Biomedical Engineering Assessment form
Master's Assignment (code 193650999)

Final assignment committee
Before the start of the master assignment, the intended chair of the graduation committee will formulate a proposal for the master assignment in consultation with the student. The chair is responsible for the appointment of the graduation committee. This committee consists at least of:

- Committee member 1: The professor or associate professor as part of whose research chair the assignment will be completed, insofar as they are not the everyday supervisor of the assignment. He/she is also the chair of the committee. The chair must be authorized to assess examinations.
- Committee member 2: The everyday supervisor of the student (professor/associate professor/assistant professor/PHD student); the everyday supervisor must be a member of the permanent or temporary scientific staff of the above-mentioned chair;
- One member of the scientific staff (professor/associate professor/assistant professor/ PhD student with supervisory experience/ Junior of senior researcher) of a different research chair than the one the final assignment will be completed in (the so-called external member). The external member may also be an external expert with a PhD if the student graduates within the UT with collaborations outside the UT
- If the everyday supervisor and the professor/associate professor are the same person, an extra member from the research chair of the assignment must be added to the committee. If this is not possible, an additional member of the scientific staff of a different research chair must be added to the committee.

Supervision and completion
During the assignment, the student has at least one interim meeting with the entire graduation committee to discuss the progress. In addition, the so-called green light meeting takes place at least two weeks before the intended graduation date. During this meeting with the entire committee, it will be discussed whether each of the aspects to be assessed is sufficient at this stage, or which points for improvement need to be implemented in order to achieve a satisfactory result. Only when the entire committee expects the student to pass on content, process and presentation by the intended graduation date, the colloquium form may be signed. This must then be handed in at CES-TNW in CITADEL 325. If during the assignment problems arise that make it difficult to complete the assignment, please contact the BME study advisor.

The final thesis must be in possession of the members of the graduation committee at least one week before the colloquium. The student defends this thesis by means of a colloquium before the graduation committee. The assessment of the assignment takes place according to the 'BME Assessment form master assignment'. This form is stored in the SIS, and the student receives a copy for perusal.

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How to use this form:

- Fill in the upper box.
- Please reference the below Assessment criteria when filling out the Aspects of assessment.
- The BME mission statement and learning outcomes have been included as an attachment.
- Fill in compliments and suggestions for improvement. The supervisor writes feedback on the process, and the whole committee on the contents, report and presentation. These compliments and suggestions for feedback are used as an explanation of the partial and final grades and as feedback for the student.
- The final grade is not a weighted average of the four grades for individual aspects. These are for reference only.
- Sign the form. Please include both names and signatures of the committee members.
- Return the original, signed form to BOZ-TNW.
- Also include an officially signed grade list to BOZ-TNW.

Assessment criteria
Research content (quality of research or design) • Has a thorough mastery of a specific field of biomedical engineering extending to the forefront knowledge and can use this in own research or design. • Is able to independently produce a research or design plan, taking the social context into account. • Is able to independently use results from former research or design to contribute to the development of knowledge in biomedical engineering. • Is able to independently contribute to the development of scientific knowledge in one or more areas of biomedical engineering.
Research Execution (process) • Is able to critically and independently reflect on his/her own thinking, decision making, and acting and is able to adjust these on the basis of this reflection. • Is able to independently perform a research or design plan (formulation of problem and research plan, perform experiments, analyse results). • Is able to work within an interdisciplinary biomedical team having great diversity. • Is able to perform complex project-based work: is pragmatic and has a sense of responsibility, is able to plan activities, to deal with limited resources, to compromise. • Is able to spot gaps in his/her own knowledge, and to revise and extend knowledge through study. • Is characterized by professional behaviour. This includes: inquisitiveness, integrity, reliability, drive, commitment, accuracy, perseverance and independence.
Report (formal criteria) • The report has an appropriate structure for the field of study. • The report is composed in scientific language. • The student uses citations and references correctly. • The core idea is presented clearly and logically. • The report has a neat layout (including tables and graphs). • The report has the appropriate length.
Presentation • The student is able to give an oral presentation about his/her own research or design, including process and results. • The presentation is clearly and logically structured (context, research problem, methods, results and conclusion). • The student makes appropriate use of audio-visual presentation tools. • The student responds appropriately to questions. • The student makes a useful contribution to any discussion that ensues after the presentation.

