

Subject-Specific Criteria

Technical Committee 06 – Industrial Engineering

Relating to the accreditation of Bachelor's and Master's degree programmes in industrial engineering

(updated: 20.09.2019)

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 06 – Industrial Engineering 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 good practice by a professional community, consisting of academics and professional practitioners in higher education, and what 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. As such, the Technical Committee 06 – Industrial Engineering holds a close cooperation with the German Association of Industrial Engineers (VWI) as well as the Faculty and Departmental Conference of Industrial Engineering (FFBT-WI), and enacts its SSC in close coordination with the quality criteria already defined in these mentioned organizations. 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.

1.2 Collaborations of the Technical Committees

The Technical Committee Industrial Engineering 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 Technical Committee Industrial Engineering is responsible for study programmes with qualifications in which technical and methodical competence in economics and one engineering science by way of a corresponding dual course is achieved. The same applies to all interdisciplinary study programmes with a larger share of studies in economics than engineering or natural sciences. Should the curriculum show a significantly lower proportion of economics, the Technical Committee Industrial Engineering and the participating technical disciplines are either jointly responsible or the Technical Committee simply provide auditors..

1.3 Applicability und Accordance to other Subject-Specific Criteria

These SSC update the SSC of 06.12.2013. They 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.

These SSC are consistent with the *Qualifications Framework Industrial Engineering*, which has been adopted jointly by the *German Association of Industrial Engineers (VWI)* and the *Faculty and Departmental Conference of Industrial Engineering (FFBT-WI)*, with reference to ASIIN's SSC, in its third version in 2019. The Qualifications Framework serves as a guideline and an important instrument for quality assurance and defines, in unison with the SSC, minimum requirements, skills and competences, which the graduates of an industrial engineering study programme should acquire.

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 degree programmes. Paragraph 2 details the requirements for Bachelor's and Master's degree programmes, which are applicable for all variants of the study programmes. Paragraph 3 contains additional requirements for those degree programmes that focus more strongly on one specific engineering discipline.

2.1 Requirements for Bachelor's Degree Programems

Knowledge

All graduates have a sound basis in natural sciences, engineering and economics. This enables them to understand the principles of a business as well as the phenomena and problems of their working environment, and to solve them with a methodological approach. Graduates have knowledge and understanding in the following areas:

1. natural sciences, engineering, mathematics
2. economics, law and social sciences
3. a set of integrated subjects including foreign languages
4. soft skills and foreign languages
5. and have completed a practical placement

All Bachelor's graduates have acquired specialist skills based on the current state of teaching and investigation in their area of expertise. They hold

- a broad understanding of selected fields within engineering and natural sciences, with in-depth theoretical and practical examples. They are familiar with the principles and laws of their chosen engineering discipline and the methods used in their working environment (engineering and scientific knowledge).
- a broad understanding of essential micro- and macro-economic contexts, with in-depth theoretical and practical examples. They are familiar with the responsibilities of different business functions and understand operational, macro-economic and management-related processes as well as their reciprocal effects (economic knowledge).
- a broad understanding of a set of interrelated and integrated subjects, which bring together economic, technical and social aspects and processes. They are familiar with the principles of coordination, communication, methodology and leadership (integrative knowledge).
- an understanding of empiricism and are familiar with the methods of academic research and writing (academic research and writing).

Skills

All graduates are able to

- identify, abstract, structure and solve technical and economic tasks and problems both in a holistic and in an integrative way,
- grasp, analyse and evaluate methods and processes,
- develop, optimise and use application-oriented solutions based on specified analyses of processes and data,
- collect and interpret relevant primary and secondary technical and economic data based on the methods of academic research and writing,
- choose and apply adequate methods of modelling, simulation, design and implementation,
- evaluate, plan and choose adequate technical and economic systems,
- conduct literature research and use specialist data for their work.

