Course Package

Transport Phenomena – Q2

Name module	Transport Phenomena – Q2 (second-year BSc module)
Course Code	202000736
Educational programme	BSc Chemical Science and Engineering
Period	Second quartile of the first semester – Q2
Study load	15 ECTS
Coordinator	Jéré van Lente

Physical Transport			
block 1A	**block 1B**	**block 2A**	**block 2B**
	Transport Phenomena **-** fluid dynamics - heat transfer - mass transfer **202000737** (7,5 EC)		
	Project Transport Phenomena* **202000738** (4 EC)		
	Numerical Methods (using matlab) **202000739** (3,5 EC)		

Required preliminary knowledge: Background in Engineering; Basic Thermodynamics; Basic Programming (preferably Matlab); Calculus.

* This study unit can only be taken in combination with Transport Phenomena

Please note, you need to register for the courses in Osiris 2 weeks before the start of the block!

202000737 - Transport Phenomena (PTP)

- Being able to formulate and solve a macroscopic balance for mass, momentum and/or energy in case of flow through a control volume
- Being able to determine the velocity and shear stress profile for fluid flow through simple geometries (2D, 3D tube flow), starting from the micro-balance for momentum, for different boundary conditions (gas-solid, liquid-solid, liquid-gas). Being able to calculate the flow rate and force exerted to the wall by the fluid.
- Understand terms as Reynolds number, laminar flow and turbulent flow. Being able to use these terms in the right context.
- Able to apply Bernoulli's Law for flow at high and at low Reynolds numbers.
- Able to determine the flow resistance for piping systems and for flow past objects of simple geometry (spheres, cylinders)
- Able to formulate and solve the equation of motion for particles moving in a fluid under influence of gravity and/or uplift

The modules are tentative and subject to change. Please check the website *regularly.*

- Able to recognize the prevailing transport mechanisms. Able to describe quantitatively heat transport by conduction, convection and radiation, separately and combined. Formulate and solve integral and differential thermal energy balances for steady state and instationary operation of open and closed systems.
- Formulate and solve differential energy balances and component mole balances to find a temperature distribution or concentration profile.
- In this, the necessary and appropriate various (integral or differential) energy and mole balances and transport (Nusselt/Sherwood) correlations must be applied.
- Knowledge of mass transfer models and be able to describe quantitatively mass transport in a single phase by diffusion and convection, as well as mass transfer between phases. Able to solve problems of coupled heat and mass transport. Apply appropriate Nu/Sh correlations.
- Analyse and solve problems on thermal energy and molar transport in exchange equipment. Formulate and solve integral and differential, stationary (component) mass- and energy balances.

202000738 - Project Transport Phenomena

- Reporting
  - Analysis of the problem statement. Recognizing the prevailing transport mechanisms.
  - Theoretical description/Model formulation.
  - Solving of model.
  - Comparing exp. results with theory.
  - Model use / validation / design, Model
  - Discussion, conclusions
  - Presentation + discussion
  - Reporting quality & General impression

202000739 - Numerical Methods

Transport phenomena are ubiquitous in science and technology, with a wide range of applications in different fields. Transport processes are usually described by a set of mathematical (differential) equations, which often can not be solved analytically. Consequently, a numerical approach is valuable and needed to understand the transport problems. This course will introduce the fundamentals of numerical computation, programming and solving of (differential) equations. A powerful software package, Matlab, will be used. The examples, problems and assignments used in this course will be closely related to the Transport Phenomena discussed elsewhere in the module.

Objective of the course is (i) to obtain elemental knowledge on numerical modelling and programming; (ii) understand and being able to apply the basic programming language of Matlab; (iii) Able to solve ordinary differential equations and systems of linear equations; (iv) being able to solve partial differential equations related to heat, mass, and momentum transport.

The course will consist of lectures and hands-on exercise sessions. Via four different assignments, the competences for the aforementioned subjects will be tested. The numerical modelling skills are further an integrated part of the Project Transport Phenomena. A reader (lecture note) is available for the theory discussed.