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Profiles for final grading

5. insufficient
The research and / or report are insufficient and the student was strongly directed by his or her supervisors. Weak points can clearly be pointed out. The student did not show an academic attitude. On average, the student scores 'insufficient' on all aspects for assessment.

6: sufficient
With respect to content, the research was conducted sufficiently. The report is mediocre. Weak points can clearly be pointed out, but are compensated by aspects on which the student performs better. The student has shown little input of his own and was strongly directed by his or her supervisors. On average, the student scores 'sufficient' on all aspects for assessment.

7: amply sufficient
With respect to content, a solid piece of research was delivered. The report is carefully edited. Either the research process or the mastery of subject matter leaves room for improvement. The supervisors clearly had a steering influence on the final product. The student scores at least 'sufficient' on all aspects for assessment and 'good' on some aspects.

8: good
With respect to content, the research was set up in a solid way and was carried out accurately. The report is carefully edited regarding language as well as lay out. The student has worked independently and was able to put forward his or her own initiatives. Guidance given by the supervisors was minimal. On average, the student scores 'good' on all aspects for assessment.

9: very good
The research is innovative and can be converted to an article for a renowned (scientific) magazine without putting in too much effort. With respect to content, the research is very solid with some points that can clearly be pointed out as strong. The report is carefully edited and shows that the student disposes of good writing skills. The student's own input and independence are large. The student clearly stands above subject matter and is able to defend his or her statements in discussions well. The student scores at least 'good' on all aspects for assessment and 'very good' on some aspects.

10: excellent
The student functions at the level of an expert in the field. With respect to content, the research is very good, with some points that can be clearly pointed out as excellent. The student is very capable of conducting research independently. The report and the presentation show that the student disposes of very good communication skills (written and oral). The student scores 'very good' on all aspects for assessment.

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Student:		S number:	
Research group:		Presentation date:	
Thesis title:		**Final grade:**	

Aspects of assessment	**Grade**	**What went well?**	**What could have been improved?**
Research content (quality of research or design)			
Research execution (process)			
Report (formal criteria)			
Presentation			

Member	**Name**	**Signature**	**Member**	**Name**	**Signature**
Chair			External advisor		
Supervisor			Member		
Member other research group			Member		

Please submit signed form to BOZ-TNW, paviljoen room 15 phone: 053 4891118

Mission statement

Biomedical Engineering is an interdisciplinary field, combining engineering disciplines and natural and life sciences. Integrating scientific and engineering concepts and methodology the Biomedical Engineer works to increase scientific knowledge and solve health care problems, by:

1) acquiring new knowledge of living systems through continuous innovation and substantive application of experimental, analytical, and design techniques.
2) design and development of new devices, algorithms, processes and systems to advance Medical Technology in health care.
3) solving health care problems through purposeful context-driven problem solving;
4) implementing solutions using excellent cross-disciplinary communication and cooperation.

Competencies and learning outcomes for biomedical engineers at the BSc and MSc levels

A Biomedical Engineer:
1. has expertise in the discipline of biomedical technology

A Biomedical Engineer is familiar with existing scientific knowledge and has the competence to expand this knowledge through study.	
BACHELOR	**MASTER**
Understands the knowledge base of physics, mathematics technology, biology, physiology and medicine (theories, methods, techniques). [ks]	Has a thorough mastery of a specific field of biomedical engineering extending to the forefront of knowledge (latest theories, methods, techniques and topical questions). [ks]
Understands the structure of engineering and life sciences, and the connections between sub-fields. [ks]	Looks actively for structure and connections with biomedical engineering in the relevant fields of physics, mathematics technology, biology, physiology and medicine. [ksa]
Has knowledge of and some skill in the way in which truth-finding and the development of theories and models take place in biomedical engineering. [ks]	Has knowledge of and skill in the way in which truth-finding and the development of theories and models take place in a specific field of biomedical engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
Has knowledge of and some skill in the way in which interpretations (texts, data, problems, results) take place in biomedical engineering. [ks]	Has knowledge of and some skill in the way in which interpretations (texts, data, problems, results) take place in biomedical engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
Has knowledge of and some skill in the way in which experiments, gathering of data and simulations take place in biomedical engineering and its supporting disciplines. [ks]	Has knowledge of and some skill in the way in which experiments, gathering of data and simulations take place in biomedical engineering and its supporting disciplines. [ksa] Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
Has knowledge of and some skill in the way in which decision-making takes place in biomedical engineering. [ks]	Has knowledge of and some skill in the way in which decision-making takes place in biomedical engineering. Has the skill and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]
Is aware of both the presuppositions of the standard methods and their importance. [ksa]	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]
Is able (with supervision) to spot gaps in his own knowledge, and to revise and extend knowledge through study. [ks]	Is able to spot gaps in his own knowledge independently, and to revise and extend knowledge through study. [ksa]

