar: 4th day semester

Contact Hours: T 37,5h; TP 30,0h; OT 7,5h

Scientific Area: Processes in Chemical and Biological Engineering

Intended learning outcomes (knowledge, skills and competences to be developed by the students):

In this UC is intended that students achieve the following objectives: physical and mathematical understanding of the mechanisms of mass transfer (diffusion and convection); acquisition of solid knowledge about transport of a component between phases in contact; understanding of the mass transfer resistance and global resistance concepts, to be able to establish macroscopic and microscopic balances of mass, in different geometries, both in steady state or transient regime; application of acquired concepts to simple equipment, developing the skills to solve technology problems.

Syllabus:

1- Diffusion. Definitions of velocities and mass fluxes. Diffusion: 1st Fick's law. Diffusion through a stagnant film. Transient diffusion: 2nd Fick's Law. Diffusion and convection.

2. Convection. The equations of continuity for binary systems. Mass transfer coefficients at low mass transfer rates in one phase. Dimensionless numbers and empirical correlations. Mass transfer in two-phase systems. Overall mass transfer coefficients.

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

This UC plays a key role in the study cycle, because it is intended to provide the student with solid skills on the mass transport, whose knowledge is essential for many other curricular units.

In this context, the UC is structured into two main chapters, the first concerning the study of transfer by diffusion. In this case the topics are divided in several modules in order to deepen the application

of Fick's law in steady and transient state in several geometries. The 2nd chapter deals with the mass transport by convection, and this issue is divided into several modules. The following modules cover convection for various geometries and physico-chemical systems of different complexity. This chapter is concluded with technological examples.

References:

1. Fundamentals of Heat and Mass Transfer , F.P. Incropera, D.P. de Witt, T.L. Bergman, A.S. Lavine, 2007, 6th ed., Wiley, N.Y.

2. Fundamentals of Momentum, Heat, and Mass Transfer, JR Welty, CE Wicks, RE Wilson , 1984, 3rd Ed., John Wiley and Sons, Nova Iorque.

3. Fundamentos de Transferência de Massa, Maria Norberta Pinho, Duarte Miguel Prazeres, 2008, IST Press.

4. Transport Phenomena, R.B. Bird, W.E. Stewart, E.N. Lightfoot, 2002, 2nd ed., Wiley, Nova Iorque