

### *Lecture 1: Introduction to colloid and interface science (Emanuel Schneck)*

In this lecture, we give an introduction to colloid and interface science. Its importance for technology and biological matter is illustrated and basic concepts are presented with a focus on colloidal forces such as van der Waals interactions, electric double layer forces, as well as solvent-, solute-, and polymer-induced forces.

### *Lecture 2: Physics of macromolecular systems (Julian Oberdisse)*

This lecture will address the basic physics of polymers. It will start with statistical properties of linear polymer chains, their conformation in space and its dependence on solvent properties and concentration. Each time, we will try to connect the relevant information to the one obtained by small-angle scattering experiments, like the radius of gyration, chain statistics, etc. Polymer solutions are not the only way to suspend chains, they can also be embedded in other matrices, forming polymer blends, the basic thermodynamics of which will be reviewed. When going into polymer materials, crosslinking is the fundamental chemical reaction, while physical bonds may also contribute, and the formation of gels and networks, as well as their thermal and mechanical properties, shall be discussed. If time is available, a short outlook on copolymers will be proposed.

### *Lecture 3: Hierarchical structures in food. Soft matter structure at various length scales (Milena Corredig)*

Food is characterized by complex hierarchical structures, interconnected over multiple length scales. A mechanistic understanding requires soft matter studies using molecular as well as colloidal soft matter tools. This lecture will bring some examples of how advanced physical techniques can help tackle important research questions, often using complementary methodologies.

### *Lecture 4: Molecular simulation in Soft Matter – Fundamental and practical aspects (Benoit Coasne)*

Atom-scale computer simulations have become a technique of choice in physical sciences and engineering. By relying on Statistical Mechanics, such numerical tools allow determining/predicting the structure, thermodynamics and dynamics of molecular systems – including those relevant to Soft Matter – from their microscopic behavior. In this lecture, we will first introduce the fundamentals of classical Monte Carlo and Molecular Dynamics using either all atom or coarse-grained descriptions. We will also consider more advanced methods including free energy approaches which allow probing the thermodynamics and dynamics of systems involving free energy barriers and/or complex free energy landscapes. All these fundamental methods will be illustrated through practical examples taken from the realm of Soft Matter.

### *Lecture 5: Introduction to Nuclear Magnetic Resonance (Alicia Vallet)*

In this lecture, we will present the basics of Nuclear Magnetic Resonance (NMR). Usable on solid as well as liquid samples, this polyvalent technique allows determining sample purity, structure of compounds, dynamics and molecular interaction at the atomic level. Used in many fields from biology to materials, as well as environment and food industries, NMR has the advantage of being quantitative and non destructive under certain conditions.

### *Lecture 6: Foams and emulsions: Soft Matter & Interfaces (Wiebke Drenckhan)*

Foams and emulsions are thermodynamically unstable liquid dispersions whose intriguing properties are dominated by the gas/liquid or liquid/liquid interfaces, respectively. We will consider how these interfaces control the structure, flow and ageing of foams and emulsions; and we will analyse the crucial role of interfacially active agents.

### *Lecture 7: Machine learning in soft matter (Laura Filion)*

Machine learning is becoming an indispensable tool in the study of soft matter – from helping us to better analyze our experiments to speeding up computer simulations. In this lecture I will briefly introduce machine learning and give a short overview of how it is currently being used in this field.

### *Lecture 8-9: Introduction to neutron scattering applied to soft matter (Sylvain Prévost & Samantha Micciulla)*

In this double lecture, an introduction to scattering techniques focused on small angle scattering and reflectometry will be given. The students will learn what information can be obtained for soft matter, food science and biology systems.