k = knowledge, s = skill, a = attitude

2. has expertise in research

A Biomedical Engineer has the competence to acquire new scientific knowledge by research. Research means here: a goal-oriented and methodical increase of new knowledge and insights.

BACHELOR	***MASTER***
Is under supervision able to reformulate ill-structured biomedical research problems. [ks] Is able to defend the new interpretation against involved parties. [ksa]	Is able to reformulate ill-structured biomedical research problems of a complex nature. Also takes account of the system boundaries. [ksa] Is able to defend the new interpretation against involved parties. [ksa]
Is observant, and has the creativity and the capacity to discover certain connections and new viewpoints. [ksa]	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]
Is able (with supervision) to produce and execute a research plan. [ks]	Is able independently to produce and execute a research plan. [ks]
Is able to work at different levels of abstraction. [ks]	Given the process stage of the research problem, chooses the appropriate level of abstraction. [ksa]
Understands the importance of other disciplines (interdisciplinarity), especially those of the basic engineering discipline and the life sciences. [ka]	Is able, and has the attitude to draw, where necessary, upon other disciplines in his own research. [ksa]
Is aware of the changeability of the research process through external circumstances or advancing insight. [ka]	Is able to deal with the changeability of the research process through external circumstances or advancing insight. [ksa] Is able to control the process on the basis of this. [ksa]
Is able to assess research within biomedical engineering on its usefulness. [ks]	Is able to assess research within biomedical engineering on its scientific value. [ksa]
Is able (with supervision) to contribute to the development of scientific knowledge in one or more areas of the disciplines involved in biomedical engineering. [ks]	Is able to independently contribute to the development of scientific knowledge in one or more areas of biomedical engineering. [ksa]

3. has expertise in design

Many biomedical engineers will design new products. Designing means here a synthetic activity aimed at the emergence of new or modified artefacts or systems with the intention of creating value in accordance with predefined requirements and needs (e.g. health).

BACHELOR	***MASTER***
Is able to reformulate simple ill-structured design problems. Also takes account of the system boundaries. [ks] Is able to defend this new interpretation against the parties involved. [ksa]	Is able to reformulate ill-structured biomedical design problems of a complex nature. Also takes account of the system boundaries. Is able to defend this new interpretation against the parties involved. [ksa]
Shows some creativity and skills in synthesis with respect to design problems. [ksa]	Shows creativity and skills in synthesis with respect to biomedical design problems. [ksa]
Is able (with supervision) to produce and execute a design plan. [ks]	Is able independently to produce and execute a design plan. [ks]
Is able to work at different levels of abstraction including the system level. [ks]	Given the process stage of the design problem, chooses the appropriate level of abstraction. [ksa]
Understands the importance of other disciplines (interdisciplinarity) and their contribution to the design process. [ks]	Is able, and has the attitude, where necessary, to draw upon other disciplines in his own design. [ksa]
Is aware of the changeability of the design process through external circumstances or advancing insight. [ka]	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]
Is able to integrate existing knowledge in a design. [ks]	Is able to formulate new research questions on the basis of a biomedical design problem. [ks]
Has the skill to evaluate design decisions in a systematic manner. [ks]	Has the skill to take design decisions, and to justify and evaluate these in a systematic manner. [ksa]

k = knowledge, s = skill, a = attitude

4. has a scientific approach

A Biomedical Engineer has a systematic approach, characterized by the development and use of theories, models and coherent interpretations, has a critical attitude and understanding of the nature of science and technology.

