FBB3640 Kolhydratvetenskap inom energi och material 7,5 hp

Glycoscience in Energy and Materials

Fastställande

Kursplan för FBB3640 gäller från och med VT18

Betygsskala

G

Utbildningsnivå

Forskarnivå

Särskild behörighet

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.

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

The course's goal is to provide an overview of current knowledge and state of glycoscience, a highly interdisciplinary field that draws from biology, bioechmistry 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

Kursinnehåll

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 carbohy-

drates.
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.

Kursupplägg

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

Kurslitteratur

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

Examination

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

Övriga krav för slutbetyg

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

Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.

- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.