Faculty of Science and Technology

University of Twente

# Programme-specific supplement to the study programme section of the students' charter including the education and examination regulations of the Biomedical Engineering (BME) master's programme

(articles 7.13 and 7.59 WHW)

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**Preamble**

a. The rules in this supplement apply to the full-time Biomedical Engineering master's programme (Central Register of Higher Education Study Programmes/CROHO number 66226).
b. This programme-specific supplement combined with the general section make up the study programme section of the students' charter including the education and examination regulations of the Biomedical Engineering (BME) master's programme as part of the Faculty of Science and Technology of the University of Twente.
c. In the event of any disputes, the original Dutch version of this supplement takes precedence before the law over this English translation of the supplement.
d. In this instance, 'the law' refers to the Dutch Higher Education and Scientific Research Act (Wet op het Hoger Onderwijs en Wetenschappelijk Onderzoek, also known as WHW).


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**Article 1 Programme objective**

The Biomedical Engineering master's programme aims to help students with a bachelor's degree in Biomedical Technology or a similar degree to delve deeper into a specific subsection of the wide biomedical technological field at a master's level, depending on the specific competencies and interests of the individual students. The overall final qualifications of the students may differ, but all of them will at the very least include the competencies listed below:

A Biomedical Engineering (BME) Master of Science

1. Is specialized in a specific field of biomedical technology;
2. Has the knowledge and skills to do research;
3. Has design skills;
4. Has a scientific approach;
5. Has intellectual knowledge;
6. Is able to collaborate with and communicate with specialists in their chosen track and other relevant parties;
7. Is able to integrate insights regarding medical and social contexts.

**Article 2 Programme attainment targets**

(k = knowledge, s = skill, a = attitude)

A BME Master of Science:

1. Is specialized in a specific field of biomedical technology. A BME master of science is familiar with existing scientific knowledge and has the competency to expand this knowledge by studying.

1a. Has a command of parts of the specific biomedical technological field that lie at the very forefront of the existing knowledge (the latest theories, methods, techniques, current issues). [ks]

1b. Actively looks for structure and cohesion between biomedical technology and relevant fields such as physics, mathematics, technology, biology, physiology and medicine. [ksa]

1c. Has knowledge of and some skill regarding the way in which fact-finding, theory formation and scientific model formation are handled in a specific field of biomedical technology. [ks] Has the skills and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]

1d Has knowledge of and is somewhat skilled regarding the way in which interpretations (of texts, data, problems, results, etc.) are made in the field of biomedical technology. [ks] Has the skills and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]

1e. Has knowledge of and is skilled regarding the way in which experiments, data collection and simulations are performed in the field of biomedical technology and related fields. [ks] Has the skills and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]

1f. Has knowledge of and is skilled regarding the way in which decisions are made in the field of biomedical technology. Has the skills and the attitude to apply these methods independently in the context of more advanced ideas or applications. [ksa]

1g. Can reflect on standard methods and their assumptions; is able to question them; is able to propose changes and estimate the impact thereof. [ksa]

1h. Is able to notice gaps in their own knowledge and amending or supplementing their knowledge by studying. [ksa]

2. Has knowledge of and is skilled at doing research. A BME Master of Science has the competency to gain new scientific knowledge by doing research. Research here refers to developing new knowledge and insights in specific and methodical ways.

2a. Is able to reformulate badly structured research problems. In doing so, also takes into account the system boundaries. Is able to defend the new interpretation to the parties involved. [ksa]

2b. Is observant and has the creativity and ability to discover certain connections and new points of view in ostensibly trivial matters. [ksa]

2c. Is able to create and implement a research plan independently. [ks]

2d. Chooses the right level of abstraction, given the research problem's process stage. [ksa]

2e. Is able to and has the necessary attitude to incorporate other disciplines in their own research if needed. [ksa]

2f. Is aware of the changeability of the research process due to external circumstances or advancing insights. [ka] Is able to deal with this changeability and adapt the process based on that changeability if needed. [ksa]

2g. Is able to accurately assess the scientific value of research in the field of biomedical technology. [ksa]

2h. Is able to independently contribute to the development of scientific knowledge in one or more of the subfields within the field of biomedical technology as a whole. [ks]

3. May in some cases have design skills. Apart from research assignments, some BME masters of science will also complete design assignments. These skills are particularly important in the Human Function Technology track, and less so in the Molecular, Cellular and Tissue Engineering track. Designing is a synthetic activity geared towards creating new or altered artefacts or systems, intended to create values in line with previously established requirements and preferences (such as mobility, health, etc.).

