Faculty of Science

KEMM23, Chemistry: Advanced Biochemistry, 15 credits

Kemi: Avancerad biokemi, 15 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2019-01-21 to be valid from 2019-01-21, autumn semester 2019.

General Information

The course is an elective second-cycle component of a degree of Master of Science (120 credits) in Chemistry and Molecular Biology and compulsory for a degree of Master of Science (120 credits) 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 play a key role in the cell's energy metabolism and in its signalling and communication with its environment. More than half of all drugs that are in use today target membrane proteins. The main aim of the course is to enable students to acquire specialised knowledge and understanding of membrane biochemistry and the molecular structure, topology and functional mechanisms of membrane proteins.

Knowledge and understanding

On completion of the course, the students shall be able to

- account for the biochemical processes involved in the membrane energy conversion that takes place in photosynthesis and respiration, the transport across membranes through uniport, symport and antiport, cell signalling through ion channel receptors, G-protein coupled receptors and kinase receptors
- describe the structure and functional mechanism of a number of membrane proteins from different groups at a molecular level and account for the use of transmembrane gradients and ATP to run different processes
- account for the expression, purification and management of membrane proteins and explain the differences and similarities compared to laboratory work with common soluble proteins

Competence and skills

On completion of the course, the students shall be able to

- use different bioinformatics and theoretical tools (including sequence and motif searches, multiple alignments, comparisons with known structures, different hydrophobicity calculations and the positive inside rule) to predict the 2D and 3D structure of membrane proteins
- identify the coding sequence and design primers for PCR cloning of prokaryotic target proteins with or without truncations and with or without extensions for affinity purification
- demonstrate advanced laboratory skills by planning and implementing practical laboratory work and revising plans in relation to the results obtained
- summarise and present the content of original articles and reviews in the field of membrane biochemistry
- compile, collate and evaluate information about a specific membrane protein from different sources including literature, sequence and structure databases
- execute a minor individual project and present the results obtained orally and in writing
- present the results obtained in the form of a scientific poster

Judgement and approach

On completion of the course, the students shall be able to

- critically discuss the differences between topological predictions and experimental results
- critically review and discuss the similarities and dissimilarities of membrane proteins

Course content

Lectures 7.5 credits: The lectures address the three different main types of membrane proteins and associated cellular processes: transport and transporters, signal transduction and receptors, bioenergetics and photosynthetic and respiratory proteins. A number of proteins from each process, for which the structure is known, are explored in greater detail in order to highlight the functional molecular mechanisms. Lectures dealing with methods for theoretical modelling of membrane protein structure, fusion protein techniques, X-ray crystallography, heterologous expression, solubilisation and purification of membrane proteins are also included in the course.

Laboratory sessions, exercises and project work 7.5 credits: Determination of the transmembrane topology of a protein starts with a model of the protein based on sequence information and theoretical methods. This is followed by experimental determination using genetic construction and expression of a fusion protein of the membrane protein and a marker protein in a bacterial system which is subsequently analysed.

In silico exercise addressing potential problems concerning the detection of heterologously expressed membrane proteins, solubilisation and evaluation of detergent properties, ion exchange chromatography and gel filtering in the presence of a detergent, and control of the protein's stability and integrity after purification.

Group discussions about e.g. the similarities/dissimilarities, cloning and overexpression strategies, and structure and function of membrane proteins.

An individually planned and executed minor project during two weeks, in which the students express a membrane protein of their choice and demonstrate in some way that the expression was successful. The project entails practice in literature searching, project planning and documentation, and provides specialised practical knowledge of expression and management of membrane proteins. The project is to be concluded with a poster presentation.

Course design

The teaching consists of lectures, exercises, laboratory sessions and project work. Compulsory participation is required in exercises, laboratory sessions, project work and associated elements.

Assessment

The assessment is based on a written exam at the end of the course and on compulsory components throughout the course.

Students who fail an assessment will be offered another opportunity for assessment soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

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.
For a grade of Pass on the whole course, the student must have passed the exam and compulsory components.

The grades awarded for the exam are Fail, Pass and Pass with Distinction. The grades awarded for the compulsory components are Fail and Pass.

The final grade is determined by the grade for the exam.

Entry requirements

To be admitted to the course, students must meet the general entry requirements for higher education and requirements for English proficiency corresponding to English 6 from Swedish upper secondary school, and have passed 90 credits in science courses including courses equivalent to:

- KEMA20 General Chemistry 15 credits, or KEMA10 General Chemistry 7.5 credits and KEMA12 Inorganic Chemistry- Basic Course 7.5 credits, KEMA01 Organic Chemistry- Basic Course 7.5 credits and KEMA03 Biochemistry- Basic Course 7.5 credits, and
- MOBA02 Chemistry of the Cell 15 credits

Students who have obtained the equivalent knowledge by other means may also be admitted to the course.

Further information

The course may not be included with the full number of credits in a degree together with KEMM13 Biochemistry- Advanced Course 15 credits.

Subcourses in KEMM23, Chemistry: Advanced Biochemistry

Applies from H19

1901 Advanced Biochemistry, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction
1902 Advanced Biochemistry, Compulsory Elements, 7,5 hp
Grading scale: Fail, Pass