

Guidelines master graduation projects

Biomedical Engineering

Medical Engineering

The guidelines in this document were developed in 2023, in consultation with representatives of the scientific staff and Master students BME and ME. They were evaluated by the program committee, the departmental council and the board.

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Introduction

Vision on graduation projects

The graduation project is the largest individual educational component (45 of 60 EC) for students at BME¹. The project is typically done internally at BME, but it is possible to do (part of) the project externally with involvement of BME scientific staff. The purpose is that students advance and individually demonstrate their knowledge and skills in the research direction that they chose to pursue during their Master.

The vision of the department is that students get familiar to steady state scientific research during their project. Therefore, they perform the project as part of a research group, and they are provided the opportunity to use our advanced departmental infrastructure and research facilities. Scientific staff will ensure that students receive appropriate supervision during their projects. In this way, the department and the scientific staff aim to create the best possible conditions for the students to flourish.

While the department offers support and infrastructure, it expects commitment from the students to deliver their best efforts during the graduation project and to follow rules associated with laboratory practice. The student, and not the teacher, is ultimately responsible for the student's learning, the quality of the work and the deliverables during the graduation project.

Thus, graduation projects come with commitments and responsibilities from the sides of both the scientific staff and the students, and are performed in the context of actual scientific research within the research clusters. However, this comes with some tension: On the one hand, students like clear responsibilities and requirements throughout the department. On the other hand, the research areas of the department's clusters associate with different types of dissemination, research groups have different views on supervising students, teachers adopt their own approaches and they need a certain amount of flexibility to tailor supervision to the student's needs. The result is that BME students experience differences in e.g. supervision and requirements for deliverables, which they deem undesirable. With regard to deliverables, teachers also acknowledge the differences and prefer more uniformity.

This document addresses the raised issues. It provides guidelines for more consistency in the supervision and deliverables of master projects, without taking away flexibility.

¹ For convenience the document only mentions BME, but the same applies to ME Master projects; BME and ME can be exchanged.

Duration

Students can choose a 45 EC or 60 EC master project

A final master project can take 45 EC or 60 EC, where 1 EC represents 28 hours of work. An academic year contains 60 EC, which is equivalent to 1680 hours or 42 weeks of full time work without free days. To calculate the duration of a project in months, official and unofficial holidays should be added. In practice, the exact duration of a project is somewhat flexible (see below).

As an example, a 60 EC project for a nominal student would typically run from beginning of September till end of June (quartiles 1-4), while 45 EC would run from mid November till end of June (quartiles 2-4). However, a 60 EC project starting in Q3 can take 13 months if the student takes the regular time for holidays (e.g. a week for skiing, 5 weeks summer break, a week before Christmas and some incidental days), and in addition follows a 5 EC course parallel to the project.

Students can choose between a 45 EC or 60 EC project. They discuss this with their mentor, who advises the student. However, the final decision is made by the student, who is responsible for the student's own program. Teachers must appreciate the student's choice, and can neither force a student to choose either way, nor give the impression that a 45 EC project is undesirable or would be of lesser value.

Students are responsible to return the completed 'project-start'-form

At the start of the master project, students are responsible to complete and submit a form which states that they start their project, contains a starting date and a project title, and is signed by the student and the teacher. They receive this form by the education office at the moment they meet the requirements to start a final master project. The date on this form is leading in case of for instance a dispute on project duration.

Student and supervisor together define the defense date

Together, student and supervisor² determine the final defense date. This depends on the size of the project (45 vs 60 EC), with some flexibility depending on the progress of the work, holidays, or other aspects such as personal conditions.

In rare cases where student and supervisor do not come to an agreement on the defense date and the project takes longer than entitled, both student and supervisor have the possibility to request an end date. This prevents the student from undesired project extensions even though sufficient work has been delivered, and it enables the supervisor to stop a project in case no appropriate results are foreseen within due time. Either student or supervisor can enforce a final defense date after the actual project work time exceeds 1.5 times the original duration, i.e. after approximately 11 months of full time work after starting a 45 EC project or 15 months in case of a 60 EC project, extended with holidays or sick leave. Unilateral request must always be agreed on by the examination committee.

² The supervisor is the scientific staff member who is responsible for supervising the student. This should not be confused by e.g. a PhD student who takes care of daily supervision.

Supervision

Students have the right to be appropriately supervised in an inclusive way

The supervisor has regular meetings with the students. The frequency of meetings may differ between groups, and can depend on the stage of the project or in case daily supervision is mandated to for instance a PhD student or Postdoc. Supervision is fair, honest, and open, and in agreement with the TU/e's policy for inclusive education.

Clusters or research groups have organized the way they coach students, PhD students, post-docs and others in a different way. Students who perform their final master project become part of the research group, typically by participating in regular team activities or research meetings in which other MSc students, PhD students and staff present their work. Research groups may or may not assign such meetings as mandatory.

Personal supervision, meeting organization or frequency may be different, for instance depending on the vision of the supervisor, or on the student's needs. Regardless, in the BME department some meetings are mandatory, as described below:

Startup meeting

At the start of the project, in a mandatory startup meeting the general aspects of the project are clarified. These pertain to supervision, group meetings where attendance is mandatory, or where they are free to join, personal meetings, and expectations with regard to the project or performance (e.g. working hours, workplace, access to buildings, lab-safety instructions, required trainings for equipment, etc).