3a. Is able to reformulate complex, badly structured design problems. In doing so, also takes into account the system barriers. Is able to defend the new interpretation to the parties involved. [ksa]

3b. Has the creativity and synthetic skills needed managing biomedical design problems. [ksa]

3c. Is able to create and implement a design plan independently. [ka]

3d. Chooses the right level of abstraction, given the design problem's process stage. [ksa]

3e. Is able to and has the necessary attitude to incorporate other disciplines in their own design if needed. [ksa]

3f. Is able to deal with the changeability of the design process due to external circumstances or advancing insights, and adapt the process based on that changeability. [ksa]

3g. Is able to formulate new research questions based on a design problem. [ks]

3h. Is able to make design decisions and justify and assess these systematically. [ks]

4. Has a scientific approach. A BME master of science has a scientific approach, characterized by the development and the use of theories, models, and interrelated interpretations, has a critical attitude, and has insight into the nature of science and technology.

4a. Is able to notice relevant developments and learning about them. [ksa]
4b. Is able to critically reflect on existing theories, models, or interpretations in their track's subfield of biomedical technology. [ksa]

4c. Is very skilled at and has a propensity for using, developing and validating models; is capable of consciously choosing between modelling methods. [ksa]

4d. Has insight into the nature of science and technology (objective, methods, differences and similarities between scientific fields, the nature of laws, theories, explanations, the role of experiments, objectivity, etc.). And is knowledgeable regarding current discussions about these issues. [k]

4e. Has insight into the practical side of science (research system, relationships with clients, publication system, the importance of integrity, etc.). And is knowledgeable regarding current discussions about these issues. [k]

4f Is able to adequately document the results of research and designs with the aim of contributing to knowledge development both within the field of biomedical technology and outside of it. [ksa]

5. Has intellectual skills. A BME Master of Science is skilled at reasoning, reflecting, and forming judgements. These are skills that are taught or strengthened in the context of a certain scientific discipline, but are more generally applicable afterwards.

5a. Is able to critically and independently reflect on their own thinking, decisions and actions and adjust them accordingly. [ksa]

5b. Is able to recognize logical fallacies. [ks]

5c. Is able to recognize and apply modes of reasoning (induction, deduction, analogy, etc.) in the field. [ksa]

5d. Is able to ask satisfactory questions and has a critical/constructive attitude in analysing and solving complex biomedical real-life problems. [ksa]

5e. Is able to form a well-reasoned judgement in the event of incomplete or irrelevant data, taking into account the method used to obtain that data. [ks]

5f. Is able to take a stance regarding a scientific argument in the field of biomedical technology and assess its value critically. [ksa].

5g. Has basic numerical skills and is aware of orders of magnitude. [ksa]

6. Is able to collaborate with and communicate with specialists in their chosen track and other relevant parties. A BME Master of Science is able to work with and for others. This necessitates satisfactory interaction, a sense of responsibility, and leadership skills, but also good communication with both colleagues and non-colleagues. A BME Master of Science is also able to participate in a scientific or public debate.

6a. Is able to communicate in writing about research and problem solutions with colleagues, non-colleagues and other relevant parties (in English). [ksa]

6b. Is able to communicate verbally regarding research and problem solutions with colleagues, non-colleagues and other relevant parties (in English). [ksa]

6c. Is able to debate on biomedical technology and its place in society.

6d. Is characterized by professional behaviour, namely drive, reliability, involvement, diligence, perseverance, and independence. [ksa]

6e. Is able to work in a project-based manner on complex projects; is pragmatic and has a sense of responsibility; is able to deal with limited resources; is able to deal with risks; is able to compromise. [ksa]

6f. Is able to work in a multidisciplinary team, with a very broad disciplinary variety. [ksa]

6g. Is able to be team leader.

7. Is able to integrate insights regarding medical and social contexts in their work. Life science and technology are not isolated and always exist in a temporal and social context. Opinions and methods have certain origins; decisions have societal consequences in their time. A BME Master of Science is aware of these things and is able to integrate these insights in their scientific work.

7a. Understands relevant (internal and external) developments in the history of biomedical technology, including the interaction between the internal (idea) development and the external (societal) development. [ks] Integrates aspects of this in their scientific work. [ksa]

7b. Is able to analyse the societal consequences (economically, socially, culturally) of new developments in relevant fields and discuss these with both colleagues and non-colleagues. [ks] Integrates these consequences in their scientific work. [ksa]

7c. Is able to analyse the consequences of scientific thinking and acting on the environment and sustainable development. [ks] Integrates these consequences in their scientific work. [ksa]

7d. Is able to analyse the ethical and normative aspects of the consequences and assumptions of scientific thinking and acting and discuss these with both colleagues and non-colleagues (both in research and in designing). [ks] Integrates these ethical and normative aspects in their scientific work. [ksa].

