MSc Final Qualifications

TU Delft Aerospace Engineering

This document describes the final qualifications for the 2-year MSc program Aerospace Engineering in terms of the competences formulated in the booklet “Criteria for academic Bachelor’s and Master’s curricula” developed by the 3TU consortium, [1]. Our Master’s curriculum will be accredited with respect to these final qualifications.

The currently proposed set of final qualifications conforms to the BSc final qualifications, thus allowing for a smooth transition between the Bsc Program Aerospace Engineering and the MSc Program Aerospace Engineering.

This framework of setting the final qualifications for an academic program have been discussed at the chair holder’s conference in Vinkeveen, 16-17 February, which served as a starting point for new Bachelor’s program.

This set of final qualifications also allows for benchmarking our program with other national and international MSc Aerospace Engineering curricula.

Despite the fact that the final qualifications are much more general than the end terms we have used before, it is quite challenging to formulate appropriate qualifications, which cover all Masters Variants.

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The areas of competence of a MSc graduate

The final qualifications are an elaboration of the following seven competences:

He or she

a. *is competent in one or more scientific disciplines*
   The Aerospace Engineering graduate is familiar with existing scientific knowledge, and has the competence to increase and develop this through study.
b. *is competent in doing research*
   The Aerospace Engineering graduate has the competence to acquire new scientific knowledge through research. For this purpose, research means: the development of new knowledge and new insights in a purposeful and methodical way.
c. *is competent in designing*
   The Aerospace Engineering graduate is familiar with the principles of design. Designing is a synthetic activity aimed at the realization of new or modified artifacts or systems with the intention of creating value in accordance with predefined requirements and desires (e.g. mobility, health).
d. *has a scientific approach*
   The Aerospace Engineering graduate has a systematic approach characterized by the development and use of theories, models and coherent interpretations, has a critical attitude, and has insight into the nature of science and technology.
e. *possesses basic intellectual skills*
   The Aerospace Engineering graduate is competent in reasoning, reflecting, and forming a judgment. These are skills which are learned or sharpened in the context of a discipline, and which are generically applicable from then on.
f. *is competent in co-operating and communicating*
   The Aerospace Engineering graduate has the competence of being able to work with and for others. This requires not only adequate interaction, a sense of responsibility, and leadership, but also good communication with colleagues and non-colleagues. He or she is also able to participate in a scientific or public debate.
g. *takes account of the temporal and the social context*
   Science and technology are not isolated, and always have a temporal and social context. Beliefs and methods have their origins; decisions have social consequences in time. A university graduate is aware of this, and has the competence to integrate these insights into his or her scientific work.

The competence areas of a MSc university graduate are represented in the figure below, that was taken from “Criteria for Academic Bachelor’s and Master’s Curricula”.

