Faculty of Science

KEMM13, Chemistry: Biochemistry - Advanced Course, 15 credits

Kemi: Biokemi - fördjupningskurs, 15 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-09-12 and was last revised on 2007-09-12. The revised syllabus applies from 2007-09-13, spring semester 2008.

General Information

The course is an optional second-cycle course for a degree of Master of Science in Chemistry and Molecular Biology and is a compulsory course for a degree of Master of Science in Protein Science.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Protein Science	A1N, Second cycle, has only first-cycle course/s as entry requirements
Molecular Biology	A1N, Second cycle, has only first-cycle course/s as entry requirements
Chemistry	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

Membrane proteins have a key role in cell energy metabolism and in its signalling and communication with the surrounding environment. 80% of all pharmaceuticals currently in use focus on membrane-bound target proteins. The overall aim of the course is that students will achieve in-depth knowledge and understanding of membrane biochemistry and membrane proteins' structure, topology and functional mechanisms at the molecular level, as well as good knowledge of technical problems when working with membrane proteins.

On completion of the course students shall be able to

- demonstrate good knowledge of the expression, cleaning and handling of membrane proteins and understanding of the similarities and differences that exist in comparison to laboratory work with ordinary soluble proteins
- demonstrate great familiarity with the biochemical processes that take place during membrane energy transformation in photosynthesis and respiration, transport across membranes through uniport, symport and antiport and cellular signalling via ion channel receptors, G-protein coupled receptors and kinase receptors
- describe structures and functional mechanisms for a number of proteins from each group at a molecular level and to account for how the transmembrane gradients, delta psi and ATP can be used to drive different processes
- use bioinformatic and theoretical tools to predict membrane proteins' 2D and 3D structures, such as sequence motif searches, Kyte-Doolittle plot, positive-inside rule and hydrophobic and mutability moment calculations
- demonstrate advanced laboratory skills and the ability to both plan and carry out practical laboratory work, as well as revising plans in relation to the results
- demonstrate excellent informational expertise in the field of biochemistry, involving both the ability to search for specific information about a protein, sifting through information and making a relevant selection and the ability to read and understand original articles and reviews written for a scientific audience

Course content

Lectures: The lectures treat the three main types of membrane proteins and associated cellular processes – transport and transporters, signal transduction and receptors, as well as bioenergetics and photosynthetic and respiratory proteins. A number of proteins from each process, for which the structures are known, are investigated in detail with the aim of highlighting the functional molecular mechanisms. Lectures that deal with methods for theoretical modelling of membrane protein structures, fusion protein techniques, X-ray crystallography, and the expression and cleaning of membrane proteins are also part of the course.

Laboratory work:

- Determination of the transmembrane topology of a membrane protein. First, a model is made of the protein using sequence information and theoretical methods. After this, the topology is experimentally determined by genetically constructing and expressing fusion protein from the membrane protein and a marker protein in a bacterial system, which is then analysed.
- Cleaning a membrane protein with a number of protein subunits and prosthetic groups from bacteria. Laboratory work covers the isolation of membranes from bacteria, solubilisation and evaluation of detergent properties, ion exchange chromatography and gel filtration in the presence of detergents, as well as controls of the protein's stability and integrity during all stages of cleaning.
- A small project, individually planned and carried out over two weeks, during which the student expresses a membrane protein of his/her choice and in some way proves that the expression has been successful. The project involves training in literature searches, project planning and documentation, as well as providing in-depth practical knowledge of expressing and handling membrane proteins.

Course design

Teaching comprises lectures, problem solving exercises and laboratory work. The two first laboratory practicals each involve one week's practical work followed by a written presentation, while the later longer and freer laboratory project is also presented as a common poster presentation.

Assessment

The course is assessed with a written examination at the end of the course. A re-sit examination is offered soon after the examination to students who do not pass.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To be awarded Pass students must pass the examination, pass the laboratory work and participate in all compulsory components.

The examination grades are: Pass with Distinction, Pass or Fail. Grades for the compulsory components are: Pass or Fail.

The final grade for the course is determined by the grade on the final examination.

Entry requirements

To be eligible for this course students must have basic eligibility, and 90 higher education credits in completed Science courses, including passes in courses equivalent to:

- KEM101 General Chemistry 1 15 credits and KEM102 General Chemistry 2 15 credits, or
  KEM111 Chemistry for Environmental and Biological Sciences – General Course 1 15 credits and KEM122 Chemistry for Environmental and Biological Sciences – General Course 2 15 credits, or
  KEMA00 General and Analytical Chemistry 7.5 credits, KEMA01 Organic Chemistry – Basic Course 7.5 credits, KEMA02 Inorganic Chemistry – Basic Course 7.5 credits and KEMA03 Biochemistry – Basic Course 7.5 credits

and

- MOBA02 Chemistry of the Cell 15 credits, MOB102 Chemistry of the Cell 15 credits or KEM114 Biochemistry 15 credits.

Equivalent knowledge that has been gained in another way also provides eligibility for the course.

Further information

The course cannot be credited as part of a degree programme that also includes KEM045 Biochemistry – Advanced Course, 15 credits.

Subcourses in KEMM13, Chemistry: Biochemistry - Advanced Course

Applies from H13

0711 Biochemistry - Advanced Course, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction
0712 Biochemistry - Advanced Course, Compulsory Elements, 7,5 hp
Grading scale: Fail, Pass

Applies from H07

0701 Biochemistry - Advanced Course, 15,0 hp
Grading scale: Fail, Pass, Pass with distinction
0702 Biochemistry - Advanced Course, Compulsory Elements, 0,0 hp
Grading scale: Fail, Pass