These Implementation Regulations apply to the teaching and the examinations related to the Master's degree programme in Life Science & Technology. This document is part of the Teaching and Examination Regulations

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Faculty of Applied Sciences at Delft University of Technology

Implementation Regulations relating to

the Teaching and Examination Regulations for the Master's degree programme

Life Science & Technology, Delft

2016-2017

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ARTICLE 1 - (in line with TER article 4) – The programme's final attainment levels

Master's graduates should:

1. **Competence in one or more scientific disciplines.**
   Building on expected prior knowledge in the basic disciplines of biology, chemistry, physics, mathematics, and chemical engineering, the student develops, in the general compulsory modules, a thorough knowledge of the field of contemporary biotechnology at large and of the major interconnecting between its founding sub-fields (e.g., cellular metabolism and industrial fermentation). Subsequently, the student takes a preferred orientation along one or two specialization(s) to develop mastery in relevant parts of the disciplines of (bio)chemistry (specialization biocatalysis) and/or industrial molecular biology/physiology (specialization cell factory) and/or biochemical engineering (specialization biochemical engineering). In these specialization-specific modules particular emphasis is put on the latest results and methodologies and in the course of their choice the student is stimulated to develop critical reading and interpretational skills with respect to the primary scientific literature.

2. **Competence in doing research.**
   The student is expected to bring some prior experience in (supervised) research, e.g. the 3-months LS&T bachelor research project. The master research project (max. 8 months) is scheduled in the second year of the curriculum, in order for the student to be able to maximally capitalize on previously acquired knowledge. The project is typically carried out in a Department of Biotechnology group with a research profile matching the student's profile to assure a head-on start and expert guidance. A project is designed to be 'integral' i.e. it should trigger exploration of a range of scientific aspects and invoke a range of sufficiently different techniques to stimulate the student to develop intellectual flexibility and interdisciplinary orientation. As an example (for a biocatalysis project): an annotated but otherwise uncharacterized gene is cloned and expressed in a model organism; this species is grown in a fermenter for biomass; the expressed protein is purified; its catalytic activity is explored; prosthetic groups are spectroscopically characterized; a fine-chemical application is devised. The student is challenged to repeatedly formulate sub-research goal and to become acquainted with literature, experimental setups, paradigms in – in the example's case – molecular biology, biochemistry, biophysics, white biotechnology.

3. **Competence in designing**
   Based on a succinctly formulated industrial assignment a group of 3-5 students runs a two-months conceptual design project for a bioprocess or a bioproduct. Starting from unbalanced information the group reformulates the assignment and chooses for a limited set of options in the form of a Basis of Design which should be defendable before a coach and an industrial representative. The subsequent design development confronts the team with questions of integration of existing knowledge, exploration of new fields, making choices of limitation, and relating the results to a range of constraints (economic, environmental, societal acceptance, safety, validation, quality assurance). The design project is scheduled to run concurrently with the compulsory module 'ethical, legal and social issues in biotechnology', whose final assignment is to reflect upon the design outcome.

4. **Scientific approach**
   The curriculum in general is aimed at educating students to become independent, critical scientists and engineers. The student is exposed to, and trained to identify new developments especially in literature assignments in the profile-specific modules. At least during the period of his/her research project the student is expected to attend the monthly ' joint colloquia' of the Department of Biotechnology, where renowned national and international specialists from academia and industry elaborate on relevant topics. Doing a research project also implies participation in the weekly work discussions of the hosting research group, where the student regularly presents intermediate results and puts interpretations tot the test of a critical peer audience. Foreign students are stimulated to adopt a 'bold and egalitarian' approach in science debates.

5. **Basic intellectual skills**
   Extending the basic intellectual skills acquired, e.g., in the LS&T bachelor programme, the student is trained towards independence in assessing problems of increased complexity and in point-of-view adjustment. Decision making (reduction, elimination, re-orientation) is a key element in the design project. The concept of falsification (one original experiment calls for many control experiments) pervades the research project on a daily basis. Critical reading of literature is an integral part of the teaching in profile-specific modules. Modelling and

numerical-analysis skills are also developed in several modules, and possible basic hiatus are remedied at curriculum entry time.