7e. Takes their place as a professional in our society. [ksa]

## Article 3 Programme admissions

1. Immediate admission to the programme is obtained with:
    a. A completed bachelor's degree in Biomedical Technology obtained at the University of Twente, the Technical University of Eindhoven, or a completed BMT specialization as part of the Life Sciences programme at the University of Groningen.
    b. Proof of admission to the programme, issued by the admission board.
2. Conditional admission to the programme may be obtained by:
    a. A student in possession of a completed technical bachelor's degree obtained at a Dutch university. The conditions that apply in this case are sections 3 through 5 of this article.
    b. A student in possession of a completed university of applied sciences degree for a programme that is relevant to the biomedical technological field. The conditions that apply in this case are sections 3 through 5 of this article, as well as the additional provisions in article 6 of this supplement.
3. In assessing admission applications for the master's programme, the admission board is permitted to require students to complete certain subjects before proof of admission to the master's programme is issued.
4. When issuing proof of admission to the master's programme, the admission board is permitted to decide to exempt the student from certain elements of the programme, with the exception of the final assignment.
5. When issuing proof of admission to the master's programme, the admission board is permitted to set conditions regarding that student's course list for the master's programme, and limit their admission to a specific track only.
6. The decisions of the admission board outlined in section 4 and 5 of this article must first be agreed upon by the examination board.
7. Students who completed non-Dutch pre-university education must be able to demonstrate that they have sufficient proficiency in English, both in written and spoken form. It may be required of them that they score sufficiently on a recognized test in order to be admitted: a score of 6.5 or higher for the IELTS test or a score of 90 or higher for the internet-based TOEFL test[1]. Students

with bachelor's degrees obtained in countries that maintain only English as the main language for higher education[2] are exempt from this language requirement.

**Article 4 Admission board**

1. The Faculty of Science and Technology dean will appoint an admission board for the admission of students who are not immediately admissible conform article 3.1 to the master's programme.
2. The authority to either admit or reject prospective students has been delegated to the board mentioned in section 1 by the Executive Board (reference S&C/387.191/lk).
3. The admission board will consist of at least two members, namely:
   a. The programme director;
   b. The professor or a delegated representative of the chair that the student wishes to graduate from;
   c. In case of foreign students, the internationalization coordinator;
   d. In case of university of applied sciences students, the transfer coordinator for students transferring from a university of applied sciences.

   The programme director is the chairperson of the admission board.
   If the board's chairperson deems it necessary, the programme coordinator and/or study adviser and/or the secretary of the examination board may be added to the board.
   The admission board is permitted to ask the examination board for advice.

[1] IELTS: International English Language Testing System; TOEFL: Testing of English as a Foreign Language; please refer to the UT's website regarding master's programme admissions, http://www.utwente.nl/admissionoffice/master/.
[2] A list of countries that qualify can be found at http://www.utwente.nl/admissionoffice/master/files/Landenlijst/.

## Article 5 Master's programme

1. In the BME master's programme, students opt for one of three tracks that line up with the three fields of study of the MIRA research institute:
   a. Bionanotechnology & Advanced Biomanufacturing (BNT)
   b. Neural & Motor Systems (NMS)
   c. Imaging & Diagnostics (I&D)
2. The BME master's programme is comprised of 120 ECs, 15 and 45 of which respectively are reserved for an internship and a final assignment. Each track has four compulsory subjects (20 ECs). On top of that, the student must fill 40 ECs worth of optional subjects. Please refer to tables 1 through 4 for the details. In terms of optional subjects, 15 out of the 40 ECs must be filled with biomedical engineering subjects. The student can use the list of BME subjects (found on the website, http://www.utwente.nl/bme/education) to choose their optional subjects.
3. The optional subjects are chosen in consultation with the chairperson of the final assignment committee. The course list must be approved by the chairperson of the final assignment committee and the examination committee. The course list must be approved by the end of the first quarter after the student has commenced their BME master's programme at the latest.
4. Any student who already completed one or more compulsory elements of the master's programme during their bachelor's programme, or completed subjects that may be approved as optional subjects for the master's programme, can be granted exemption for those subjects. However, the total number of ECs that the student must complete for the master's programme will not be reduced in such an event.

