

MICRO-390

**Light, liquids and interfaces**

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Cursus	Sem.	Type
Biomedical technologies minor	H	Opt.
Materials Science and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

This course provides an overview of relevant interactions in liquids, combining thermodynamics, statistical physics and pair potentials. Water and aqueous systems will be considered in detail. Optical techniques to investigate liquid and liquid interfacial structure will be treated.

**Content**

Interactions in liquids and at interfaces

Probability and different length scales over which these interactions work

Water and aqueous solutions

Techniques to probe molecular properties in water and at liquid interfaces (linear and non-linear spectroscopy)

In addition to learning about interactions, water, interfaces and methods to probe them in-situ, this course aims to provide instructions and exercises on how to deal with the unknown. To do that, most of the exercises require a certain routine for solving them, which is the same routine that is useful for solving research questions.

Broadly speaking in most questions the following tasks need to be performed:

- Define the physics laws and system concepts that are appropriate for this question.
- Write / compute / derive an expression for the physical property we are looking for in terms of parameters that can be measured.
- Fill in appropriate numbers and compute a value, if needed.

In about 40 exercises you will have the chance to practice this problem solving procedure.

**Learning Prerequisites****Required courses**

This course uses concepts from the following courses:

Analysis I-IV; Lin Algebra; Gen. Physics; Electrical Engineering; Adv. Gen. Chemistry

and also from: Biology for engineers; Surfaces and Interfaces; Theory of materials; Functional properties of materials

This course is normally scheduled to run in tandem with Soft Matter. Exceptionally in 2021 this will not be the case and therefore the material about interactions will be slightly longer at the cost of the later part of the course (optical methods).

**Learning Outcomes**

By the end of the course, the student must be able to:

- Contextualise analytical interactions in a liquid
- Predict liquid / interfacial properties
- Theorize about appropriate methods

- Quantify interactions
- Interpret spectroscopic data
- Compare interactions and properties

### **Assessment methods**

Written exam

### **Resources**

#### **Bibliography**

parts of:

Jacob N. Israelachvili

Intermolecular and Surface Forces, Third Edition, 2011 Elsevier Inc.

ISBN: 978-0-12-375182-9

Dor Ben-Amotz, Understanding Physical Chemistry 1st Edition, 2013, Wiley.

ISBN: 978-1-118-71939-8

Peter W. Atkins and Julio de Paula, Physical Chemistry 8th Edition, 2006, Oxford University Press

ISBN: 9780198700722

and handouts / notes