Course Package

Molecular and Materials Science

Name module	Molecular and Materials Science - 1A + 1B
Educational programme	MSc Chemical Engineering
Period	First semester (block 1A + 1B)
Study load	30 ECTS
Coordinator	A.S. Elbersen - Grote

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(5 EC)</td><td>AMM Organic Materials Science - 193700030
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Required preliminary knowledge: Basic knowledge of Catalysis and Kinetic, Basics of Physical Chemistry, Organic and Inorganic Chemistry, Molecular Biology, Basic knowledge of Thermodynamics. This is an advanced level graduate course, thus Polymer Science taught in the bachelor curriculum is a prerequisite and will be assumed. Basic knowledge of Material Science and Molecular Biology, Basic knowledge of Thermodynamics, Advanced knowledge of Characterization Method.

193700020 - AMM Molecular and Biomolecular Chemistry and Technology

Molecular recognition is an essential phenomenon in living systems as well as in artificial ones. It describes the specific interaction between molecules, ranging from discrete complexes to large architectures. The course will discuss supramolecular systems going from basic molecular recognition (involving single, monovalent interactions), to systems with cooperativity and/or multivalency, and finally to lage polyvalent systems. For all subclasses, molecular and biomolecular examples will be discussed as well as materials applications.

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

193700010 - AMM Characterization
In this course a wide range of modern, state-of-the-art analytical techniques and tools (microscopy, spectroscopy and diffraction methods) to characterize structure and properties of nanostructures will be introduced and discussed. The central goal is to provide a fundamental understanding of various aspects of molecular, nanoscale and continuum (macroscopic) scale characterization that are essential for the study of nanostructures.

201800083 – Advanced Colloids and Interfaces
This course is about the description of colloids, surfaces and interfaces. All kinds of interfaces between different phases are treated. In addition, thermodynamic descriptions of these interfaces are deduced and several techniques for characterizing interfaces are discussed. During contact hours, the contents of the course will be presented and discussed, and exercises will be made and discussed. For each topic, a case assignment is offered.
Topics include: Lifshitz-van der Waals Interactions, Polar/Acid-Base Interactions, Wetting and Contact Angles, Electrostatics, Electrokinetic Phenomena, Electrostatic and Polymeric Stabilization of Colloids, and Colloidal Phenomena (Marangoni-Effect, Ouzo effect, etc.)

193700030 - AMM Organic Materials Science
Organic materials feature enormous variations in their physical properties as a result of the tremendous wealth of the different possible existing molecular structures of carbon based compounds. The consequence of this plethora of properties is that function and use of organic materials can be tailored by controlling molecular structure virtually at will by using modern synthetic approaches, allowing one to realize many advanced applications, which belonged to the realm of phantasy just a few decades ago. In this lecture molecular structure-property relations will be discussed for the different types of (advanced) synthetic and natural (macromolecular)organic materials, including man-made polymers, liquid crystals, carbon allotropes (nanotubes, fullerenes and graphenes), dendrimers, nucleic acids, proteins and polysaccharides. Materials selection diagrams will be used to compare organic, inorganic, metallic and other materials, focusing on mechanical properties. Similarities and differences on the basis of molecular/atomic structures among the different classes of materials will be elucidated. Approaches will be treated which allow materials engineers to quantitatively estimate physical properties based on the molecular structure (by the so-called group contribution techniques). Effects of processing on structure (texture) and hence on properties will be demonstrated. A description and comparison of the major classes of the most frequently used industrial polymers for different function will complement this course.

Electrochemistry
Fuel cells show great promise to contribute to the ultimate aim of environmentally friendly, efficient *energy production*, while regenerative fuel cells (or electrolysers) and batteries are key devices in *energy storage* from intermittent energy sources such as solar and wind. Salinity gradient power or blue energy is the energy available from the difference in the salt concentration between seawater and river water. The course treats fundamentals and applications of different electrochemical energy harvesting and storage technologies.

193700070 - AMM Project Inorganic Materials
The objective of this course to train experimental skills needed in the field of chemical engineering. Students learn more about a variety of synthesis and characterization techniques by means of two experiments. The possible experiments are embedded in research groups with different research themes. Students will work in pairs (or if needed in groups of three) and do two experiments in two different Chemical Engineering research groups. Students will acquire a working knowledge of a variety of synthesis and characterization techniques.

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