

Subject-Specific Criteria of the Technical Committee 09 – Chemistry

*Relating to the accreditation of Bachelor's and Master's degree programmes in chemistry
(as of 29 March 2019)*

The following specifications complement the “ASIIN General Criteria for the Accreditation of Degree Programmes”.

1 Classification

1.1 Function

The Subject-Specific Criteria (SSC) of the Technical Committee for Chemistry have the premise that the intended learning outcomes formulated and aspired by Higher Education Institutions in their own responsibility and in accordance with their academic profile with regard to the study programmes submitted for accreditation form the central yardstick for their curricular evaluation.

In addition, the Subject-Specific Criteria of all ASIIN Technical Committees fulfil a number of important functions:

The SSC are the result of a regular assessment carried out by ASIIN Technical Committees, which summarise what is understood as good practice in higher education in a professional community supported equally by academia and professional practice and what is demanded as future-oriented training quality in the labour market. The expectations outlined in the SSC for the achievement of study objectives, learning outcomes and competency profiles are not static. Rather they are subject to a constant examination in close co-operation with organisations of the specialized Community, like associations of faculties and university departments, professional societies and federations of the professional practice.

Thus, the Subject-Specific Criteria (SSC) of the Technical Committee for Chemistry were developed under consideration of the recommendations of the Society of German Chemists (GDCh) for the introduction of Bachelor's and Master's courses in the area chemistry.

In addition, the Technical Committee 09 – Chemistry cooperates closely with the European Chemistry Thematic Network (ECTN) at the European level, and its SSC are in agreement with the ECTN guidelines for the award of the Eurobachelor® and Euromaster® labels.

The SSC are thus also internationally enacted and coordinated and contribute to the realisation of the European Higher Education Area. The SSC take up demands of the European "Bologna 2020" strategy to formulate subject-specific, discipline-oriented learning outcomes as one of the most important instruments for the promotion of academic and professional mobility in Europe as a quality requirement. The SSC take into account, among other things, the diverse preparatory work within the framework of European projects (e.g. "Tuning") and specialist networks.

Against this background, the learning objectives and competences for Bachelor's and Master's degree programmes in chemistry as described in Section 2 of this SSC are intended as support for application and assessment in accreditation procedures.

1.2 Collaboration of the Technical Committees

The Technical Committee Chemistry works together with the other Technical Committees of ASIIN, mostly to consider the requirements of interdisciplinary study programmes. The universities are called upon to submit their assessment of the assignment of one or several Technical Committees in the course of the application for an accreditation procedure.

Degree programmes with a proportion of more than 50 percent of chemistry content are overseen by the Technical Committee Chemistry, which is, as a rule, in charge of the accreditation procedure and seeks advice of experts from other areas, if needed. When it comes to interdisciplinary study programmes with a weighted share of chemistry contents (below, up to, and including 50%) the Technical Committee Chemistry and the disciplines involved are jointly responsible or simply provide auditors.

2 Educational Objectives for Chemistry Degree Programmes

The educational objectives are outlined by the description of the learning outcomes required by the graduates for practising their profession or for post-graduate studies. The outcomes vary in extent and intensity in accordance with the differing objectives of Bachelor's and Master's programmes.

2.1 Requirements for Bachelor's Degree Programmes

Successfully completed Bachelor's degree programmes are to facilitate early professional careers (professional qualification) as well as qualify the graduates for advanced scientific degree programmes or additional degree programmes other than in chemistry.

2.1.1 Specialist competences

Graduates of Bachelor's degree programmes in the field of chemistry:

- have gained chemistry-relevant **fundamental knowledge of mathematics and the natural sciences**,
- have sound knowledge of the **core subjects of chemistry** including inorganic, organic and physical chemistry, as well as of analytical chemistry,
- have gained knowledge in one or several other **special areas** in the natural sciences or humanities,

- are able to carry out **practical chemistry work** and have learnt how to handle chemicals independently and safely in lab work,
- have knowledge of **safety and environmental issues** and the legal fundamentals,
- have gained **methodological competence** in chemistry and are able to apply this in other contexts, and
- have **interdisciplinary** knowledge and skills, such as in economics, ethics or philosophy.

Such graduates are able to

- **obtain, interpret and evaluate data** of scientific and technical relevance, and to draw sound conclusions, which **take into account scientific, technological and ethical findings**,
- **solve problems** of a scientific/application-oriented nature independently, and to present the results, as well as
- pursue **lifelong learning**.

2.1.2 Social competences

Graduates of Bachelor's degree programmes in the field of chemistry:

- are able to **communicate** with colleagues working in the field as well as with the broader public, about chemistry-related contents and problems, also in a foreign language and on an intercultural basis,
- are aware of social and ethical **responsibility** in their actions and are familiar with the professional ethical principles and standards of chemistry,
- are able to work both alone and as a member of international, mixed-gender **groups**,
- are familiar with the basic principles for conduction of **projects** and able to **develop appropriate leadership responsibility** and
- are prepared for entry to professional life in an industrial or academic environment, through adequate **practical relevance** of the degree programme.

