



FBB3640 Glycoscience in Energy and Materials 7.5 credits

Kolhydratvetenskap inom energi och material

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FBB3640 valid from Spring 2018

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

The applicant must hold a University degree in natural science. Graduation in biology, biotechnology, chemistry, biochemistry, chemical engineering, material science is recommended. Good knowledge in written and spoken English is required.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The course's goal is to provide an overview of current knowledge and state of glycoscience, a highly interdisciplinary field that draws from biology, biochemistry and chemistry as much as medicine, materials science, nanotechnology, and computational science, and give good theoretical insight and practical training on how glycoscience can make significant contributions in energy and materials science.

After passing the course, the student should be able to:

- Recognize the challenges and opportunities in integrating glycoscience broadly into the fields of health, energy, and material science.
- Describe glycan diversity and the roles of glycans as modifiers of other biological molecules.
- Describe the microstructure and function of cellular structure of wood and plant cell wall, and how cell wall composition may be engineered for different applications.
- Describe how to overcome the recalcitrance to degradation of biomass feedstock.
- Describe the concepts and methods developed for obtaining a range of nanoscale building blocks from biomass and how these building blocks can be reassembled to develop materials with tailored properties and functionality.
- Plan and execute experimental assignments including carbohydrate analysis, carbohydrate active enzyme production and application, preparation and characterization of wood-derived nanomaterials, carbohydrate biosynthesis, interpret the results and write a report

Course contents

The course is on the advanced level and consists of lectures and experimental work given by the lecturers including Vincent Bulone, Lauren Mckee, Francisco Vilaplana, Qi Zhou.

Lectures

1. Introduction, basics and importance of glycoscience in health, energy and materials science.
2. Glycoscience and health – the role of glycans.
3. Carbohydrate analysis of complex carbohydrates, glycans, and glycoconjugates
4. The plant cell wall
5. Glycoenzymes
6. Enzymatic degradation of biomass and fiber modification
7. Cellulose and chitin biosynthesis and self-assembly
8. Novel composites through bioengineering of plant cell wall – manipulating glycans by pathway engineering
9. Converting biomass to fine chemicals and feedstocks, polymeric materials and nanomaterials.
10. Assembly of biomass nanomaterials for new materials and applications

There is literature to read before each lecture and a written assignment to do afterwards. The purpose of these assignments is to generate appropriate learning activity for you and increase the quality of learning of each lecture. As you understand, you must set aside time for reading and working between the lectures.

Laboratory work

1. Carbohydrate analysis. This module will provide theoretical and experimental background to understand and determine the molecular composition and structure of complex carbohydrates.
2. Carbohydrate active enzyme. In this module, students will produce and purify arabinofuranosidases and use them to create a series of tailored arabinoxylan structures. These will be used to produce films that the students will use to perform a series of mechanical tests.
3. Carbohydrate-based nanomaterial. In this module, students will prepare nanostructured films and aerogels from microfibrillated cellulose and characterize their morphology and mechanical properties.
4. Carbohydrate biosynthesis. In this module, students will learn how to manipulate glycan biosynthesis for material applications through the cultivation of *Acetobacter xylinum* for bacterial cellulose production.

Disposition

10 theoretical lectures, 2x45 minutes each

4 practical training assignments:

Carbohydrate analysis, 2x8 hours

Carbohydrate active enzyme, 4x8 hours

Carbohydrate-based nanomaterial, 2x8 hours

Carbohydrate biosynthesis, 2x8 hours

Course literature

Scientific articles (state-of-the-art review and research papers) will be announced closer to the course start.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Completed assignments after each lecture, completed Laboratory work and passed laboratory reports together with written examination.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.