Fachausschuss Biowissenschaften

ASIIN e.V.

SUBJECT-SPECIFIC CRITERIA

Relating to the accreditation of Bachelor's and Master's degree programmes in life sciences

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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 Life Sciences have the premise that the intended learning outcomes framed by Higher Education Institutions in their own responsibility and according to their academic profile concerning the programmes submitted for accreditation build the main scale for their curricular review.

Above this the Subject-Specific Criteria of all ASIIN Technical Committees meet a number of important functions:

The SSC are the result of an assessment, regularly performed by ASIIN Technical Committees, which summarize what is considered as good practice by a professional community formed equally by academics and professional practitioners in higher education and is required as future-oriented quality of training in the labour market. The expectations outlined in the SSC for the achievement of study objectives, learning outcomes and competency profiles are not developed statically. They are rather subject to constant review in close cooperation with organizations of the professional community, such as associations of faculties and university departments, professional societies and federations relating professional practice. Applicant universities are asked to study critically the interaction between the intended learning outcomes they strive for, the curricula and their relating quality expectations by using SSC and to position themselves in the light of their own higher education goals.

In their role in the accreditation process the SSC also provide a professionally elaborated basis for discussion among experts, Higher Education Institutions and bodies of ASIIN. By this they make an important contribution to the comparability of national and international accreditation procedures, since it should not be left to chance of the characters of the individual evaluators which technical parameters find their way into discussion and individual assessment. Simultaneously the SSC enumerate those abilities, skills and competencies which may typically be considered as state of the art of a discipline, but which can always be exceeded and varied, and also should be in accordance with the objectives of the university.

For inter- and multidisciplinary studies the SSC of ASIIN can provide orientation for presentation and evaluation. However, they are basically aligned on the core subjects of particular disciplines.

The SSC of the ASIIN are positioned and coordinated internationally and thus contribute to the achievement of the unified European Higher Education Area. They act on requirements of the "Bologna 2020" European strategy to formulate subject specialized, discipline-oriented learning outcomes as one of the most important means for the promotion of academic and professional mobility in Europe as quality requirement. The SSC consider, among others, the many preparations in the context of European projects (e.g. "Tuning") and professional networks.

In this context, the educational objectives and competencies for Bachelor's and Master's degree programmes in life sciences described in the following sections should be a support tool for the application and the assessment in the accreditation process.

1.2 Responsibility

While the "inanimate" part of nature is covered by independent sciences such as physics, chemistry, geosciences etc., the entire "animate" part of nature is covered by numerous heterogeneous subdisciplines of a single discipline: biology. The dynamic development of interdisciplinary research (e.g. biochemistry, biomedicine, biotechnology, the environmental sciences, nanobiotechnology and even bioinformatics) has led to a far-reaching differentiation in the content of biological degree programmes. The new collective term life sciences not only includes all the "classical" disciplines (e.g. botany, human biology, microbiology, zoology) and their derivative disciplines (e.g. biodiversity and ecosystem research), but also includes "modern" disciplines of biology (e.g. bionics, molecular biology, neurogenetics and others), as well as newly structured teacher training degree programmes. Degree programme planners therefore face the challenge of meeting the progressively increasing growth of knowledge in biology and its related areas with a continuous adaptation of course contents.

1.3 Collaboration of the Technical Committees

The Technical Committee 10 – Life Sciences (TC 10) works together with the other Technical Committees of ASIIN, primarily to meet the requirements of interdisciplinary study programmes. The responsibilities of TC 10 should be defined, if necessary in cooperation with other Technical Committees of ASIIN, particularly with regard to the diversity of degree programmes in the life sciences and the frequent integration of life science components in other natural science, technical or interdisciplinary degree programmes.

In the course of application for an accreditation procedure, higher education institutions are asked to select appropriate allocation to one or several Technical Committees according to the following classification system:

- **Type 1** Degree programmes with a life science proportion of *at least 65 per cent* (e.g. biology, biomedicine),
- **Type 2** Degree programmes with a life science proportion of *at least 50 per cent* (e.g. biochemistry, biotechnology),
- **Type 3** Interdisciplinary degree programmes with a *smaller life science proportion* (e.g. bioinformatics, bioprocess engineering).