6. **Competence in co-operation and communication**
   Fruitful cooperation with equals, but also with external parties, is attained as conditio sine qua non for a successful design project. Choosing, assigning and accepting roles and responsibilities is an integral part of managing the project. Similarly, research projects by necessity provide many opportunities to develop professional cooperativity with technical assistants and with junior and senior scientists. In a different vein cooperativity skills are obtained in the course of the 3-months industrial internship intended to be a 'culture shock' for the student to juxtapose 'the outside' versus academic life. Each of these parts of the curriculum call for formal verbal and written reporting usually in the English language.

7. **Taking account of the temporal and social context.**
   With the compulsory general module 'Ethical, legal and social issues in biotechnology' the student learns to choose his/her place as a professional in society. In the combination of this module with the Design project the student actualizes the integration of societal aspects in scientific work. Elements of contemporary interaction between society and science & technology also appear in several modules, e.g., atom efficient green chemistry (biocatalysis), toxic metals (advanced enzymology), products from waste (environmental biotechnology).

ARTICLE 2 (in line with TER article 5) – Admission to the programme

1. All students possessing a certificate proving that they have successfully completed their Bachelor of Science studies in Life Science & Technology or *equivalent* will be admitted to the programme. These equivalencies and a description of the entry levels, are laid down in the webpage transfer matrix.

2. Students who do not possess the degree mentioned in paragraph 1 are required to obtain proof of admission to the programme from the dean, who will seek the advice of the admissions officer on this matter. The levels and subjects for assessing previous education are a sufficient level in the following knowledge areas:
   a) Mathematics (differential equations, linear algebra)
   b) Chemistry (organic, inorganic, analytic, physical)
   c) 'Bio' (i.e. biochemistry, molecular genetics, microbiology)
   d) (Bio) chemical technology (including transport phenomena)

3. In order to obtain proof of admission, the student must meet or, as the case may be, possess:
   a. the general relevant criteria set by the executive board in the "Policy on fees and enrolment", laid down in Appendix 1 of the Student Charter (central part), and clarified in Part 1.2 " Entrance and admission" of the mentioned Student Charter.
   b. a certificate, together with the accompanying list of marks, proving that he/she possesses knowledge of a sufficiently high level and broad scope to successfully complete the master programme within the allotted period.

4. Students in possession of
   a. *Bachelor's diploma from a foreign university* can only be admitted to the programme provided that he/she has a minimum Grade Point Average of 75% of the maximum number of credits available. Proof of English language proficiency is another admission criterion. The equivalencies for holders of foreign diploma's and a description of the entry levels, are laid down on the webpage International Applicants.
   b. *a Bachelor of Engineering degree in Life Science & Technology (*HBO) or equivalent will be admitted to the programme. These equivalencies and a description of the entry levels, are laid down in the webpage admission HBO.
      Students with a Bachelor of Engineering degree (HBO) can be admitted to the programme provided he/she has a minimum Grade Point Average of 75% and no delay of study (guideline). Before starting the (Bridging) Programme, students should have passed the entrance exams for Mathematics and English.

ARTICLE 3 - The study load and academic year

1. The study load for the Master's degree programme is 120 credits. None of the components of the programme may have formed part of the Bachelor's degree programme.
2. The Master's degree programme consists of 2 academic years.
3. One academic year is divided into two semesters, each containing 2 teaching periods.

ARTICLE 4 - The composition of the Master's programme

4.2. The study programme is completed in the following way:
   a. In the first year: general compulsory courses (15 EC), specialisation courses (18 EC), electives (12 EC), Design Project (12 EC), and Ethical, Legal & Social Issues in Biotechnology (3EC).
   b. In the second year: master thesis project (45 EC) & company internship (18 EC).

