# BB2450 The Cell Factory 7.5 credits

**Cellfabriken**

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 BB2450 valid from Spring 2019

## Grading scale

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

## Education cycle

Second cycle

## Main field of study

Biotechnology

## Specific prerequisites

**Admission requirements for program students at KTH:**
At least 150 credits from grades 1, 2 and 3 or 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 or Chemistry, possibly including courses in Chemical Measurement Techniques and 20 credits or Biochemistry, Biotechnology or Molecular Biology.

**Admission requirements for independent students:**
A total of 20 university credits (hp) in Biochemistry, Biotechnology or Molecular Biology. 20 credits or chemistry, including courses in chemical measurement methods and 20 credits in the subjects of mathematics, numerical analysis and computer science, 5 or these must be within the fields of numerical analysis and computer science, documented proficiency in English at Dutch B.

## Language of instruction

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

## Intended learning outcomes

At the end of the course, students should be able to:

- Builds on knowledge of the metabolism in standard industrial workhorses like E. coli and S. cerevisiae and expands to different production systems

- Differentiate cellular organization and signaling systems between prokaryotic and eukaryotic cells

- Describe the function of cellular compartments, in particular, the subcellular localization and integration of metabolic pathways

- Describe prokaryotic and eukaryotic cell factories, including special features of eukaryotic hosts, involve codon usage, post-translational modifications, protein folding, protein processing, disulfide bond formation

- Describe new technologies in synthetic biology and how this has impact in bioproduction

- Described consequences of the complexity and elemental composition of the substrates on the growth of cell gases and how these growth conditions affect metabolic pathways and the cell's accumulation of desired macromolecules

- Describe the flux of carbon in prokaryotic and eukaryotic (including yeast, fungi, algae and higher plants) organisms in relation to carbohydrate metabolism

- Describe pathways specific to certain types of microorganisms whose products have potential industrial applications (eg leading to the production of building blocks and polymers)

- Describe complex gene regulation processes in prokaryotes, plants, and fungi

- Verstaan geïntegreerde pathways en regulatieprocessen voor metabolische engineering van prokaryoten en eukaryoten die leiden tot de productie van biomaterialen

- Understand and describe cultivation processes to produce biologics by engineered organisms, including production of biologics by mammalian cells and by plant-based systems.

## Course contents

- Prokaryotic and eukaryotic cell structure and cellular compartment functions, including subcellular localization or specific metabolic pathway

- Prokaryotic and eukaryotic carbon flux and energy generation, with emphasis on carbohydrate metabolism

- Uptake or substrate and types of transports across biological membrane

- Specific prokaryotic and eukaryotic pathways for the production of cellulose, alginate, cellulose, and peptidoglycans, etc.)

- Regulation of gene expression in prokaryotes (eg operons) and eukaryotes, and exploitation for the manipulation of metabolic pathways

- Metabolic engineering of fungi and plants, with particular emphasis on biomaterials production, including transformation system (eg plastid targeting, Agrobacterium) - emphasis on carbohydrates, plasticizer, lipid derivatives), and punctually on biofuel production

- Exploitation on different cellular systems and their metabolic pathways for the production of energy, biopharmaceuticals, small molecules, biomaterials and vaccines

- Process of mammalian cell-based system (eg Chinese Hamster Ovary cells, HEK293)

- Demonstrator of fed-batch bioreactor process for mammalian cell culture

## Disposition

The course is worth 7.5 credits (ECTS) and runs over a period of approximately 8 weeks. This is equivalent to approximately 200 hours of full-time study, ie approx. 25 hours / week including lectures, journal clubs, tutorials, two assignments, and preparation for the final exam.

## Course literature

Lezing of chapters from the following textbooks is recommended: Biochemistry (Foot and Foot, latest edition); Microbiology: principles and explorations (Black, 7th Edition); Microbial Physiology (Moat et al., 4th Edition); Genes IX (Lewin); Ozturk S and Hu WS (2006) "Cell Culture Technology for Pharmaceutical and Cell-Based Therapies" Taylor and Francis ISBN 0-8247-5334-8

But the course has a wide width and more specialized material will be made available during the course. Materials from one of the following bookkeepers will be offered: Plant Biotechnology, Genetic Engineering of Plants (Slater, Scott and Fowler, 2nd Edition); Microbial production of biopolymers and polymer precursors (Rehm, 1st edition); Plant lipids: biology, utilization and manipulation); etc

## Examination

- KON1 - Intermediate Exam 1, 1.0 credits, grading scale: P, F
- KON2 - Intermediate Exam 2, 1.0 credits, grading scale: P, F
- NÄR1 - Mandatory Participation at Lectures, 1.0 credits, grading scale: P, F
- TEN1 - Written Exam, 4.5 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.

De uiteindelijke score zal gebaseerd zijn op de eindtermen (90% of de uiteindelijke score) en de twee tussenbeoordelingen (vertegenwoordigt totaal 10% van de uiteindelijke score). The course is worth 7.5 ECTS.

Scale: **A to F** , **A** being the **highest** , **F** being a **failing mark**

## Other requirements for final grade

Pass KON1, Assignment, Lab Assignment, and TEN1

KON1- Intermediate Exam, 1.0 credit, grade scale, P, F

Assignment - 1.0 credit, grade scale, P, F

Lab Assignment - 1.0 credit, grade scale, P, F

TEN1-Written Examination, 4.5 credits, grade scale: A, B, C, D, E, FX, F

## 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.