Responsibility for accreditation is divided as follows for these three degree programme types

- **Type 1** TC 10 has sole responsibility, specialised auditors from other areas if appropriate
- **Type 2** TC 10 is responsible or jointly responsible in consultation with the Technical Committee of another subject area involved in the individual case
- **Type 3** TC 10 is jointly responsible with the specialised disciplines involved or only provides specialised peers

2. Educational Objectives - Competences

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. These outcomes vary in extent and intensity in accordance with the differing objectives of Bachelor's and Master's degree programmes.

In the life sciences, two basic types of Bachelor's degree programmes can be distinguished: 1. A general education biology Bachelor (possibly even sufficiently polyvalent to permit a teacher training degree) and 2. a basic subject-specific Bachelor (e.g. molecular biotechnology), which offers specialisation at the cost of a more general education.

TC 10 considers the special challenge of the design of basic subject-specific Bachelor's degree programmes despite a more specialised education, to nevertheless provide graduates with adequate fundamental knowledge. This is to ensure good chances of successful further professional development, even if scientific developments should change quickly.

As far as Master's degree programmes are concerned however, an individual focus on a subject appears essential, especially with regard to preparation for an academic career with a doctorate, but also with regard to concrete professional orientation.

2.1 Requirements on Bachelor's Degree Programmes

A successfully completed Bachelor's degree programme is intended on the one hand to allow an early career start (professional qualification), and on the other hand to qualify graduates for an advanced scientific degree programme or an additional degree programme in a field other than biology.

The general criteria of ASIIN demand clear statements by the institutions of higher education about the practical orientation and professional qualification of the particular degree programme. This is of special significance in view of the complexity and heterogeneity of an academic education in the life sciences described earlier.

Specialist competences

Graduates of Bachelor's degree programmes in the area of the life sciences:

- have acquired sound **fundamental biology-relevant knowledge of mathematics and the natural sciences**,
- have sound knowledge of the **fundamentals** of **molecular, cell** and **organismic biology**,
- have gained **methodological competence** in bio sciences and are also able to apply this in other contexts,
- are able to carry out **practical work in labs and outdoors** independently as well as **handle organisms**,

- have relevant knowledge of **safety and environmental issues as well as the associated legal fundamentals**,
- have gained sound knowledge in **at least one special life science area** of the degree programme,
- are able to **recognise** and **solve subject-relevant problems**,
- are able to **solve life science problems** and **present the results**.

Social competences

Graduates of Bachelor's degree programmes in the area of the life sciences:

- have trained **conceptual, analytical** and **logical** thinking,
- have an **awareness of** possible social, ethical and environment-related **effects of their actions**,
- have acquired **communication skills** – also in a foreign language – and can communicate scientific information to experts and laypersons in a suitable manner,
- have a capacity for **teamwork**, also on an intercultural basis,
- have acquired **lifelong learning** strategies.

2.2 Requirements on Master's Degree Programmes

Building up on a first higher education degree, a Master's degree programme leads to the acquisition of advanced analytical and methodological competences. At the same time, subject-related and social competences gained in first degree programme are deepened and extended.

Specialist competences

Graduates of Master's degree programmes in the area of the life sciences:

- have **advanced** their **knowledge** in core subjects, subject-relevant or interdisciplinary subjects;
- are in a position to **discuss** complex life science issues as well as **own research results** comprehensively and in the context of current international research **and present** these in writing (e.g. Master's thesis, scientific publication) and orally (e.g. lecture with free discussion);
- have gained subject-specific and interdisciplinary **problem solving competence**.

Social competences

Graduates of Master's degree programmes in the area of the life sciences:

- have gained the ability to combine specialised knowledge of various component disciplines, **carry out independent scientific work** and organise, conduct and lead **more complex projects** as well as publish the results;
- have acquired social competences, such as abstraction ability, systems analytical thinking, capacity for teamwork, ability to communicate, international and intercultural experience and others, and are therefore especially prepared to take on **leadership responsibilities**;
- are in a position to also assess the social and environment-related **effects of their actions**.

3. Curriculum

The design of specific curricula has to be based on the particular objectives of the degree programme and the desired learning outcomes. On the one hand, this section specifies exemplary teaching contents, relating to the competences specified in Section 2, which depend on orientation and objectives of the degree programme. On the other hand, important basic conditions favourable for reaching the typical objectives of degree programmes in the life sciences are stated.

