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Subject-Specific Criteria of the Technical Committee 13 – Physics

relating to the accreditation of Bachelor's and Master's degree programmes in physics and related degree programmes orientated on physics

(adopted: 09 December 2016)

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 Physics 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 accredita-

tion 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.

1.2 Collaboration of the Technical Committees

The Technical Committee Physics works together with the other Technical Committees of ASIIN, mostly to give consideration to 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.

The field of responsibility of the Technical Committee comprises two focal points – on the one hand the principally research-oriented university degree programmes “Physics” and on the other hand the degree programmes “Physical Technology”, mostly offered by universities of applied sciences which are, as a rule, application-oriented. It is not possible to define general rules for additional degree programmes, where it needs to be decided in the single case, on the basis of which educational elements the objective of the studies can be reached best.

Based on sound knowledge of the fundamentals of mathematics and physics, the degree programme “Physical Technology” provides application-oriented knowledge including modern physical developments. The respective Subject-specific Criteria were created by the Technical Committee 5 (Physical Technologies, Materials and Processes). They are updated in collaboration with the Technical Committee 13, whereby a special focus is on the assurance of a comprehensive and well-founded education in the fundamentals of physics.

As to degree programmes particularly close to the degree programme “Physics”, the Subject-specific Criteria issued by the Technical Committee 13 are to be considered with a view to the concept of the degree programme and the stipulation of transition rules.

2 Educational Objectives and Learning Outcomes

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 physics. With their knowledge and skills graduates of Bachelor's degree programmes in physics have a qualification based on sound fundamentals of natural sciences and mathematics, certain key qualifications, and a high degree of flexibility which, in particular, provides an excellent basis for further qualification and specialisation. They are principally qualified to complete corresponding Master's degree programmes. This means in detail that:

- They have sound knowledge of classical physics (mechanics, electrodynamics, thermodynamics, vibrations, waves and optics) and are familiar with the fundamentals of quantum, atomic and molecular, nuclear, elementary particle and solid state physics.

- They are familiar with important mathematical methods used in physics and can use these to solve physics problems.

- They have an extensive understanding of the fundamental principles of physics, their inherent relation and mathematical formulation and, based on this, have acquired methods suitable for theoretical analysis, modelling and simulation of relevant processes.

- They have applied their knowledge to physics problems in an exemplary manner and studied some areas in greater depth, thereby acquiring a first basis for problem solving competence.

- They have a basic capacity to comprehend physics problems. This will in general however not yet facilitate a deeper understanding of current research areas.

- They are therefore in a position to independently classify physics-based and to some extent also interdisciplinary problems that require a target-oriented and logic-based approach, and to analyse and/or solve them by using natural scientific and mathematical methods.

- They are familiar with basic principles of experimentation, are able to use modern physics measurement methods, and are in a position to assess the significance of results correctly.

- They have generally also acquired an overview knowledge in selected other natural science subjects or technical disciplines.

- They are able to apply their knowledge to different fields and act responsibly in their professional activity. They are moreover able to recognise new trends in their subject area and integrate the relevant methodology – possibly after appropriate qualification – into their further work.

- They are able to continuously and self-reliantly extend and deepen the knowledge acquired in the Bachelor's degree programme. They are familiar with suitable learning strategies (lifelong learning) for this; they are in particular capable of a consecutive Master's degree programme in principle.

- They have gained initial experience with regard to generic qualifications (e.g. time management, study and work techniques, willingness to cooperate, capacity for teamwork, ability to communicate and communication techniques, rules of good scientific practice) in their degree programme, and are able to develop these skills further.

- They are familiar with the basic elements of the relevant specialised English.

- They are able to solve a simple scientific problem and to present their results orally (lecture) and in writing (demonstrated in a Bachelor's thesis).

2.2 Requirements for Master's Degree Programmes

As a continuation of an initial university degree, Master's degree programmes lead to the development and extension of the analytical-technical competences acquired in first-cycle degree programmes. At the same time, the technical competences gained in first degree programmes are advanced and extended. The knowledge and skills acquired by graduates of Master's degree programmes in physics cover the comprehensive professional profiles of physicists highly regarded due to their technical broadness and flexibility; they are principally qualified to pursue studies leading to the award of a doctorate. This means in detail that:

- They have advanced their knowledge in natural sciences and mathematics, extended their overview of inner-physical correlations as well as those with related disciplines, and have specialised themselves on one field of physics in such a way that they can find access to current international research.

- They have exemplarily applied their knowledge to complex physical problems and tasks to analyse, formulate, and possibly broadly solve them on a scientific basis.

- They are qualified to plan, construct, and conduct experiments and interpret the results (focus on experimental physics) in order to solve complex physical problems or use simulation and modelling on the basis of physical fundamental principles (focus on theoretic physics).

- They have acquired generic competences in their degree programme, e.g. in the areas communication, presentation, project work and capacity for teamwork.

- They have advanced knowledge of relevant specialized technical English. Basic knowledge of another foreign language are desirable.

- They have gained the capacity to acquaint themselves with any special area in physics/technology, to research and understand the relevant current international specialist literature, to conceive and conduct experiments or theoretical methods in the field, to classify the findings in the light of diverse physical phenomena, and to draw relevant conclusions for technical developments and scientific progress.

- They have learnt to have the necessary persistence to cope with failures, unexpected difficulties and delays in research and development projects, and still reach the target possibly using a modified strategy.

- They are in a position to commence professional activity even in a field not related to the area of specialisation of the Master's degree programme, using their basic knowledge of physics together with the scientific methods and problem solving strategies acquired.

- They are qualified to discuss complex physical issues and their own research findings within the context of current international research comprehensively and to present them in written (Master's Thesis) and oral form (presentation with free discussion).

- They are aware of their responsibility toward science and possible consequences of their activities for the environment and society and act in accordance with the principles of good scientific practice (Deutsche Forschungsgemeinschaft 1998).

3 Curriculum

The educational objectives of a degree programme in physics are achieved as students gain a diversity of knowledge, skills and competences through various didactic methods in the course of the degree programme. The extent to which students reach the learning objectives during the degree programme is determined by course and examination assessments. This can be expresses through the form of examination selected as well as the content of the examination.[1] The study offers the opportunity for students to gain an insight into professional fields and to recognize the relevant key qualifications.

[1] Exemplary didactic concepts and assessment methods for different groups of learning outcomes can be found at: http://www.kfp-physik.de/dokument/KFP_Handreichung_Konzeption-Studiengaenge-Physik-101108.pdf