BIR1310 Transfer phenomena

[45h+15h exercises] 4.5 credits

This course is taught in the 1st semester

Teacher(s):	Mathieu Javaux, Marnik Vanclooster
Language:	French
Level:	First cycle

Aims

To understand the laws of conservation of mass , quantity of momentum and energy and their mathematical formulations (local formulation, 1D formulation, steady state, ...); knowledge of closure laws (viscosity, heat conduction, diffusion coefficient); ability to solve classical flow and heat transfer problems; familiarisation with orders of magnitude, associated technologies (pumps, heat exchangers, ...) et measuring instruments (Pitot tube, flow measurements, psychrometer, ...); ability to tackle various applications through a basic knowledge of the modeling of conduction phenomena, convection, radiation, turbulence, diffusion, vaporisation. This teaching should serve as a basis for several courses oriented towards technical aspects of the applications to bio-engineering and environmental protection.

Main themes

The teaching alternates academic courses and exercices in small groups so as to face the student with direct application of the subjects.
The courses includes the following chapters: Kinematic of fluids - mass conservation - law of momentum - Kinetic and Mecanical energies - Conservation of energy - Closure of the set of equations - Viscosity - Navier-Stokes equation - Laminar flows - boundary layer - Turbulence - Friction factor - Head losses - Pumps - Measurement of pressure and flow - Heat transfer by conduction - Forced convection, natural convection - Dimensional analysis - Unsteady conduction - Heat exchangers - Radiation - Boiling, condensation - Humid air - Molecular diffusion in simple binary systems - Mass transfer coefficient.
The teaching alternates between academic courses and exercises in small groups so as to face the student with direct application of the subjects.

Content and teaching methods

The course contents include the following chapters: kinematics; conservation of mass; law of momentum; Bernoulli equation and mechanical energy balance equation; conservation of energy; viscosity; Navier-Stokes equation; laminar flows: plane surface, cylindrical tube, flow between two rotating cylinders; dimensional analysis and similitude; flow around a small sphere; notion of boundary layer; notions of turbulent flows; friction factors; calculation of head losses; choked flow; measuring techniques of pressure and flow rate; conduction heat transfer: plane wall, cylindrical wall, electrical cable, chemical reactor; forced and natural convenction; transient heat conduction; convection coefficient; heat exchangers; diffusion; Fick's law for a binary mixture; humid air; priciples of air conditioning. The course includes a set of exercise sessions where the student is got used to the concepts and to the orders of magnitude.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Evaluation : Exercises : written examination at the end of the course; Theory : oral examination
Support : Book which is being re-edited ; compilation of all exercises' solutions ; slides available on the teacher's web site: http://www.term.ucl.ac.be//cours/overview.html

Other credits in programs

BIR13BA/A	Troisième année de bachelier en sciences de l'ingénieur, orientation bioingénieur (option : agronomie)	(4.5 credits)	Mandatory
BIR13BA/C	Troisième année de bachelier en sciences de l'ingénieur, orientation bioingénieur (option : chimie)	(4.5 credits)	Mandatory
BIR13BA/E	Troisième année de bachelier en sciences de l'ingénieur, orientation bioingénieur (option : environnement)	(4.5 credits)	Mandatory