For further orientation, these SSC also include an annex containing an exemplary catalogue of curricular contents with teaching and learning forms, classified according to Bachelor's and Master's degree programmes as well as specialist and social competences.

Basic **biological course contents** of a broad biology degree programme include:

- Biology and function of the cell and sub-cellular systems,
- Genetics, evolution and systematic of microorganisms, fungi, plants and animals,
- Structure, function, development and behaviour of organisms,
- Ecology, biosystems research,
- Aspects of applied biology and biotechnology.

Non-biological course contents particularly include basic and for the degree programme necessary advanced principles and methods in the fields of chemistry, physics, informatics and mathematics (incl. statistics), since these are required for an understanding of biological issues and work methods. Corresponding modules are adapted to the specific requirements of life scientists.

Relevance of any **non-biological contents** to the particular degree programme objectives should be recognisable. These include for instance:

General educational sciences	Cultural landscape protection and non-biological environmental protection	Environmental sciences
Soil science	Food chemistry	Process engineering
Chemistry	Oceanography	Administrative sciences
Ergonomics/occupational medicine	Politics/administrative sciences	Economic sciences
Ethnology	Philosophy	History of science
Geography	Psychology	
Geology	Media studies	
Engineering sciences	Law	
Cybernetics	Sociology	

Biological safety is ideally an essential component of an education in the life sciences. Safety-relevant topics included in interdisciplinary contents are:

- Introduction to significant laws and regulations
  (e.g. labour protection law, lab guidelines, ordinance on biomaterials, ordinance on hazardous substances, genetic engineering law, nature protection law, radiation protection law, animal testing guideline, animal protection law)
- Organisation of safety and health protection in the lab
- Liability and responsibility

- Safety aspects and protective measures for laboratory activities
  (e.g. GLP, instruction of employees, operating procedure, building and equipment)
- Hazard assessment (e.g. biosafety/biosecurity)

Optimal professional preparation can be achieved by integration of professionally usable certificates (e.g. officially recognised courses for gaining competence as a project leader or officer for biological safety according to Section 15 of the Genetic Engineering Safety Regulations (§15 GenTSV), for competence in animal protection according to Section 8b of the Animal Welfare Act (§8 b TierSchG), or in radiation protection according to Sections 31-33 of the Radiation Protection Ordinance/Sections 13-15 of the X-ray Ordinance (§§31-33 StrlSchV/§§13-15 RöV).

For the life sciences, the acquisition of **key competences** or so-called soft skills should ideally be integrated in specialised modules as well as practical/research phases.

3.1 Curricular Requirements for Bachelor's Degree Programmes

The following points are formulated as aids for the design of curricula of Bachelor's degree programmes in the life sciences:

- A significant proportion of practical work, appropriate for the desired learning outcomes, in the attendance components of the degree programme ensures achievement of solid competence in practical methodology (e.g. experimental practicals, exercises, project work, excursions and field courses if appropriate). These can be considered as a typical, common feature of the otherwise broad field encompassed by the life sciences. Applicants are asked to state the proportion of demonstration and experimental practicals in the self-assessment.
- Interdisciplinary key qualifications are taught in a life science context (e.g. scientific research, relevant specialised English, communication and management competences, bioethics; the Bachelor's thesis can be associated with a prior experimental phase, particularly in view of the aspired professional qualification and the typical features of an academic education in the life sciences.

A broad field of professionally qualifying specialisation options is obtained by integration of biomedicine-oriented or natural science subjects in the curriculum of a broad Bachelor's degree programme in the life sciences, or also by integration of economic science, educational science or media-related courses. In specialist degree programmes (e.g. biochemistry, macromolecular chemistry, technical chemistry) some contents of traditional, general course offerings in biology may give way to more intensive teaching and study of the fundamentals and features of the specialisation. This is also obvious from the name of the degree programme.

3.2 Curricular Requirements for Master's Degree Programmes

The following points are formulated as aids for designing curricula of Master's degree programmes in the life sciences:

- The diversification of degree programmes in the life sciences in terms of subjects, especially on a Master's degree level, means that the admission requirements, taking into account previous education in the field and measures taken to harmonise a previous heterogeneous education, are of particular importance. A coherent overall concept is considered essential. This should aim to provide a high standard of education and offer students individual support in making up for any lacking previous knowledge.
- A significant proportion of practical work, appropriate for the desired learning outcomes, in the attendance components of the degree programme ensures achievement of solid

competence in practical methodology (e.g. experimental practicals, exercises, project work, excursions and field courses if appropriate). These can be considered as a typical, common feature of the otherwise broad field encompassed by the life sciences. Applicants are asked to state the proportion of demonstration and experimental practicals in the self-assessment.
An opportunity to do external work placements is useful for occupational orientation.