***Table 1 BME master's programme***

| | EC |
|---|---|
| Compulsory subjects (differ for each track) | 20 |
| Optional subjects (conditions in article 5, section 2 and 3) | 40 |
| Internship | 15 |
| Final assignment | 45 |
| *Total* | 120 |

***Table 2 Compulsory subjects for BNT track***

| Subject code | Name | EC |
|---|---|---|
| 193640040 | Tissue engineering | 5 |
| 201400283 | Biomedical Materials Engineering | 5 |
| 201400330 | Applied Cell Biology | 5 |
| 201400285 | Biostatistics | 5 |

***Table 3 Compulsory subjects for NMS track***

| Subject code | Name | EC |
|---|---|---|
| 191211310 | Technology for Health | 5 |
| 191150700 | Integrative Design of Biomedical Products | 5 |
| 201400286 | Clinical Research Methods | 5 |
| 201400285 | Biostatistics | 5 |

***Table 4 Compulsory subjects for I&D track***

| Subject code | Name | EC |
|---|---|---|
| 201400289 | In vitro molecular diagnostics | 5 |
| 193640020 | Biophysical techniques and molecular imaging | 5 |
| 201400281 | Advanced Medical Imaging & Therapy Systems | 5 |
| 201400285 | Biostatistics | 5 |

## Article 6 Programme for university of applied sciences students

1. The student must first complete a transfer programme of around 30 ECs, determined by the admission board. This programme will be adapted to be in line with any competencies the student has acquired elsewhere.

2. After completing the transfer programme, the student can then be admitted to the BME master's programme.

### Article 7 Internship

The objective of the internship is to let the students gain experience in their future field and apply the knowledge and skills they have acquired thus far into practice, by completing an assignment in an external organization. This external organization may be a health care establishment, a research institute, a university, or a biomedical company.

### Article 8 Final assignment

1. The objective of the assignment is for students to learn how to independently complete a research assignment of a certain size and degree of complexity.
2. The final assignment is usually completed at one of UT's biomedical chairs.
3. The final assignment is chosen in consultation with the graduation professor.
4. If the student has chosen to graduate externally, this falls under the responsibility of one of the professors involved in the BMT/BTE programme.
5. Additional provisions regarding the final assignment can be found in the BME examination board's Regulations.

### Article 9 Transition arrangement

1. Should the programme outlined in article 5 of this supplement be changed, or if any of the other articles in this programme-specific supplement or the general section are changed, the programme director will develop and announce a transitional arrangement.
2. Article 8.4 of the general section outlines the conditions that any such transitional arrangement must meet.
3. The transitional arrangement will be published on the Biomedical Engineering programme's website.

### Article 10 Safety

There are certain safety requirements for working in a laboratory. The student is obliged to take note of these rules[3], and to comply with them.

### Article 11 Order of study units

1. The student must meet the prescience requirements for a study unit before commencing that study unit.
2. The student may not commence the final assignment until they have completed at least 65 ECs as part of the master programme, including the mandatory internship.
3. Before the graduation examination takes place, all other study units must be completed.
4. The examination board is authorized to grant exemption from the provisions in section 1 through 4 of this article, should strict application of these provisions cause an unjustifiable delay in the student's study progress. The student can file a request therefore with the examination board.

[3] Please refer to the Working Conditions and Environmental Regulations (Arbo- en Milieuregelement) at http://www.tnv.utwente.nl/intra/diensten/amh/ and the information about the Practical Group of the Faculty of Science and Technology Practical Group at http://www.tnw.utwente.nl/onderwijs_overig/practica/.

**Article 12 Optional courses**

Contrary to the provisions in article 5 of this supplement, the student may request the examination board's permission for pursuing a free programme as outlined in article 7.3d WHW. The examination board will then assess whether this programme fits within the programme's domain, is cohesive and of a sufficient level in light of the programme's attainment targets.

**Article 14 Student guidance**

Upon enrolment in the programme, the student will be assigned a study adviser. The study adviser's tasks are to on the one hand provide the individual students with both solicited and unsolicited advice regarding all aspects of students' studies, and on the other hand to inform the programme director regarding the students' study progress.

**Article 15 Entry into force and modification**

This arrangement enters into force on 1 September 2016, taking the place of the previous arrangement dated 20 August 2015.

**Confirmed by the dean of the Faculty after having obtained the advice of the Faculty Council and the Programme Committee.**

Enschede, dated 15 July 2016.