4.3. General overview of the programme:

Code	Course name	Instructor/remark	Period	EC	Total
YEAR 1	General compulsory courses				
LM 3572	Introduction to Algorithmics & Programming Skills	Dr. S.A. Wahl, Dr. C. Picioreanu	1	1	
LM 3452	Bioprocess Integration	Dr. Ir. A.J.J. Straathof, Dr. Ir. M.Ottens	1	6	
LM 3433	Analysis of Metabolic Networks	Dr. S.A. Wahl	1, 2	5	
	Other compulsory modules				
LM 3561	Ethical, Legal and Social Issues in Biotechnology	Dr. L. Asveld, Prof. Dr. P. Osseweijer	4	3	
LM 3822	Design Project	Prof. dr. Ir. L.A.M. van der Wielen	4	12	
					27
	Specialisation modules (art. 4.4.)	Students must complete one full specialisation!			18
	Electives (art. 4.5.)				12
(LM 3171	*Metabolic Engineering Assistance class (art. 4.5.)*	*Dr S.A. Wahl – homologation course*	*1*	***3)***	
YEAR 2	Compulsory modules				
LM 3901	Master Research Project		Year 2	45	
LM 3802	Company Internship	Preferably after the master research project	Year 2	18	
					63
	Total				120

4.4. Specialization-specific Compulsory Modules (18 EC) – year 1 (Students must complete at least one full specialization!)

2A: Specialization: BIOCHEMICAL ENGINEERING

Code	Course name	Instructor/remark	Period	EC
LM 3741	Fermentation Techn. & Environmental Biotechnology	Dr. ir R. Kleerebezem, Dr. W.M. van Gulik, Prof. Dr ir. M.C.M. van Loosdrecht, Prof. Dr ir. H.J. Noorman	1,2	6
LM 3751	Transport & Separation	Dr. M. C. Cuellar Soares, Prof. Dr. ir. L.A.M. v.d. Wielen	3	6
LM 3761	Numerical Methods, Modeling & Simulation Techniques	Dr. C. Picioreanu	1,2	6
				18

2B: Specialization: BIOCATALYS

Code	Course name	Instructor/remark	Period	EC
LM 3731	Biocatalysis	Prof. Dr. U. Hanefeld, Prof. Dr. I.W.C.E. Arends	1, 2	6
LM 3701	Advanced Enzymology	Dr. ir. P.L. Hagedoorn	1, 2	6
-	Elective(s)	*Students choose 6 EC from the preferred elective list of the 'specialization Biocatalysis'*	3	6
				18

2C: Specialization: CELL FACTORY

Code	Course name	Instructor/remark	Period	EC
LM 3442	Metabolic Reprogramming	Dr. P.A.S. Daran-Lapujade	1, 2	6
LM 3601	Molecular Biotechnology & Genomics	Dr. J.G. Daran	1, 2	6
LM 3611	Microbial Community Engineering	Dr. ir. R. Kleerebezem	3	6
				18

4.5. Electives (12 EC)

A list with preferred electives & an extensive description of the procedures on choosing an elective, are published on the blackboard organisation 'Student information Master Life Science & Technology' → study information → Electives.
The coordinator of the specialisation must approve the preferred electives. Courses chosen from the other LS&T specialisations, are automatically approved as an elective.

The course LM3171 'Metabolic Engineering Assistance class' (3EC) is offered as a homologation course for international & lateral entry students. Although offered in the elective part of the programme, this homologation class is indispensable for all those student with insufficient prior knowledge on the topic.

ARTICLE 5 - Variations

Students are allowed to substitute 30 EC of the above mentioned programme (12 EC electives + 18 EC company internship) by the following variations

- Science Education Track of MSc-SEC (M.A.F.M. Jacobs – TNW) (see also article 6)
- Science Communication Track of MSc-SEC (M.A.F.M. Jacobs – TNW)
- Annotation in 'Technology in Sustainable Development' (TiSD) (Prof.dr P. Osseweijer – TNW)
- Study abroad (InternationalOffice-TNW@tudelft.nl).