- Due to the broad scope of subjects, particularly in the life sciences, and the great number of possible specialisations, the convention of stating the educational objectives and the key subject areas with the name of the degree programme, is of special importance for Master's degree programmes.
- Graduates of Master's degree programme in the life sciences will generally be faced with the challenge of being able to be active in an international environment. English-language events (e.g. seminars) and opportunities to spend time abroad are very helpful in this context.

Annex – Exemplary statement of curricular contents

The annex to the SSC of Technical Committee 10 – Life Science (TC 10) is concerned with the learning outcomes and competence objectives of graduates of Bachelor's and Master's degree programmes specified in the SSC and includes an exemplary list of suitable curricular contents. The information provided in the following tables is intended as an **exemplary orientation aid** for designing degree programmes. It is provided to support higher education institutions in their own responsibility of concrete specification of educational objectives, profile development and organisation of their degree programmes, as well as of assignment of curricular contents. The information should on no account be considered as a *checklist* or limitation for degree programme planners. TC 10 explicitly welcomes innovative further development of contents and measures. Teaching and learning forms should aim to promote the intrinsic motivation of students.

1. Bachelor's degree programmes

Specialist competences	Curricular contents, teaching and learning forms, exemplary
Sound fundamental knowledge of mathematics and the natural sciences with relevance to the life sciences	Basic and for the degree programme relevant advanced principles and methods in the fields of chemistry, physics, informatics and mathematics (incl. statistics), necessary for an understanding of life science issues and work methods. Corresponding modules should be adapted to the specific requirements of life scientists, convey practice-relevant contents and therefore also include exercises, practicals or other methods to be selected by the applicant, in addition to lectures.
Knowledge of the fundamentals of molecular, cell and organismic biology	An exemplary statement of the most important subdisciplines is provided below: The proportions can be varied depending on the degree programme: ◦ Biology and function of the cell and sub-cellular systems ◦ Genetics, evolution and systematics of microorganisms, fungi, plants and animals ◦ Structure, function, development and behaviour of organisms ◦ Ecology, biosystems research ◦ Aspects of applied biology and biotechnology Promotion of intrinsically motivated learning and consolidation by proactive study of contents can e.g. be achieved by inclusion of exercises, practicals or other methods to be selected by the applicant.
Acquisition of methodological competence in the life sciences, as well as the ability to apply this in other contexts. Capability of carrying out independent scientific work in labs and outdoors, as well as with regard to handling organisms	Practice-oriented contents based on the subject-related fundamentals referred to above should be conveyed. Attendance components can include practical work (experimental practicals, exercises, project work, excursions and field courses) and others. Applicants are asked to state the proportion of demonstration and experimental practicals in the self-assessment.
Sound knowledge in at least one special area of the degree programme	A diversification in terms of subjects/disciplines can be achieved by optional advanced study areas (compulsory elective subjects).
Relevant knowledge of safety and environmental issues as well as	Introduction to significant laws and regulations concerning lab safety (GLP), concerning biological safety issues, concerning hazard as-

the associated legal fundamentals	sessment, concerning the genetic engineering law and other subject-specific basic legislation in accordance with the necessary contents of the developed degree programme. This can also apply to related natural science subjects, e.g. hazardous materials studies or radiation studies. For instance: ◦ Consideration of significant laws and regulations – depending on the profile of the degree programme (e.g. labour protection law, lab guidelines, ordinance on biomaterials, ordinance on hazardous substances, genetic engineering law, nature protection law, radiation protection law, animal testing guideline, animal protection law) ◦ Consideration of safety aspects and protective measures for laboratory activities (e.g. GLP, instruction of employees, operating procedure, building and equipment) as part of practical training ◦ Consideration of biological safety issues (biosafety/biosecurity), hazard assessment with regard to organisms and activities as part of practical training Consideration of the aspects referred to above can take place in the form of lectures or in a practical environment. This can facilitate early and effective familiarisation with essential safety standards.
Capability of recognising and solving subject-relevant problems	Depending on the design of the specific degree programme, this goal may be reached by e.g. project-oriented work, career preparatory studies or external work placements with potential employees if appropriate.
Capability of solving a scientific problem and presenting the results thereof	The Bachelor's thesis encompasses an independent achievement by the student; this can be associated with a prior experimental phase, particularly in view of the aspired professional qualification.
Capability of doing literature research, of engaging in scientific discussion; presentation competence	e.g. Seminar with preparation, integration in lab meetings, defence of the Bachelor's thesis