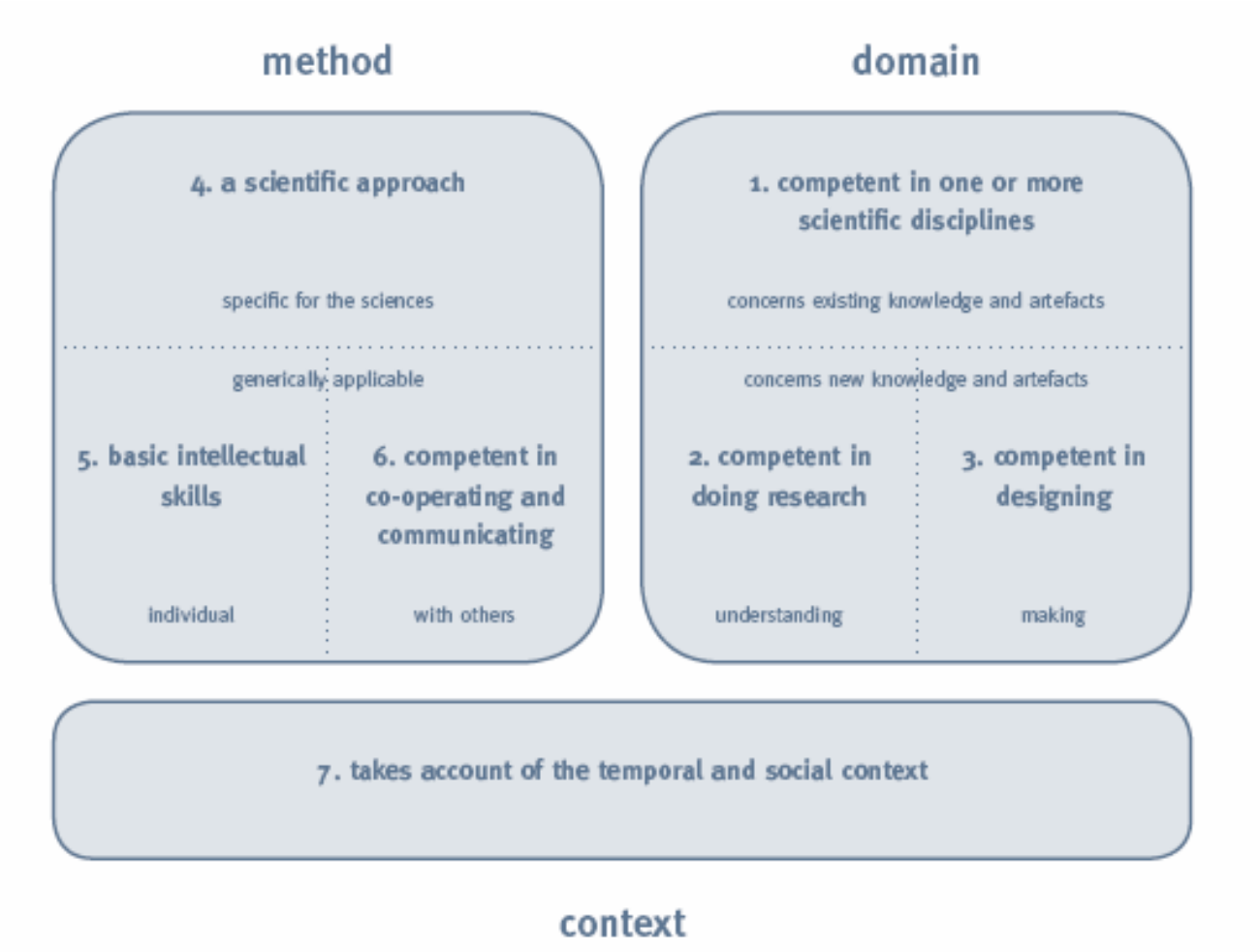

Figure 1: the areas of competence of a university graduate

[k] = knowledge
[s] = skill
[a] = attitude

References used

Criteria for Academic Bachelor's and Master's Curricula, ISBN: 90-386-2217-1, issued by TU Delft, TU/e and University of Twente, 2005

Study Guide BSc/MSc Aerospace Engineering 2005-2006

Qualification Profile of the Aeronautical Engineer in the IDEA League, issued by IDEA League 27 September 2005

1. MSc-I Competent in the domain of Aerospace (Engineering) sciences

The Aerospace Engineering graduate is familiar with existing scientific knowledge, and has the competence to increase and develop this through study.

a. Has a thorough mastery of a particular field in Aerospace Engineering extending to the forefront of knowledge (latest theories, methods, techniques and topical questions). [ks]
b. Looks actively for structure and connections in a particular field of Aerospace Engineering and related scientific disciplines. [ksa]
c. Has knowledge of and skill in the way in which truth-finding and the development of theories and models take place in a particular field of Aerospace Engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
d. Has knowledge of and skill in the way in which interpretations (texts, data, problems, results) take place in a particular field of Aerospace Engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
e. Has knowledge of and some skill in the way in which experiments, gathering of data and simulations take place in a particular field of Aerospace Engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
f. Has knowledge of and some skill in the way in which decision-making takes place in a particular field of Aerospace Engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
g. Is able to reflect on standard methods and their presuppositions; is able to question these; is able to propose adjustments, and to estimate their implications. [ksa]
h. Is able (with supervision) to spot gaps in his / her own knowledge, and to revise and extend it through study, independently. [ks]

2. MSc-II Competent in doing research

The Aerospace Engineering graduate has the competence to acquire new scientific knowledge through research. For this purpose, research means: the development of new knowledge and new insights in a purposeful and methodical way.

a. Is able to reformulate ill-structured research problems in multi-disciplinary context such as Aerospace Engineering. Also takes account of the system boundaries in this. Is able to defend the new interpretation against involved parties, for problems of a more complex nature. [ksa]
b. Is observant, and has the creativity and the capacity to discover in apparently trivial matters certain connections and new viewpoints and is able to put these viewpoints into practice for new applications. [ksa]
c. Is able to produce and execute independently a research plan. [ks]
d. Is able to work at different levels of abstraction. Given the process stage of the research problem, chooses the appropriate level of abstraction. [ksa]
e. Understands, where necessary, the importance of other disciplines (interdisciplinarity). Is able, and has the attitude to, where necessary, draw upon other disciplines in his or her own research. [ksa]
f. Is able to deal with the changeability of the research process through external circumstances or advancing insight. Is able to steer the process on the basis of this. [ksa]
g. Is able to assess research within a particular field of Aerospace Engineering on its scientific value. [ksa]
h. Is able to independently contribute to the development of scientific knowledge in one or more areas of the disciplines involved in a particular field of Aerospace Engineering. [ksa]

3. MSc-III Competent in designing

The Aerospace Engineering graduate is familiar with the principles of design. Designing is a synthetic activity aimed at the realization of new or modified artifacts or systems with the intention of creating value in accordance with predefined requirements and desires (e.g. mobility, health).

a. Is able to reformulate ill-structured design problems in the field of Aerospace Engineering. Also takes account of the system boundaries in this. Is able to defend this new interpretation against the parties involved for design problems of a more complex nature. [ksa]
b. Has creativity and synthetic skills with respect to multi-disciplinary design problems, such as they occur in the field of Aerospace Engineering. [ksa]
c. Is able to independently produce and execute a design plan. [ks]
d. Is able to work at different levels of abstraction including the system level. Given the process stage of the design problem, chooses the appropriate level of abstraction. [ksa]
e. Is able, and has the attitude, where necessary, to draw upon other disciplines in his or her own design. [ksa]
f. Is able to deal with the changeability of the design process through external circumstances or advancing insight. Is able to steer the process on the basis of this. [ksa]
g. Is able to formulate new research questions on the basis of a design problem. [ks]
h. Has the skill to take design decisions, and to justify and evaluate these in a systematic manner. [ksa]