Competences

All industrial engineering Bachelor's graduates have acquired specialist skills and competences. They are able to

- understand and evaluate the economic, political, social and legal framework of the economy (understanding of the economic environment),
- make rational decisions based on an ethical argumentation, think critically in order to find innovative and effective solutions for inter-divisional, qualitative and quantitative problems (critical thinking),
- express themselves in a logical and convincing way both orally and in writing and communicate with their specialist colleagues on the contents and problems of their respective discipline, -in different languages and between different cultures (communication),
- effectively cooperate with others in different situations, in international environments, across several disciplines and in a constructive manner (cooperation and teamwork),
- recognise and solve complex tasks and problems of a technical and economic context in a holistic and systematic manner across several disciplines (inter-disciplinary problem solving and professional competence),
- demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context,
- the ability to responsibly apply and independently consolidate their knowledge in different fields under consideration of economic, ecologic and safety requirements as well as sustainability and environmental compatibility,

- use the appropriate scientific methods and new findings of the engineering and economics environment in their practical work while taking into consideration the economic, ecological, technical and social requirements (transfer competence),
- work individually and as part of an international group, organise and implement projects effectively and become accustomed to the responsibilities of leadership (cross-cultural competence),
- integrate into a working environment with ease thanks to a sufficient practical orientation of the degree and collaborate with partners on different levels (social competence),
- effectively use modern information technologies (IT competence),
- acquire knowledge autonomously thanks to their Bachelor's degree and continue their training and studies (life-long learning),
- transfer new findings in engineering and natural sciences to industrial and commercial production under consideration of economic, ecologic and safety requirements as well as sustainability and environmental compatibility.

2.2 Requirements for Master's Degree Programmes

Building on the basis of an undergraduate degree, a Master's degree endows the student with in-depth analytical skills and methods. At the same time, it enhances and broadens the specialist skills acquired during the first degree.

After finishing their degree, Master's students have typically processed further the objectives of a Bachelor's degree and are on their way to specialist maturity, having increased their level of confidence in applying their specialist and generic skills. After graduating, postgraduates are therefore generally able to conduct academic research and writing, and act responsibly within their working environment and the society.

The following points describe the knowledge, skills and competences of students graduating from industrial engineering Master's degrees.

Knowledge

All graduates have

- acquired in-depth knowledge of their relative fields within engineering and natural sciences in both theory and practical work, based on a broad understanding of their area of expertise. They are familiar with the principles and laws of their chosen engineering discipline and the methods used in their working environment and can develop them further independently (engineering and scientific knowledge).
- also acquired in-depth knowledge of essential micro- and macro-economic contexts in both theory and practical work, based on a broad understanding of their area of expertise. They are familiar with the principal responsibilities of different business functions and understand operational, macro-economic and management-related processes as well as their reciprocal effects. They can develop such models further independently (economic knowledge).

- acquired in-depth knowledge of a set of interrelated and integrated subjects which bring together economic, technical and social aspects and processes, based on a broad understanding of their area of expertise. They have a broad knowledge of the principles of coordination, communication, methodology and leadership (integrative knowledge).
- acquired in-depth knowledge of empirical research and are familiar with independent academic research and writing as well as with the methods of inductive and deductive modelling (knowledge based on scientific theory).

Skills

All graduates know how to

- identify, abstract, structure and solve complex technical and economic tasks and problems within a broad context and with, to some extent, new and/or unknown parameters, both in a holistic and an integrative way,
- grasp, analyse and evaluate scientific methods and operational processes systematically and use them for new areas of application, develop, optimise and apply complex application-oriented solutions based on specified analyses of processes and data,
- collect, interpret and critically reflect on relevant primary and secondary technical and economic data based on the methods of academic research and writing,
- choose and apply adequate methods of modelling, simulation, design and implementation and develop them further,
- devise and develop adequate technical and economic systems autonomously and define the framework for their implementation,
- conduct in-depth literature research and use current research findings for their work.

