



Board of Teacher Education  
Chemistry

## Syllabus

### Chemistry and Chemistry Education III

<b>Course Code:</b>	KEGL13
<b>Course Title:</b>	Chemistry and Chemistry Education III <i>Kemi III med didaktisk inriktning</i>
<b>Credits:</b>	30
<b>Degree Level:</b>	Undergraduate level
<b>Progressive Specialisation:</b>	First cycle, has at least 60 credits in first-cycle course/s as entry requirements (G2F)

**Major Field of Study:**  
KEA (Chemistry)

#### Course Approval

The syllabus was approved by the Board of Teacher Education 2017-02-15, and is valid from the Autumn semester 2017 at Karlstad University.

#### Prerequisites

Completed course KEGL01 and attended course KEGL12, or equivalent

#### Learning Outcomes

The aim of the course is that students develop further sound and relevant knowledge in analytical chemistry, biochemistry and chemistry education. The aim of practical placement 1 is to introduce students to school practice and give them the opportunity to develop professional knowledge by processing the relation between theory and practice. The aim of practical placement 2 is that students develop their professional skills by applying evidence- and experience-based knowledge to learning and development.

#### Module 1

Module 1: Analytical Chemistry C, 6,5 ECTS cr

Upon completion of the module, students should be able to:

1. give an account of general analytical processes and formulate, delimit, and interpret an analytical chemical problem,
2. give an account of the theories and models relating to separation in the chromatography, analytical separation process,
3. give an account of the specific experimental conditions and the theory of the most recent applications of liquid chromatography,
4. perform and give an account of the different types of sample preparation depending on analysis and sample matrix components.
5. give an account of underlying causes of the most common sources of interference in the analytical separation system and how these can best be avoided to obtain as robust an analysis as possible,
6. give an account of the possibilities and limitations of modern instrumental separation techniques,

7. conduct methods development and optimise a complete analysis method, including sampling, sample preparation, separation method and detection technique on a basis of a given task.

#### Module 2 Biochemistry and Molecular Biology, 13 ECTS cr

Upon completion of the module, students should be able to:

1. explain the conditions for the most important reactions in cellular metabolism and energy supply based on chemical thermodynamics and, when appropriate, organic-chemical reaction mechanisms,
2. describe a selection of metabolic reaction pathways, their interaction and regulation depending on the physiological conditions and apply organic-chemical reaction mechanisms and chemical thermodynamics to explain the conditions,
3. describe gene expression in prokaryotes and eukaryotes, including different mechanisms for regulating gene expression and cloned genes,
4. describe the biosynthesis of proteins in prokaryotes and eukaryotes,
5. explain basic concepts relating to protein folding and stability based on chemical and statistical thermodynamics,
6. give an account of the chemical basis for enzyme catalysis and apply chemical kinetics to describe enzyme catalysis,
7. describe the most important mechanisms for regulating enzyme activity,
8. plan, perform and report a laboratory investigation in one or several of the areas treated in the course.

#### Module 3 Chemistry education, 4.5 ECTS cr

Upon completion of the module, students should be able to:

1. give an account of and problematise how the school subject chemistry is related to the academic discipline
2. identify chemistry-specific teaching issues and problems related to curricular content and school syllabi
3. analyse and reflect on how pupils' ability to understand chemistry can be handled in the classroom, and
3. critically review textbook units and internet resources.

#### Module 4a Practical Placement 1, 7.4 ECTS cr

Upon completion of the module, students should be able to:

1. act in accordance with the foundational values stipulated in the Swedish Education Act and the national curriculum,
2. explain the meaning of legislation pertaining to teachers' confidentiality and obligation to notify irregularities and relate to school practice,
3. reflect on how the equity and equality perspectives can be integrated in pedagogical activities,
4. communicate professionally with students and staff, both one-on-one and in groups, and both orally and in writing, in ways that are both functional and adequate,
5. under some supervision, plan and conduct teaching on the basis of national curricula and subject knowledge and subject-specific pedagogy,
6. describe special education and students welfare efforts on the basis of local examples
7. describe and reflect on their own teaching and how it relates to national curricula, subject knowledge and subject-specific pedagogy, and
8. give an account of their own professional development and identify their need of further development.

#### Module 4b Practical Placement 2, 7.5 ECTS cr

1. act in accordance with the foundational values stipulated in the Swedish Education Act and the national curriculum,
2. give an account of legislation concerning school obligations to prevent and take measures against bullying and abuse and analyse local school policy on discrimination,
3. under some supervision, integrate a norm critical perspective in pedagogical activities with a focus on equality and equity,
4. communicate professionally with students and staff, both one-on-one and in groups, and both orally

- and in writing, in ways that are both functional and adequate,
5. under some supervision, plan, lead and conduct teaching sequences on the basis of national curricula and subject knowledge and subject-specific pedagogy,
  6. plan and conduct teaching with consideration of students' different circumstances and under supervision reflect on special education needs,
  7. analyse their own teaching and explain how it relates to national curricula, subject knowledge and subject-specific pedagogy,
  8. under supervision assess students' knowledge progress and social situation at school and discuss how this can be communicated with students, guardians and staff,
  9. with some guidance use digital tools in pedagogical activities, and
  10. discuss their own professional development and identify their need of further development.