2.2 Requirements for Master's Degree Programmes

As a continuation of an initial university degree, Master's degree programmes lead to the acquisition of advanced analytic-methodical competences. At the same time, the technical competences acquired in the first study cycle are advanced and extended.

2.2.1 Specialist competences

Graduates of Master's degree programmes in the field of chemistry:

- have **deepened** their knowledge in core subjects, special subjects or interdisciplinary subjects,

- have knowledge building up on a Bachelor's degree level in chemistry, which forms a basis for original and competent **development and implementation** of ideas within a research area and
- have competences qualifying them professionally, e.g. to work as a **chemist** in industry or public service.

Such graduates are able to

- **carry out independent scientific work** as well as
- apply their knowledge and understanding, in order to **solve problems in new and unaccustomed situations**, involving broader (or multidisciplinary) issues.

2.2.2 Social competences

Graduates of Master's degree programmes in the field of chemistry (beyond the social competences specified for the Bachelor's degree programmes):

- have acquired a capacity to carry out independent scientific work and to organise, conduct and lead **more complex projects**,
- have acquired scientific, technical and social competences (abstraction ability, systems analytical thinking, capacity for teamwork, ability to communicate, international and intercultural experience etc.), and are therefore prepared to take on **leadership responsibility**,
- can combine and independently apply specialised knowledge in various component disciplines, in order to organise, work on and manage **complex problems**,
- are also capable of making **decisions**, based on incomplete or limited information and
- take into account ethical **responsibility** in their decisions.

3 Curriculum

3.1 Bachelor's Degree Programmes

The Bachelor's degree programme offers an introduction to the core subjects of chemistry including inorganic, physical and organic chemistry, as well as to analytical chemistry. The programme also provides adequate course offerings conveying fundamentals in the natural sciences and information technology, particularly in physics, mathematics/informatics. Corresponding modules are appropriately adapted to the specific requirements of an education in chemistry.

In specialist degree programmes (e.g. biochemistry, macromolecular chemistry, technical chemistry), some contents of traditional, general course offerings in chemistry may give way to more intensive teaching and study of the fundamentals and features of the specialisation. This is also reflected in the name of the degree programme.

A broad field of professionally qualifying specialisation options results from integration of subjects with a bioscience, information science or engineering orientation, or also from integration of economic science, educational science or media-related courses.

3.2 Master's Degree Programmes

Master's degree programmes build up on Bachelor's degree programmes and offer technically advanced or specialised education either in chemistry or another subject (e.g. other subjects focussing on technology, natural sciences, economics etc.). The specific design of Master's degree programmes is orientated on the specific strengths of the offering university.

4 Designation of the Degree Programmes

The various possibilities for new orientation and specialisation in the new degree programmes in chemistry require the designation of degree programmes to reflect their central contents.

5 Annex 1 – Eurobachelor®*

5.1 Learning Outcomes and Fields of Knowledge

It is expected that graduates of Bachelor's degree programmes in chemistry have dealt with the following fields of knowledge. As these fields are frequently dealt with in different modules, the following table is to serve the purpose of verification of the allocation of areas to modules.

Field of knowledge	Dealt with in module
a) Major aspects of chemical terminology and nomenclature; rules and units	
b) The major types of chemical reaction and the main characteristics associated with them	
c) The principles and procedures used in chemical analysis and the characterisation of chemical compounds	
d) The principal techniques of structural investigations, including spectroscopy	
e) The characteristics of the different states of matter and the theories used to describe them.	
f) The principles of thermodynamics and their applications to chemistry	
g) The principles of quantum mechanics and their application to the description of the structure and properties of atoms and molecules	
h) The kinetics of chemical change, including catalysis; the mechanistic interpretation of chemical reactions	
i) The characteristic properties of elements and their compounds, including group relationships and trends within the Periodic Table	
j) The structural features of chemical elements and their compounds, including stereochemistry	
k) The properties of aliphatic, aromatic, heterocyclic and organometallic compounds	
l) The nature and behaviour of functional groups in organic molecules	
m) Major synthetic pathways in organic chemistry, involving functional group interconversions and carbon-carbon and carbon-heteroatom bond formation	
n) The relation between bulk properties and the properties of individual atoms and molecules, including macromolecules (both natural and man-made), polymers and other related materials	

o) The structure and reactivity of important classes of biomolecules and the chemistry of important biological processes.	
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* Universities having applied for the Eurobachelor®/Euomaster® Label are compelled to complete this Annex. The assessment for the award of these labels is based on the criteria set forth by the European Chemistry Thematic Network Association (ECTN).