These variations must be approved by the coordinator of the specialisation.

ARTICLE 6 - Honours programme

Regulations on the Honours programme are described in *article 11 of the Teaching & Examination Regulations* of the Master's degree programmes Applied Sciences 2016 – 2017.
The honours programme is a challenging additional programme for students with higher than average performance (>7.5 weighted average). The honours programme consists of at least 20 EC on top of the regular master programme of 120 EC. The full Master's programme LST, including the additional honours programme should be finished according to nominal duration , with again a weighted average of 7.5.
Each individual honours programme needs to be discussed with, and approved by the programme director **before the start** of the honours programme!

Schematic overview of the honours programme

Collective Part (5 EC) Critical Reflection on Technology (UD2010, 5EC, obligatory)

Individual Part (15 EC):
Students have the choice

1. to join the Company Oriented Honours Programme of Applied Sciences (AS1011HPM 15 EC), or
2. to compose a challenging, coherent package of courses or projects of at least 15 EC, or
3. to participate in the iGEM project (LM3691, 18 EC). The iGEM project can be performed as part of an individual honours programme, under the condition that the Design project (12 EC) will be carried out as well, or
4. to complete the Unitech Programme

The programme should be submitted to the faculty contact person for the honours programme, mrs Helen Emmerink, after approval by the LST programme director Prof. Dr W.R.Hagen.

ARTICLE 7 - Education track of the MSc-programme Science Education & Communication (only Dutch-speaking students).

Students in the MSc-programme Life Science & Technology can do educational modules.
The coordinator of the specialisation has to approve.

The educational programme is aimed at Dutch-speaking students with a BSc-background in (applied) physics, chemistry, life science & technology, applied mathematics and computer science only, because they are oriented towards the Dutch school system and because it includes internships (Schoolpracticum) at Dutch secondary schools. Consequently the educational specialisation modules are taught in Dutch. The programme consists of Basisdeel/Ed1 (30 EC) and Verdiepingsdeel/Ed2 (30 EC).

- The minor Education (Basisdeel/Ed1) can be done during the bachelor programme and leads to certification as a *tweedegraads* secondary school teacher with limited qualification (*beperkte bevoegdheid*).
- If a student has done the minor Education, only the Verdiepingsdeel/Ed2 of 30 EC remains for the master programme specialisation. The combination of the minor Education and Ed2 specialisation leads to certification as a fully-qualified *eerstegraads* (grade-one) secondary school teacher. The qualification will be mentioned on the master diploma. These students can do the Verdiepingsdeel/Ed2 also as a second master.
- Students that did not take the minor Education can follow the Basisdeel/Ed1 specialisation as part of their master programme and then do the Verdiepingsdeel/Ed2 as a second master in order to become fully qualified.

The programme should be approved by the coordinator, M.A.F.M. Jacobs.

ARTICLE 8 - Double degree

Students who opt for a **double degree** (second master) and have obtained permission are allowed to spend the Scientific and Social Orientation on modules from the second master programme.
Double degree programmes combining Life Science & Technology with other master programmes, such as Management of Technology, are always subject to the restrictions imposed by the university. The main restrictions are that the double degree programme comprises at least 180 EC and that there are two identifiable final project reports for both degrees. Formal permission from the Boards of Examiners of both faculties is required.

The approved application has to be sent to the Executive Board for final decision on the Double Degree.

ARTICLE 9 - Explanation of programme components.

Every year, the digital study guide includes a description of the various programme components, along with the criteria for assessing these components if assessment is different from that applied for interim examinations (reports, presentations, etcetera).

ARTICLE 10 - Deviations from the programme

Only in exceptional cases a deviation from the programme is possible. Such deviations need prior approval by the Board of Examiners; for this reason a student should send a legitimate request to the Board of Examiners after consultation with the coordinator of the specialisation.

If students participate in iGEM (LM3691 - 18 EC) as part of their regular programme, they can apply for an exemption for the Design project (LM3822 - 12 EC). The remaining 6 EC are extracurricular