TU9 Guidelines

on Defining Engineering Degree Programs

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German Institutes of Technology

Explanatory note

The introduction of bachelor's and master's degrees in engineering sciences has resulted in the discontinuation of the German academic qualification 'Diplom-Ingenieur' for a number of programs, meaning that the term 'engineer' as a professional designation has disappeared from many degree titles.

Universities are therefore called upon to define which of their degree programs can be designated as engineering degrees, thus qualifying the degree holder to use the professional title of engineer. Eligibility regarding a professional title is to be recorded in section 5.2 of the diploma supplement.

These guidelines are intended to aid the faculties of TU9 Universities in deciding whether a degree program, irrespective of the academic qualification, exhibits the specific characteristics of an engineering degree, thus enabling the use of the professional title of engineer. To this end a set of outcome-oriented, future-focused criteria have been developed to set out the engineering-specific learning outcomes and the essential nature of engineering sciences. These criteria further serve in the development of engineering degree programs. They can also shape students' and graduates' own identity as engineers and thus play a key role in the engineering community overall.

The definition of engineering programs presented here provides clarification as to the core aspects of the engineering disciplines. It further serves to establish the learning outcomes of engineering degree programs as well as their relationship to other science disciplines.

The following aspects and learning outcomes must be addressed in their entirety. The criteria described must be adhered to in cases where a study program is classified as an engineering degree.

It is also necessary to verify if a degree program entitles the holder to use the professional title of engineer in accordance with the engineering laws of the respective German state.

Core aspects of engineering disciplines

Creating solutions to problems through the development and implementation of products[1] of the most varied tangible and intangible nature is characteristic of engineering. In the engineering process, the product-relevant disciplines are first identified and analyzed. These are combined in defining a problem, finding a solution, and designing the products to be developed.

[1] In this context, the term 'product' refers to a human-made product of a tangible or intangible nature, and serves as a generic term for the outcome of engineering endeavor, embracing products, systems and structures.

The product-relevant disciplines are subject to ongoing change in terms of their content, structure and interconnections, bringing about changes to engineering and engineering disciplines as a result.

Until only a few decades ago, products traditionally occupied a central position in defining engineering disciplines (construction, electrical engineering, and mechanical engineering). New methodological approaches or modifications to such approaches are, however, emerging that can be deployed independently of a specific area of application, thus giving rise to new subject areas (such as computational engineering) and enriching traditional engineering disciplines. In addition, knowledge-based sciences continually evolve new disciplines whose methodologies and approaches qualify them as engineering sciences. The establishment of computer science as an engineering science is a fitting example of this emerging trend.

Core aspects of engineering processes

The outcome-oriented approach typical of engineering processes is marked by the following core features:

- Specifying the problem
- Creating a solution
- Modeling the slice of reality relevant to the solution by means of a systems approach
  - Using analytical, physical and/or simulation models to describe and predict the properties of the products and their interdependencies
  - Review and continuous improvement of the models
- Evaluating knowledge gained with the models
- Optimizing the solution, by iteration if required
- Preparing the optimized solution for implementation
- Organizing and supervising its implementation
- Testing and reflection

The following aspects are taken into account during the development and implementation processes:

- Observing the model's economics, making it as simple as possible and as complex as necessary, taking account of the model boundaries
- Use of components, taking account of their properties and their interaction
- Dealing with uncertainty and incomplete information
- Feasibility testing
- Looking at ways to embed the products into the respective environments having due regard to economic, ecological, social and ethical aspects

Characteristic learning outcomes of engineering degree programs

The following learning outcomes characterize a degree program in engineering sciences. Attainment of these learning outcomes results in the ability to practice the profession of engineer. The engineering-specific learning outcomes in engineering degrees represent only a part of the entire range of learning outcomes for these programs.

Products and their points of intersection

- Understanding and applying a holistic systems approach

Models

- Analyzing and reducing the reality to be described (feature extraction)
- Understanding and selecting model types
- Abstracting and generating models
- Classifying limitations

Problem solving, design, developing the product

- Analyzing problems and specifying solutions
- Understanding and applying methods for use in developing designs
- Selecting suitable components
- Selecting models and adapting them to objectives
- Determining and designing interfaces
- Making predictions
- Assessing and optimizing the model and design in economic terms
- Evaluating prediction results

Implementing the product

- Evaluating and selecting implementation processes in a holistic context
- Executing and optimizing implementation processes
- Evaluating final implementation

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