UNIVERSITY OF GOTHENBURG

DEPARTMENT OF CHEMISTRY AND MOLECULAR BIOLOGY

KEM360 Structure and Dynamics of Biomolecules, 15 credits

Biomolekylers struktur och dynamik, 15 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Chemistry and Molecular Biology on 2013-09-24 and was last revised on 2022-02-21 to be valid from 2022-02-23, spring semester of 2022.

Field of education: Science 100%
Department: Department of Chemistry and Molecular Biology

Position in the educational system

The course can be read as a free-standing course. The course replaces course KEM450, Structural biochemistry, and the two courses may not be counted in together for a degree.
The course is classified at the level 120-180 credits for Degree of Bachelor and is regarded as a course at second cycle level for Degree of Master (120 credits).

The course can be part of the following programmes: 1) Molecular Biology, Master's Programme (N2MBI), 2) Chemistry and learning, Master's Programme (N2KOL), 3) Master's Programme in Organic and Medicinal Chemistry (N2KEL), 4) Master's Programme in Chemistry (N2KEM), 5) Bachelor of Science Programme in Medicinal Chemistry (N1LMK), 6) Bachelor of Science Programme in Chemistry (N1KEM) and 7) Biology, Master's Programme (N2BIO)

Main field of studies	*Specialization*
Chemistry	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

For admission to the course, completed and passed courses comprising 120 credits in the the field of natural science are required including at least 45 credits in the field of

chemistry, in particular passed course KEM060 Biochemistry 1 (15 credits) or equivalent knowledge.

Learning outcomes

After completing the course the student should be able to:

Knowledge and understanding

Part 1:

- **account for** the structure of biomolecules on an advanced level,
- **account fo**r modern biophysics and biomolecular structural research methods and be ready for further research studies on the subject.
- **account for** the concepts of structure-based drug design

Part 2:

- **account for** practical knowledge of methods for characterisation of proteins and determination of their three-dimensional structure,
- **account for** different analytical tools such as molecular graphics and Fourier transformation.

Part 3:

- **account for** several examples where structural biology has had impact on the understanding of cells.
- **account for** the concepts of structure-based drug design

Competence and skills

Part 2:

- **account for** practical knowledge of methods for determination of three-dimensional structure in biomolecules,
- **implement** basic experimental tasks as protein crystallization,
- **interpret, discuss** and **present** laboratory results as well as **draw** reasonable **conclusions**.

Part 3:

- independently and creatively **analyse** structure and function of a protein,
- **identify** and **use** relevant research literature,
- clearly **present** and **discuss,** orally as well as in writing, their conclusions and the knowledge and the arguments they are based upon, in dialogue with different groups, in both national and international contexts.

Judgement and approach

Part 1:

- critically **assess** theoretical possibilities and limitations of various experimental methods.

Part 2:

- critically **assess** the practical possibilities and limitations of different experimental methods.

Part 3:

- critically **assess** the possibilities and limitations of various experimental methods in the literature.

Course content

The course consists of a lecture block on the theory of X-ray crystallography, NMR spectroscopy and Electron Microscopy, which are the major method in structural biology of macromolecules. This is complemented by laboratory exercise in X-ray crystallography, NMR spectroscopy and Electron Microscopy. The third part of the course is a critical analysis of relevant scientific literature using flipped classrooms. The students communicate via written abstracts and give lectures, which is complimented by introductory lectures into the scientific literature to be examined by the teachers.

The emphasis of the course is on experimental methods and can be divided into three parallel sub-courses:

Sub-courses

1. **Methods of structural biology** *(Metoder för strukturbiologi),* 7.5 credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)
   The sub-course provides advanced knowledge of biomolecules with regard to
   - structure,
   - function.

   as well as about the following experimental methods:
   - crystallisation,
   - X-ray diffraction and scattering techniques,
   - nuclear magnetic resonance (NMR) spectroscopy,
   - electron microscopy (EM).

2. **Practical structure analysis of biomolecules** *(Praktisk strukturanalys av biomolekyler),* 3 credits
   Grading scale: Pass (G) and Fail (U)

The sub-course provides advanced practical knowledge of structural analysis with X-ray diffraction techniques, nuclear magnetic resonance spectroscopy (NMR) and electron microscopy.

3. **Applied stuctural biology** *(Tillämpad strukturbiologi),* 4.5 credits
Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)
The sub-course provides in-depth knowledge of the structure of biomolecules in cells:
   - cytoskeleton,
   - ion channels,
   - receptor mechanism of action
   - other proteins with significance in neuroscience

   and additional methods such as:
   - machine learning and structural prediction (ML)
   - structure based drug design (SBDD)

Form of teaching

Part 1: The instruction is given in the form of lectures.

Part 2: The instruction includes laboratory sessions and presentations.

Part 3: The instruction in the form of lectures and individual assignments including a presentation in the form of flipped classroom.

Language of instruction: English
The course is given in English.

Assessment

Part 1: Examination takes place through written examinations. For students who have not passed the regular examination additional examination sessions are offered.

Part 2: Assessment is based on laboratory sessions and presentations.

Part 3: Assessment is done through a written and oral presentation of assignments..

If a student who has has failed the same part of the examination twice wants to change the examiner before the next examination session such request should be submitted in writing to the department and be approved if there are not special causes against this.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Part 1: The grade corresponds to the result from the written examination.

Part 2: To pass are required participation in all laboratory sessions and approved laboratory reports.

Part 3: Grade is decided by project work and presentation.

Final grade: For grade Pass, at least grade Pass in all modules is required. For grade Pass with distinction, in addition grades Pass with distinction on modules 1 and 3 are required.

Regarding application of ECTS scale for grades please see the Vice-chancellor's decision 20070528, dnr G 8 1976/07.

Course evaluation

The course evaluation is done in relation to the expected learning outcomes and contents of the course and is carried out at the end of the course through an individual written questionnaire on the teaching platform of the University of Gothenburg. A student who participates in or has completed a course should be given possibility to anonymously express experiences of and views in the course in a course evaluation. A compilation of course evaluation and reflections of the responsible teacher should be made available to the students within reasonable time after the end of the course. Next time the course is given the compilation and, if applicable, actions taken should be presented for the students.