4. MSc-IV A scientific approach

The Aerospace Engineering graduate has a systematic approach characterized by the development and use of theories, models and coherent interpretations, has a critical attitude, and has insight into the nature of science and technology.

a. Is able to identify and take in relevant developments in a particular field of Aerospace Engineering. [ksa]
b. Is able to critically examine existing theories, models or interpretations in the area of his or her graduation subject. [ksa]
c. Has great skill in, and affinity with the use, development and validation of models; is able to consciously and conscientiously choose between alternative modeling techniques. [ksa]
d. Has insight into the nature of science and technology (purpose, methods, differences and similarities between scientific fields, nature of laws, theories, explanations, role of the experiment, objectivity etc.) and has knowledge of current debates about this. [k]
e. Has insight into the scientific practice (research system, relation with clients, publication system, importance of integrity etc.) and has knowledge of current debates about this. [k]
f. Is able to document adequately the results of research and design with a view to contributing to the development of knowledge in the field and beyond and is able to publish these results. [ksa]

5. MSc-V Basic intellectual skills

The Aerospace Engineering graduate is competent in reasoning, reflecting, and forming a judgment. These are skills which are learned or sharpened in the context of a discipline, and which are generically applicable from then on.

a. Is able (with supervision) to critically reflect on his or her own thinking, decision-making, and acting and to adjust these on the basis of this reflection, independently. [ksa]
b. Is able to reason logically within the field and beyond; both 'why' and 'what-if' reasoning. Is able to recognize fallacies. [ks]
c. Is able to recognize modes of reasoning (induction, deduction, analogy etc.) within the field. Is able to apply these modes of reasoning. [ksa]
d. Is able to ask adequate questions, and has a critical yet constructive attitude towards analyzing and solving more complex (real-life) problems in the field . [ksa]
e. Is able to form a well-reasoned opinion in the case of incomplete or irrelevant data and taking account of the way in which that data came into being [ks]
f. Is able to take a standpoint with regard to a scientific argument in the field of aerospace (engineering) sciences and is able to assess this critically as to its value. [ksa]
g. Possesses basic numerical skills, and has an understanding of orders of magnitude. [ksa]

6. MSc-VI Competent in cooperating and communicating

The Aerospace Engineering graduate has the competence of being able to work with and for others. This requires not only adequate interaction, a sense of responsibility, and leadership, but also good communication with colleagues and non-colleagues. He or she is also able to participate in a scientific or public debate.

a. Is able to communicate in writing about research and solutions to problems with colleagues, non-colleagues and other involved parties. [ksa]
b. Is able to communicate verbally about research and solutions to problems with colleagues, non-colleagues and other involved parties. Is able to do so in second language. [ksa]
c. Is able to debate about both the Aerospace Science and Technology and its place in society. [ksa]
d. Is characterized by professional behaviour, showing flair in performing experimental and other project work. This includes: drive, reliability, commitment, accuracy, perseverance and independence. [ksa]
e. Is able to perform project-based work: is pragmatic and has a sense of responsibility; is able to deal with limited sources; is able to deal with risks; is able to compromise for more complex problems [ksa]
f. Is able to work within an interdisciplinary team and for a team with great disciplinary diversity. [ksa]
g. Has insight into, and is able to deal with, team roles and social dynamics. Is able to assume the role of team leader. [ks]

7. MSc-VII Takes account of the temporal and societal context

Aerospace science and technology are not isolated, and always have a temporal and societal context. Beliefs and methods have their origins; decisions have societal consequences in time. The MSc graduate is aware of this and therefore has knowledge and understanding of the context in which Aerospace Engineering and utilization is practiced by industry, institutes and organizations. He or she has the competence to integrate these insights into his or her work.

a. Understands relevant (internal and external) developments in the history of aeronautics and spaceflight. This includes the interaction between the internal developments (of ideas) and the external (societal) developments, both national and international. Integrates aspects of this in scientific work [ksa]
b. Is able to analyze the societal context of the Aerospace industry (economic, social, cultural) and the consequences of new developments and applications of aerospace science and technology and to discuss these with colleagues and non-colleagues. Integrates aspects of this in scientific work. [ksa]
c. Is able to analyse the consequences of scientific thinking and acting on the environment and sustainable development. Integrates aspects of this in scientific work. [ksa]
d. Is able to analyze and to discuss the ethical, safety and aesthetic aspects of the consequences and assumptions of scientific thinking and acting in the domain of Aerospace Engineering with colleagues and non-colleagues (both in research and in designing). Integrates these ethical and normative aspects in scientific work. [ksa]
e. Has an eye for the different roles of the “actors” in the fields of Aerospace Engineering, Technology and Space Sciences. Chooses a place as a professional in society. [ksa]