UCL Université catholique de Louvain

LMECA2620

2010-2011

Simulation of transfer phenomenia in industrial processes.

4.0 credits	30.0 h + 15.0 h	2q

Teacher(s) :	Dupret François ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	a. Modeling: Methodology for developing the equations governing various kinds of transfers in industrial forming processes. Establishment of detailed partial derivative or integral equations representing the involved physical phenomena. Simplification of the equations to facilitate the problem solution by means of asymptotic methods (from dimensional analysis). Boundary layer and singular perturbation problems. Selection of initial and boundary conditions. b. Numerical simulation: Brief recall on the Finite Element Method. Detailed analysis of the simulation of evolution (hyperbolic or parabolic) problems. Method accuracy and numerical stability. Geometrical problems. Mesh or grid generation. c. Application: Complete study of a selected process. Analysis of simulation results. Comparison with experiments.
Aims :	The course provides an introduction to the numerical modeling and simulation of heat and mass transfer phenomena such as encountered in several industrial processes (polymer extrusion, injection molding of plastics, film coating, crystal growth, etc.). The objective is to introduce a methodology whose importance is growing in the industrial world, viz. the use of simulation software to help or partly replace some experimental procedures (which could be long and very expensive). Nowadays simulation software becomes a common tool in industrial forming and hence it is useful to allow the students to understand on which principles such software is built and can be used in a critical way. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Content :	The course begins with a detailed study of the advection-diffusion heat equation from a numerical viewpoint, on the basis of previous knowledge acquired by the students on the Finite Element Method. The effort bears on the temporal scheme stability as well as on the difficulties associated with the solution of hyperbolic problems. The modeling of a particular process is considered. Although the selected process may change every year, the injection molding of thermoplastics is frequently addressed. It is shown how simplified equations can be established by means of dimensional analysis. In particular, the theory of hydrodynamic lubrication is elaborated in the case of injection or compression molding (Hele Shaw model). All the problems generated by this simplification are studied (boundary layers, fountain flow). Particular simulation results are analyzed. The course aims at preparing the student with the use of integrated simulation software, as dedicated to a given process, where the only data are the equipment geometry, the material properties and the operating conditions. The goal is to emphasize the methodology and difficulties encountered in this procedure. A project is devoted to put the students in direct and concrete contact with these problems.
Other infos :	Prerequisite: MECA2120 Introduction to the Finite Element Method. Assessment method: Normal (partly written, partly oral) exam, with discussion on the project report. Support: Document photocopies. Exercises: project consisting in introducing a new potentiality (typically an improved model, a special kind of boundary condition) into an existing software, with a written report on which students are evaluated. Associated stream: Computing Methods in Applied Mechanics (50.12).
Cycle and year of study :	> Master [120] in Mechanical Engineering > Master [120] in Electro-mechanical Engineering
Faculty or entity in charge:	MECA