MSc Applied Physics
Faculty S&T
Office for Educational Affairs (BOZ AP)
Citadel H436 BOZ-AP@utwente.nl

MSc Biomedical Engineering
Faculty S&T
Office for Educational Affairs (BOZ BME)
Citadel H440 BOZ-BME@utwente.nl

UNIVERSITY OF TWENTE.

MASTER'S ASSIGNMENT DOUBLE PROGRAMME AP & BME

Assessment form *(can be filled in digital)*

Name student | Student number

Research group | Cohort | Date of presentation

Title thesis

☐ *The report has been checked for plagiarism by the student.*

Grade Scientific Aspects, code 201900319 EC Cum Laude M-AP ☐

Grade General Aspect, code 201900318 EC Cum Laude M-BME ☐

How to use this form
On page 4 you find the general information and course information. On page 5 you find the assessment plan. Please read this before the assessment. From page 7 you find the Mission Statement of Biomedical Engineering.
On page 2 and 3 you will find the tables in which you indicate the strengths and/or the points for improvement for each subject. Subsequently fill in the two grades on page 1. And if applicable, that the master's degree was awarded with "cum laude".
After filling in the form, it has to be signed by the members of the master's final project committee. When digitally signed, after each digital signature the form will be saved. After that, the next one can sign. Make or save a copy for the student and the research chair and send the assessment form to the office of Education Affairs: BOZ-BME, Citadel H325, BOZ-BME@utwente.nl and BOZ-AP, Citadel H332, BOZ-AP@utwente.nl

Master's Final Project Committee

	Titles and name	Affiliation	Signature[1]
Chair			
Daily supervisor			
Reference member[2]			
External advisor			
member (optional)			
member (optional)			

[1] *Link to: How to Create a digital signature*

[2] *A member of a chair in the discipline committee Applied Physics other than the chair in which the final project is carried out.*

Scientifical aspects of assessment

	Comments and feedback
Research plan and positioning	Strong points
	Points for improvement
Theoretical and experimental skills	Strong points
	Points for improvement
Analysing skills	Strong points
	Points for improvement
Scientific approach & handling of complexity	Strong points
	Points for improvement
Integration Mathematical and Physical Aspects	Strong points
	Points for improvement
Reflective capabilities	Strong points
	Points for improvement

General Aspects Grade

	Comments and feedback
Reporting	Strong points
	Points for improvement
Oral presentation & discussion	Strong points
	Points for improvement
Professional research attitude	Strong points
	Points for improvement
Professional communication	Strong points
	Points for improvement
Arrangement of own work within conditions of research group	Strong points
	Points for improvement

Course information and assessment plan

General information

Lecturers (chair of the MGC is examiner/coordinator):	The MSc Graduation Committee (MGC) is responsible for the supervision and assessment. The committee consists of a minimum of three members, that all have a doctors degree. The chair of the committee is the graduation professor. The composition of the MGC must comply with the rules that apply to both the Applied Physics and Biomedical Engineering programme.
Determining pass mark:	In the assessment of the MSc assignment, two marks will be determined: (i) One grade covers the quality of the scientific, physical and biomedical aspects and the research performance, (ii) One grade covers the other objectives, concerning the oral and written reporting as well as other general aspects of the research. For each mark a distinct course code has been assigned. The assignment can only be finalized when both grades are six (6) or higher.

Course Description

Course objectives

The main objective of the assignment is that the student learns and proves that (s)he is able to define, perform, complete and reflect on a research project in the applied physics and mathematical domain with a large degree of independence.
In the master's assignment, the objectives of the Applied Physics and the Biomedical Engineering programmes are met, which focuses on acquiring most of the learning outcomes of the complete programme;

- a thorough knowledge of the basic physics and mathematics theories,
- a more in-depth knowledge of one or more sub-areas of physics and biomedical engineering,
- knowledge of physical and biomedical technology, including skill in designing and applying measuring equipment and experimental techniques,
- orientation in the application areas of applied physics and biomedical engineering,
- insight into how the sciences are interconnected and the relation between science and society and the resulting responsibilities,
- skills such as being able to acquire knowledge independently; being able to contribute creatively and systematically to solving issues relating to the subject area; being able to work with colleagues,
- in and outside the discipline; and communicative, social and organizational skills.

General aspects that will be assessed include;

- Reporting,
- Oral presentation & discussion,
- Professional research attitude,
  Professional communication,
- Arrangement of own work within conditions of the research group.

Course Content

The individual master's assignment comprises the completion of the double master programme Applied Physics and Biomedical Engineering. The assignment is performed in one of the research groups within the Applied Physics or Biomedical domain of the University of Twente under the supervision of a researcher with a doctors degree and the responsibility of a master's final project committee.
The assignment can be performed (partially) within a research group outside the domain of Applied Physics and/or Biomedical Engineering or an external institute or organization. This needs the approval of the master's examination boards of Applied Physics and Biomedial Engineering.
The student has to perform a substantial research or design project that meets scientific criteria. The level of profundity and complexity is defined by the chair of the MSc graduation committee. The student completes the assignment with a written report (the MSc thesis) and an oral public presentation.

Assessment Plan Scientific Aspects

Learning objectives After following the course, the student is able to perform scientific research in the field of Applied Physics and Biomedical Engineering.	**Way of assessment**	**Level**	**Weight**
1a. Is able to formulate an interpretation a research problem and to define the research goals 1b. Is able to define the theoretical and experimental research plan and position the research in the field.	Meeting MGC Report & presentation	Complex research subject at master level	~10%
2. Has the theoretical and experimental skills to execute the research, works systematically and makes well founded choices. Is able to recognize flaws in theory and has the skills to acquire missing parts.	Observation by supervisor Report & Presentation		~30%
3. Is able to analyse the results, draw conclusions and to reflect on the results with respect to the problem definition and research goals.	Observation by supervisor Report & Presentation		~30%
4. Has a scientific approach and possesses intellectual skills (can handle complexity)	Observation by supervisor Report &		~20%
5. Is able to reflect on the contextual aspects of the research (social context, safety and environmental consequences, scientific and ethical aspects)	Report, Meeting MGC Publication (if applicable)		~10%

Assessment plan Reporting & General aspects

Learning objectives After following the course, the student is able:	Way of assessment	Level	Weight
1. Is able to report adequately about the research in English. (report is well structured in clear and correct language)	Report	Report sufficient	~25%
2. Is able to present and to discuss adequately about the research in English (presentation is well structured, with a clear explanation, supported by tools)	Presentation	Presentation for staff	~25%
3. Is able to work with a high degree of independence, creativity, dedication, pace, commitment (the student himself is responsible for the progress, planning and consultation of his supervisors)	Observation by supervisor and MGC members	Profes-sional attitude	~20%
4. Is able to communicate professionally with the supervisor (problem owner), to co-operate with the members of the research group and to communicate with others from inside and outside the community of Biomedical Engineering and Applied Physics.	Observation by supervisor and MGC members		~15%
5. Is able to arrange his research within the conditions set by the group.			~15%

Mission statement Biomedical Engineering

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]

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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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