Course Package

Materials Science – Q4

Name module	Materials Science – Q4
Educational programme	MSc Chemical Science & Engineering
Period	Fourth quartile of second semester – Q4
Study load	15 EC
Coordinator	C. C. Diepenmaat

Materials Science			
Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
			Polymer Synthesis: Fundamentals, Advanced Techniques, and Designing Functional Materials 202001532 (5 EC)
			Membrane Materials 201800331 (2,5 EC) **Process Optimization 202001581** (2,5 EC)
			Molecular Modelling 201800333 (2,5 EC) **Membrane Processes 201800330** (2,5 EC)

<u>Required preliminary knowledge</u>: Organic Chemistry; Mathematics (among others Statistics for Chem. Process Analysis); Molecular Chemistry; Bachelor chemistry or Chemical Engineering; or Inorganic Chemistry course; Statistical Thermodynamics or Statistical Physics.

202001532 - Polymer Synthesis: Fundamentals, Advanced Techniques, and Designing Functional Materials

This new lecture was developed in order to increase the molecular perspective of students to the field of polymers. They shall learn polymers from the perspective of macro-molecules and will learn classical and state-of-the-art synthesis protocols and theories for making all kinds of polymeric materials. This course builds on the basic principles of polymerization reactions.

This course merely focuses on synthesis of polymers and how to control or tune the molecular structure of polymers. This course will expand the current curriculum and enable the students to understand and plan synthesis routes to sophisticated polymeric materials but also understand, how and why certain polymers have entered the industrial scale of up to 100 million tons per year.

201800331 - Membrane Materials

The different methods and materials for membrane fabrication will be discussed, including phase inversion, interfacial polymerization (or localized reactions), sintering, crosslinking and coatings. These methods lead to porous, dense, or ion selective membranes. Characterization techniques are presented, crucial to define the separation properties of membranes. The materials properties, combined with the fabrication method, results in a selective transport medium, for which the transport theory is basically explained.

202001581- Process Optimization

In this course we will learn that process systems can be viewed at different levels of detail (time and space) but that they share the fact that they require input (or sources) and generate output (or sinks).

A process system could be a coffee machine, a photovoltaic cell, a human body, a hybrid car, an industrial plant, a electrolysis unit, a network of power generators or a complete biobased supply chain.

Raw materials and energy move through process systems and have become one of the main needs of human kind. The systematic generation, conversion, storage and distribution of it has become an urgent matter. In this course we will pay attention to the analysis and design of process systems from a process systems engineering point of view. We will translate our process systems in mathematical optimization models and solve them with the appropriate tools.

201800333 - Molecular Modelling

Student will get a generic introduction to molecular modelling. We will cover the basic techniques employed in molecular dynamics simulations and Monte Carlo simulations. There will be 3-5 assignments in which you will solve simple problems that link back to the concepts of general physics and statistical thermodynamics.

201800330 - Membrane Processes

The course contains aspects related to selective transport phenomena that are relevant for diverse applications and processes. We will include processes utilizing porous, dense and ion selective membranes.

Transport theory will be derived for the different separation processes, including porous and dense membranes. Module design and process related conditions are then highlighted to describe their influence on the separation performance. Concepts like concentration polarization, boundary layer, limiting flux, and pressure ratio, will be introduced and explained connected to their corresponding application.