### **Content**

Module 1: Analytical Chemistry C, 6,5 hp

Instruction is in the form of lectures, exercises, and mandatory laboratory sessions and reports.

The theoretical part of the module includes advanced studies in the following areas:

- survey of analytical separation processes from a regulatory perspective,
- enhanced modern analytical separation theory,
- various liquid chromatography variants such as "reversed phase chromatography", "normal phase chromatography", hydrophilic interaction chromatography, ion pair chromatography and chiral separation of optical isomers
- modern chromatography matrices such as pH-stable phases, semiporous phases, monolites,
- different trends in separation processes: Green modern chromatography techniques,
- survey of empirical and mechanistic modelling of separation processes
- validation of chemical analysis methods,
- sample preparation of analysis components/pharmaceuticals from different sample matrices/preparation formats, and
- detection principles based on molecular spectroscopy and mass spectrometry.

Module 2: Biochemistry and Molecular Biology, 13 ECTS cr

Content treated:

- different types of respiration and fotosynthesis, including the related ATP synthesis and the thermodynamic link between redox, membrane transport, and phosphate transfer reactions,
- fermentation and substrate level phosphorylation, including reaction mechanical and thermodynamic aspects,
- metabolic reaction pathways: gluconeogenesis, pentose phosphate pathway and the Calvin cycle, citric acid cycle, glyoxylate cycle, fatty acid metabolism, overview of the biosynthesis of amino acids with some examples of reactions and an overview of nucleotid metabolism,
- prokaryote and eukaryote gene expression and protein biosynthesis,
- thermodynamic and kinetic aspects of protein stability and folding
- legal framework for genetically modified micro organisms
- the chemical foundations of enzyme catalysis, and
- steady-state kinetics: Michaelis-Menten equation and kinetic description of reversible inhibition of enzymes.

Module 3, Chemistry Education (3 ECTS cr)

Module content:

- education research on students' understanding and conceptions of chemistry
- the scientific nature of chemistry
- analysis of textbooks and digital learning resources in education
- formative assessment of student performance.

Module 4a Practical placement 1 (when chemistry is the first subject studied)

Students have the opportunity to

- meet different groups of staff, for example, teaching teams, student welfare personnel and school management and partiipate in everyday activites,

- apply central regulations and guidelines and local pedagogical planning with consideration of equality and equal opportunities policies,
- apply subject-specific teaching theories and transform subject knowledge into teaching and reflect on the relation between theory and practice,
- use ICT in school,
- make observations,
- discuss and reflect on the profession and professional development,
- describe special education and student welfare efforts in school,
- acquire knowledge of legislation pertaining to confidentiality and obligation to notify irregularities.

Module 4b Practical placement 2 (when chemistry is the second subject)

Students engage in the following activities:

- use IT in school
- make classroom observations
- interpret and implement central steering documents and local pedagogical planning
- apply pedagogical and subject-specific teaching theories and transform subject knowledge into teaching material with consideration of students' different knowledge and interests
- consider the special education perspective
- practise their communicative skills in cooperation with different staff groups and pupils in school
- discuss the profession and their professional development and identify areas to develop in the third practical placement period.

### **Reading List**

See separate document.

### **Examination**

Assessment is based on:

Module 1 Analytical Chemistry C, 6.5 ECTS cr

Learning outcomes 1 3 and 5 6: written exam

Learning outcome 4: active participation i laboratory sessions and a written exam

Learning outcome 7: active participation i laboratory sessions and a report according to instructions within a given time frame.

Module 2 Biochemistry and Molecular Biology, 13 ECTS cr

Learning outcomes 1-7: written exam and individual hand-in assignments.

Learning outcome 8: active participation i laboratory sessions and a report according to instructions within a given time frame.

Module 3 Chemistry Education 3 ECTS cr

Learning outcomes 1 4: hand-in assignments and seminar participation.

Module 4a

Learning outcomes 1, 4 and 5: completed and documented practical placement Learning outcomes 2, 3, 6, 7, and 8: oral and/or written assignments at the university.

Module 4b

Learning outcomes 1, 3, 4, 5, 6, 8. and 9: completed and documented practical placement.

Learning outcomes 2, 7 and 10: oral and/or written assignments at the university.

Attendance is required for the introduction to and the school placement component. The occasional day of absence can be completed on agreement with the module convener. Students who fail to attend more than five days will have to retake the whole module, unless there are special circumstances. The number of retake opportunities for the practical placement is limited to two.

**Grades**

One of the grades Distinction (VG), pass (G) or Fail (U) is awarded in the examination of the course.

**Quality Assurance**

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

**Course Certificate**

A course certificate will be provided upon request.

**Additional information**

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.

Teacher education: Secondary school levels

Replaces KEGL03 effective from the autumn 2016.