Course Package

Materials Science – 2A

Name module	Materials Science - 2A (first-year BSc module)
Course Code	202000727
Educational programme	BSc Chemical Science and Engineering
Period	First block of the second semester (block 2A)
Study load	15,5 EC
Coordinator	Jéré van Lente

Material Science			
block 1A	**block 1B**	**block 2A**	**block 2B**
		Chemistry of the Biological Cell **202001554** (3 EC)	
		Linear Algebra for CSE **202001206** (3 EC)	
		Materials Science - theory and project - Quantum Mechanics - Structure and Properties of Materials - Polymer Materials - Project **202000728** (9,5)	

Required preliminary knowledge: Basic chemistry; Basic physics; Calculus; Thermodynamics; Molecular Structure.

Note: this module has limited capacity. In case of much interest, students will be selected.

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

202001554 - Chemistry of the Biological Cell

Proteins are the workhorses of life, they are responsible for the processes that make life possible. In this course, we will discuss how proteins enable the processes of life. We will explore the fundamental principles that allow proteins to function including protein structure and function. We will also discuss how protein structures have evolved (and are still evolving). The function of proteins comes through their interaction with proteins and other molecules. We will investigate how specific targets are recognized and how interactions can result in ultrasensitive responses. Together the topics covered will give you first insights into how proteins control biological processes.

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

202001206 - Linear Algebra for CSE

In this course, we mainly focus on systems of linear equations (linear systems). Many real-life situations can be modeled as a linear system. Examples are networks (traffic networks, data networks, electrical networks, etc.), economic models, chemical reactions, cryptography (coding of messages), scheduling, computer graphics, GPS.

Linear Algebra starts with an introduction of linear systems which will be described using a (coefficient-)matrix. Already in the first week we learn how to solve linear systems systematically, using a row reduction technique on the coefficient matrix.

In the second week we focus on operations vectors and matrices, such as addition, multiplication, inverse and transpose. These operations are a fundamental issue in Linear Algebra.

In the third week we deal with sets of vectors with very nice properties: subspaces. It turns out that the properties of subspaces can tell us a lot about the structure of solution sets of linear systems. Here the concepts of linear combination, linear independence, basis and dimension play an important role.

In the fourth week we introduce the concept of determinant of a square matrix. We explore its properties and show some interesting interpretations.

The fifth week will be about eigenvectors and eigenvalues of a square matrix. These concepts play a crucial role in discrete dynamical systems, which arise in many scientific fields.

Finally, in the last week, we examine linear transformations and their properties. Some well-known applications in geometry will be treated as well.

Much emphasis is laid on the relations among the various concepts.

A case study may be implemented in each program, to become acquainted with applications of Linear Algebra.

202000728 - Materials Science - theory and project

Matter and materials are the central themes in this module: from fundamental quantum matter of which properties are ruled by the laws of quantum mechanics, via atoms, bonds between atoms, to larger microscopic and macroscopic structures with mechanical and electrical properties that are used everywhere in our society.

An introduction to quantum mechanics and the quantum chemical description of atoms and molecules is given.

This is complemented by lectures on materials science, in which the structure of materials is described and discussed, from individual atoms, to unit cells, to microstructures on larger mesoscopic and macroscopic length scales.

The main mechanical and electrical properties that emerge from this microstructure are also discussed. Because of the importance of polymers for chemical engineers, their properties are discussed in a series of lectures. In the Project Materials for Energy all gained knowledge from the theoretical lecture series is applied in a literature survey on a materials-related topic in the field of energy harvesting, production, storage, or a closely related area.