

Curriculum Framework Document – Executive Summary

The goal of SEFI's Mathematics Working Group (MWG) is to provide a discussion forum and orientation for those who are interested in the mathematical education of engineering students in Europe. An important contribution to this goal is the group's curriculum document which was first issued in 1992. After ten years, in 2002, a second edition was published which brought the document more in line with current curriculum practices by formulating a detailed and structured list of concrete content-related learning outcomes. During the last decade, in many of the MWG's seminars the topics of higher-level learning goals and outcomes have been discussed. It is the intention of this volume, the third edition of the curriculum document, to state, explain and exemplify a framework for systematically including such higher-level learning goals based on state-of-the-art educational research. For this purpose, the competence concept developed in Denmark and later adopted in the famous OECD PISA study is used. Mathematical competence is the ability to understand, judge, do and use mathematical concepts in relevant contexts and situations, which certainly is the predominant goal of the mathematical education for engineers. Therefore, the main message of this new edition is that although content remains important, knowledge should be embedded in a broader view of mathematical competencies.

This document adapts the competence concept to the mathematical education of engineers and explains and illustrates it by giving examples. It also provides information for specifying the extent to which a competency should be acquired. It **does not** prescribe a particular level of progress for competence acquisition in engineering education. There are many different engineering branches and many different job profiles with various needs for mathematical competencies; consequently it is not appropriate to specify a fixed profile. The competence framework serves as an analytical framework for thinking about the current state in one's own institution and also as a design framework for specifying the intended profile. A sketch of an example profile for a practice-oriented study course in mechanical engineering is given in the document. This document retains the list of content-related learning outcomes (slightly modified) that formed the 'kernel' of the previous curriculum document. These are still important because lecturers teaching application subjects want to be sure that students have at least an 'initial familiarity' with certain mathematical concepts and procedures which they need in their application modelling.

In order to offer helpful orientation for designing teaching processes, teaching and learning environments and approaches are outlined which help students to obtain the competencies to an adequate degree. It is clear that such competencies cannot be obtained by simply listening to lectures, so adequate forms of active involvement of students need to be included. Moreover, in a competence-based approach the mathematical education must be integrated in the surrounding engineering study course to really achieve the ability to use mathematics in engineering contexts. The document presents several forms of how this integration can be realized. This integration is essential to the development of competencies and will require close co-operation between mathematics academics and their engineering counterparts. Finally, since assessment procedures determine to a great extent the behaviour of students, it is extremely important to address competency acquisition in assessment schemes. Ideas for doing this are also outlined in the document.

The main purpose of this document is to provide orientation for those who set up concrete mathematics curricula for their specific engineering programme, and for lecturers who think about learning and assessment arrangements for achieving the intended level of competence acquisition. It also serves as a framework for the group's future work and discussions.