At least 2 development-meetings

At least two times during the project, students receive feedback on their personal development and project planning. In these meetings students receive feedback on their strong aspects as well as on skills for improvement. Also, the status of the project is discussed regarding progress relative to invested time and expected duration towards graduation. Supervisor and student are together responsible for scheduling these development meetings. If the student is seeking for such feedback, the student may at any time during the project request for an (additional) development-meeting.

Formative midway presentation

To train presentations skills and receive feedback from a broader audience on the project, students present their work at least once during the project for a larger audience. The organization and audience may vary per research group. Typically it is part of a regular series of presentations in the research group, with staff, PhD students and fellow master students. This presentation occurs at a moment that feedback and suggestions are useful for the student to improve their work and skills. Thus, it normally occurs around halfway into the project.

Organizing this presentation is a shared responsibility, i.e. a supervisor should make it possible and the student takes responsibility to take the opportunity to present.

Feedback to the midway presentation counts as formative assessment and does not count to the final grade. Feedback that is not related to the content of the project but pertains to e.g. the student's attitude, skills or planning, can coincide with a developmental meeting.

Deliverables, defense and grading

A graduation committee grades the quality of the project based on advice on the student's work, the final written report, the public presentation and the private defense. The committee consists of at least three scientific staff members, and may be supplemented with advisors, e.g. the daily supervisor and clinical or industrial partners. The chair of the committee is granted the right to grade final master projects by the examination committee. They grant this right if the chair has a UTQ, or otherwise qualifies (e.g. based on experience). If the supervisor is not allowed to chair the committee and grade the project, one of the other members chairs the private defense. At least one of the committee members has a research area that is to some extent remote to the subject of the defense, to provide a different perspective to the defense. By sitting in on various remote committees, teachers benchmark grading between groups within BME.

Final written report

The final report is written in English and may be structured in several ways as discussed with the supervisor. The structure is presumably in agreement with the way results are disseminated in the field of research. In general, the final report contains the typical aspects of a scientific publication as mentioned below, yet somewhat more extensive. The structure of the report is not predefined; it does not necessarily follow the listed order.

- an abstract;
- an introduction, written in a scientific way (the introduction is not a general textbook), such that external committee members can understand it. It includes a description of the scientific and (if applicable) the societal importance of the subject, and funnels to a clear hypothesis, research question, scientific aim and/or design goal;
- a materials & methods section, written such that external committee members can understand what has been created and how experiments or analyses have been conducted;
- a section showing the results of the study, not limited to only the most successful final experiment, but also including results of e.g. pilot experiments that were relevant to the final study design or outcome;
- the final conclusion, answer, or design;
- a discussion in which the methods, results, and conclusion are evaluated against existing literature, and put in perspective of the scientific field, and (if applicable) are valued for their potential societal impact. These contents may be discussed in a separate section, or they may be part of the results section, or for instance be captured in an epilogue;
- a list of references;
- it is possible to add appendices to the report, such as a literature survey that was produced at the onset of the project, an extensive overview of raw data, a technical or design file, new protocols, or software. The supervisor makes clear to the student and the committee beforehand whether the quality of such appendices counts towards the final grade or not.

The report is written such that all defense committee members can understand the importance and the reasoning behind the work, and they should be able to judge the results and conclusions even though they may not be familiar to the field and may not understand the ins and outs of the methods or results. At the same time, the report/introduction should be at a decent scientific level, focus on the topic without very general and broad explanations, and content-wise go beyond the level of a textbook. Supervisors will guide students where needed to understand the level of detail and depth that is required. The report may also contain parts of the work that failed if these are important for e.g. particular decisions in the project.

Given the above, the report cannot be as concise as a scientific publication and would typically count 25-50 pages (not counting appendices). A scientific publication, even when it is submitted, cannot replace the graduation report because it violates some of the above requirements. However, a publication could be the core part of the report, if the report is extended with general sections to accommodate the above requirements.

Public presentation and discussion

The student provides a public presentation of the results in English (typically 20-25 minutes), followed by a short (5-10 minutes) public discussion. The introduction, conclusion and relevance should be clear for a broader public, but methods and results may go more in depth and require more specialist background to follow.

Private oral defense

A 45-60 minute private defense with the graduation committee and advisors follows after the public presentation.

The grade is explained

After the defense, the committee discusses the final grade in the absence of the student. The grade is a combination of assessment of the scientific quality of the work, the quality of the report and the presentation, and the quality of the oral defense. In addition, the skills of a student, in terms of practical, engineering and analytical skills, creativity, and self-sufficiency, are assessed. These are graded on the assessment form with --, -, 0, + or ++, to indicate strong and weak points, relative to the final grade.

The grade is conveyed orally to the student, with clear explanation. The grade is supported with a written explanation on the graduation form, which is submitted to the secretary of the examination committee. The text explains strong and weak points of the student and explains why the committee concluded on the grade. The student receives a copy of the written explanation via the examination committee.

Knowledge and information transfer

At the end of the project, it is the responsibility of the supervisor to store the results. The student must collaborate to the transfer thereof. What this entails depends on the project and is to be discussed with the supervisor. Typically it includes:

- Logbook: Supervisor must keep logbooks for 10 years after the project finished.
- Data & software: Which data and software to transfer, and in which format it is to be transferred, is to be discussed between student and supervisor. Supervisor provides the physical means (e.g. disk space) to do so. Raw data must be stored if the data could potentially become part of a scientific publication.