Social competences	**Curricular contents, teaching and learning forms, exemplary**
Conceptual, analytical and logical thinking	e.g. Lecture series on work, concepts and ways of thinking typical for different specialised disciplines; exercises in experimental planning, project conception, analysis of scientific literature, or similar
Awareness of possible social, ethical and environment-related effects of actions	Depending on the orientation of the specific degree programme, interdisciplinary social competences can be taught in a life science context (e.g. bioethics, environmental protection). Examples: interfaculty events, together with philosophers, representatives of the ethics committee of the university, DFG (German Research Foundation) liaison officer, or similar.
Acquisition of communication skills – also in a foreign language – and ability to appropriately communicate scientific information to experts and laypersons	Interdisciplinary events integrated in a life science context, e.g. about: scientific research, relevant specialised English, communication and management competences. Seminar lecture; poster presentation; moderation of discussion rounds or similar.
Capacity for teamwork, also on an intercultural basis	e.g. Project-oriented work in small groups, joint poster presentation or similar; stays abroad
Acquisition of lifelong learning	e.g. Interdisciplinary events in education/psychology;

strategies	information about options of further extracurricular education; information about career paths inside and outside academia

2. Master's degree programmes

Specialist competences	Curricular contents, teaching and learning forms, exemplary
Advancement of knowledge in core subjects, subject-relevant or interdisciplinary subjects; advancement of practical methodological competence	Practical work can include e.g. experimental practicals, exercises, project work, excursions and field courses if appropriate.
Capability of carrying out independent scientific work in selected areas of the life sciences	Practicals can be conducted e.g. in small groups or with individual supervision, with a progressive increase in the responsibility for conducting the practical work assumed by the students. An adequate proportion of compulsory elective subjects allows individual specialisation (e.g. by project and course work). The Master's thesis encompasses an independent scientific achievement appropriate in depth to the level of education. It could therefore be associated with a prior experimental phase, particularly in view of the aspired professional qualification.
Relevant knowledge of safety and environmental issues as well as the associated legal fundamentals	The knowledge and skills in the area of biological safety acquired in the Bachelor's degree programme can be deepened with practical orientation. In view of professional qualification, it appears appropriate for the graduates to be able to acquire professionally usable certificates (e.g. officially recognised courses for gaining competence as a project leader or officer for biological safety according to Section 15 of the Genetic Engineering Safety Regulations (§15 GenTSV), for competence in animal protection according to Section 8b of the Animal Welfare Act (§8 b TierSchG) or in radiation protection according to Sections 31-33 of the Radiation Protection Ordinance/Sections 13-15 of the X-Ray Ordinance (§§31-33 StrlSchV/§§13-15 RöV).
Acquisition of subject-specific and interdisciplinary problem solving competence	e.g. Independent scientific research, project-oriented work, also in a research-related and/or interdisciplinary setting

Social competences	Curricular contents, teaching and learning forms, exemplary
Ability to organise, conduct and lead complex projects, as well as to present and publish the results	e.g. Events/exercises in project planning, project leadership, project management or similar; course work, poster presentations, short lectures, writing a scientific article (journal contribution) or project application or similar
Abstraction ability, systematic thinking, capacity for teamwork, ability to communicate, international and intercultural experience with the resulting preparation for taking on leadership responsibility	Examples: evaluation and summarisation of original scientific work; group work phases; project lessons, result presentations as lectures or discussions; brainstorming, mind maps etc. English-language events (e.g. seminars) and opportunities (time windows) for stays abroad
Capability of estimating the social and environment-related effects	Depending on the design of the specific degree programme: Interdisciplinary events e.g. on bioethics or environmental protection.

of their actions	Inter-faculty events, e.g. together with philosophers, representatives of the ethics committee of the university, DFG (German Research Foundation) liaison officer, or similar.