BB2420 Glycobiology and Carbohydrate Technology 7.5 credits

Glykobiologi och kolhydratsteknologi

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

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

Establishment

Course syllabus for BB2420 valid from Autumn 2016

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Biotechnology

Specific prerequisites

Admission requirements for programme students at KTH:
At least 150 credits from grades 1, 2 and 3 of which at least 100 credits from years 1 and 2, and bachelor's work must be completed. The 150 credits should include a minimum of 20 credits within the fields of Mathematics, Numerical Analysis and Computer Sciences, 5 of

these must be within the fields of Numerical Analysis and Computer Sciences, 20 credits of Chemistry, possibly including courses in Chemical Measuring Techniques and 20 credits of Biotechnology or Molecular Biology.

Admission requirements for independent students:
A total of 20 university credits (hp) in Biotechnology or Molecular Biology. 20 credits of Chemistry, possibly including courses in Chemical Measuring Techniques and 20 credits within the fields of Mathematics, Numerical Analysis and Computer Sciences, 5 of these must be within the fields of Numerical Analysis and Computer Sciences, Documented proficiency in English corresponding to English B.

Language of instruction

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

Intended learning outcomes

Glycobiology and Carbohydrate Technology will provide the student with an overview of carbohydrates (sugars) as an important class of biomolecules involved in numerous biological functions and industrial applications. Knowledge of carbohydrate and glycoconjugate functions, structures, modifications and biosynthesis will prepare the students for problem solving in the areas of food, feed, health, energy and materials. Especially possibilities and challenges related to sustainable development using renewable carbohydrate raw materials will be emphasized. The course is designed to build upon and compliment the student's knowledge of molecular biology/biotechnology, protein structure & function, and molecular enzymology obtained from other courses in the Biotechnology programs.

Carbohydrate structure-function relationships will be highlighted using numerous examples from plant, animal, and microbial systems. Particular attention will be paid to the enzymes responsible for carbohydrate biosynthesis, modification and biodegradation: carbohydrate-active enzymes (CAZymes). The interactions of carbohydrates with various non-catalytic proteins (lectins and carbohydrate-binding modules) will also be covered. Through specific examples and case studies, special focus will be placed on carbohydrate-protein/enzyme interactions in the context of important applications, including: glycoprotein pharmaceutical development, biofuel production, modification of wood and textile fibers, food production and human nutrition, brewing, treatment of inherited metabolic disorders, and treatment/prevention of pathogen infection, including influenza. The acquired complete knowledge base will aid students in their future studies and/or in an industrial employments to forsee future challenges and developments in the scientific area

Upon completion of the course, the student will be able to:

- describe carbohydrate structure on the mono-, oligo-, and polysaccharide organizational levels and discuss the interaction of carbohydrates with other biopolymers as structural components in various cell types

- describe the importance of the pool of sugar phosphates as precursors in carbohydrate biosynthesis

- describe the molecular mechanisms of key enzymes involved in the biosynthesis and biodegradation of carbohydrates across diverse kingdoms

- discuss the structural diversity of carbohydrate-active enzymes and carbohydrate binding proteins in terms of their biological functions, and outline how these biocatalysts can be used in enzyme technology to develop environmentally-friendly sustainable processes in vitro or increase plant biomass in planta

- describe and use the CAZy database, and identify candidate genes encoding enzymes potentially relevant for bioconversion

- describe the biosyntheses of glycoproteins and glycolipids and discuss their diverse biological functions including disease states

- understand and discuss the importance of carbohydrates as raw material for sustainable development and describe molecular details of selected examples of "carbohydrate biotechnology" in biorefinery (biofuels and biofiber), food, and medical applications

- understand and critically evaluate contemporary research literature dealing with various aspects of carbohydrate structure, biochemistry, enzymology, and applications thereof

- explain and discuss influenza pandemics and understand the risk and threat of a new pandemic as well as discuss ethical and social aspects of bioethanol production, enzymatic HFCS conversion, production of gum arabic, use of phytases, GMOs, and lab-modified influenza viruses

Course contents

Disposition

Lectures will form the basis of the course. Attendance of all the lectures is strongly encouraged. Lecture periods will serve as the primary mode of instructor-student interaction, including passing various practical information to the students. A certain amount of time scheduled for lectures will be used for questions/answer sessions, small assignments, discussions and to go over practical assignments. Moreover, short videos will be integrated in order to enhance learning, visualize and explain difficult biological concepts and inspire debate.

Assignments & computer graphics laboratory:
Throughout the course, exercises will be assigned which are designed to improve learning of various topics in the course. These assignments will form the basis for in-class discussion, and successful completion of these assignments will greatly improve chances for success on the final examination. Similarly, a computer graphics laboratory exercise will provide important understanding of structure-function relationships in carbohydrate-active enzymes. Completed and passed assignments may give the students the opportunity to get bonus points for the final examination.

Course literature

Introduction to Glycobiology, 3rd ed., by Maureen E. Taylor & Kurt Drickamer, Oxford University Press, ISBN 0 19 928278 1.
Additional reading material will be distributed during the course.

PDF versions of the lecture slides will be made available after the lectures through the BILDA online resource.

Examination

- TENA - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, F

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.

Other requirements for final grade

To pass the course students should actively participate in course meeting activites and discussions.

The student's final grade in the course will be based on performance on a final written examination. This examination will consist exclusively of essay-style questions which will test the student's overall comprehension of the various topics covered in the course.

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.