Competences

All industrial engineering Master's graduates have typically enhanced their methodological and analytical skills based on their previous degree, especially with regard to the combination of teaching and investigation, therefore enabling them to acquire a number of additional skills. They are able to

- understand and evaluate the economic, political, social and legal framework of the economy (understanding of the economic environment),
- make rational decisions based on an ethical argumentation in a complex environment with, to some extent, new and/or unknown parameters, think critically in order to find innovative and effective solutions for inter-divisional, qualitative and quantitative problems (critical thinking),
- think in an abstract, analytical and interconnected way beyond individual cases and are able to familiarise themselves quickly, systematically and methodically with new and unknown concepts (interconnected thinking),

- communicate in a logical and convincing way at all times, both orally and in writing, and exchange with both their specialist colleagues and the general public on the contents and problems of their respective discipline in different languages and between different cultures (communication),
- effectively cooperate with others in different situations, in international environments, across several disciplines and in a constructive manner (cooperation and teamwork),
- work in a leading position in inter-disciplinary and cross-cultural teams and organisations (leadership skills), recognise and solve complex tasks and problems of a technical and economic context in a holistic, innovative and systematic manner across several disciplines,
- use and further develop scientific methods and new findings in the engineering and economics environment during their research and practical work whilst taking into consideration economic, ecological, technical and social requirements (inter-disciplinary and innovative problem solving and professional competences),
- work individually and as part of an international group, organise, implement and lead projects effectively (transfer competences),
- integrate into a working environment with ease based on a sufficient practical orientation of the degree and collaborate with partners on different levels, form social relationships and take on social responsibilities (social skills), (project management competences),
- be flexible in their actions according to the changing requirements of today's dynamic and globalised business world (change-management competences),
- plan and manage the use of modern information technologies (IT competence),
- apply and support management methods in an international and intercultural environment (cross-cultural competency),
- acquire knowledge autonomously in order to remain up to date with the developments in science and research (life-long learning).

3 Additional Requirements

For those degree programmes that hold a distinct focus on engineering, the following competences are of particular importance:

Knowledge and Comprehension

Before achieving every other educational objective of their study programme, students must first master the basic knowledge and comprehension of natural sciences, mathematics and engineering. Graduates can prove their knowledge and comprehension both in their chosen speciality as well as an additional field of engineering.

Analysis und Methods

Graduates should be capable to solve engineering tasks according to the level of their knowledge and comprehension, even if these tasks contain aspects outside the graduates' area of specification. This analysis may contain identifying the problem, clarifying its specifications, contemplating possible solutions, choosing the most suitable method as well as its correct implementation. The graduates should be able to use different methods – e.g. mathematical analysis, computer-based model design or practical experiments – and to discern the importance of parameters pertaining social, ecological or economic aspects or questions of health and security.

Development (Design)

Graduates should be capable to implement engineering blueprints in cooperation with engineers and non-engineers according to their level of knowledge and comprehension. Those blueprints can refer to machines, processes, methods, buildings or infrastructure measures and their specifications can furthermore require careful consideration of social, ecological and economic factors or questions of health and safety.

Research and Evaluation

Graduates should be capable to utilize appropriate methods for conducting their detailed research according to their level of knowledge and comprehension. Research may contain literary research, the drafting and conduction of projects and experiments, the interpretation of data as well as computer simulations. It may be necessary to consult databases, guidelines (e.g. norms) and safety regulations.

Engineering Application and Engineering Practice

Graduates should be able to apply their knowledge and comprehension to develop practical skills for solving problems, conducting experiments and for developing equipment and processes expedient for the area of engineering. These skills should contain the knowledge, usage and restrictions of materials, computer-aided model design, engineering processes, equipment and tools, technical literature and sources of information as well as the experience of working in production facilities. Graduates should furthermore identify non-technical impacts of engineering actions, such as ethical, ecological, commercial and industrial effects.

Social Competencies

Graduates should be capable to communicate appropriately about the subjects of their discipline and to work effectively in a team composed of diverse characteristics. They should be aware of the repercussions their professional activities have on various areas of life and neighbouring disciplines and should consider these when reaching for a decision.