BACHELOR	***MASTER***
Is inquisitive and has an attitude of lifelong learning. [ka]	Is able to identify and take in relevant developments. [ksa]
Has a systematic approach characterized by the development and use of theories, models and interpretations. [ksa]	Is able to critically examine existing theories, models or interpretations in the area of his or her BME MSc track. [ksa]
Has the knowledge and the skill to use models for research and design and assess their value ('model' is understood broadly: from mathematical model to scale-model). [ks] Is able to adapt models for his own use. [ks]	Has great skill in, and affinity with, the use, development and validation of models; is able consciously to choose between modelling techniques. [ksa]
Has insight into the nature of life sciences and technology (purpose, methods, differences and similarities between scientific fields, nature of laws, theories, explanations, role of the experiment, objectivity etc.) [k]	Has insight into the nature of life sciences and technology (purpose, methods, differences and similarities between scientific fields, nature of laws, theories, explanations, role of the experiment, objectivity etc.) and has some knowledge of current debates about this. [k]
Has some insight into scientific practice (research system, relation with patients and other clients, publication system, importance of integrity etc.) [k]	Has insight into scientific practice (research system, relation with clients, publication system, importance of integrity etc. [ksa]) and has knowledge of current debates about this. [k]
Is able to document adequately the results of research and design. [ksa]	Is able to document and publish adequately the results of research and design with a view to contributing to the development of knowledge in his or her field of biomedical engineering and beyond it. [ksa]

5. possesses basic intellectual skills

A biomedical engineer is competent in reasoning, reflecting, and judgment. These are skills learned or sharpened in the context of a discipline and then generically applicable.

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

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6. has expertise in cooperation and communication

A Biomedical Engineer has the skills to work with or for others. This competence requires adequate interpersonal skills, responsibility and leadership, but also excellent communication with colleagues and non-specialists. He or she is also able to participate in a scientific or public debate.

BACHELOR	***MASTER***
Is able to communicate in writing in Dutch about the results of learning, thinking and decision-making with colleagues and non-colleagues including health care providers and patients. [ks]	Is able to communicate in writing about research and solutions to problems with colleagues, non-colleagues and other involved parties including health care providers and patients in English. [ksa]
Is able to communicate verbally in Dutch about the results of learning, thinking and decision making with colleagues and non-colleagues including health care providers and patients. [ks]	Is able to communicate verbally about research and solutions to problems with colleagues, non-colleagues and other involved parties including health care providers and patients in English. [ksa]
Idem to above (verbally and in writing), but in a second language. [ks]	Idem to above (verbally and in writing), but in a second language. [ksa]
Is able to follow debates about both biomedical engineering and the place of biomedical engineering in society. [ks]	Is able to debate about both biomedical engineering and the place of biomedical engineering in society. [ksa]
Is familiar with professional behaviour. This includes: drive, reliability, commitment, accuracy, perseverance and independence. [ksa]	Is characterized by professional behaviour. This includes: drive, reliability, commitment, accuracy, perseverance and independence. [ksa]
Is able to perform project-based work: is pragmatic and has a sense of responsibility; is able to deal with limited sources. [ksa]	Is able to perform project-based work for complex projects: 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. [ksa]
Is able to work within an interdisciplinary team of medical and engineering people. [ks]	Is able to work within an interdisciplinary biomedical team having great diversity. [ksa]
Has insight into, and is able to deal with, team roles and social dynamics. [ks]	Is able to assume the role of team leader. [ks]

7. takes into account the temporal and social context

Science and Technology are not isolated and always have a temporal and social context. Ideas and methods have their origins; decisions have social consequences in time. Biomedical Engineers are aware of this and have the competence to integrate these insights into their scientific work.

BACHELOR	***MASTER***
Is able to analyse and to discuss the social consequences (economic, social, cultural) of new developments in relevant fields with colleagues and non-colleagues. [ks]	Understands relevant (internal and external) developments in the history of biomedical engineering. [ksa] This includes the interaction between the internal developments (of ideas) and the external (social) developments. Integrates aspects of this in scientific work. [ksa]
Is able to analyse and to discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues (in research, designing and applications). [ks]	Is able to analyse and to discuss the social consequences (economic, social, cultural) of new developments in relevant fields with colleagues and non-colleagues. Integrates aspects of this in scientific work. [ksa]
Has an eye for the different roles of biomedical engineering professionals in society. [ks]	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]
Is able to analyse and to discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues (both in research and in designing). Integrates these ethical and normative aspects in scientific work. [ksa]	Is able to analyse and to discuss the ethical and the normative aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues (both in research and in designing). Integrates these ethical and normative aspects in scientific work. [ksa]
Chooses a place in society as a professional person. [ksa]	Chooses a place in society as a professional person. [ksa]

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