SECTION B: PROGRAMME-SPECIFIC SECTION EMBEDDED SYSTEMS

1. General provisions

Article 1.1 Definitions
In addition to definitions in Section A, Article 1.2, the following definitions are used in this Section B:
1. Programme mentor: a staff member, who is appointed by the examination board, to supervise students until they start their Master's thesis project.
2. The individual study programme is the course programme of a student that is approved according to the rules of the master Embedded Systems.

2. Programme objectives and final attainment targets

Article 2.1 Aim of the programme
This Master's programme is intended to impart sufficient knowledge, skills and a clear understanding of the area of Embedded Systems in order that the graduate is able to perform independent professional and scientific activities in the area at an academic level.

Article 2.2 Final attainment targets

1. The graduate has an all-embracing view on embedded systems, their design and their application in systems of various sizes (e.g. from small robots to cyber physical and networked systems) including their evolution over time, demonstrated by an integration approach in system design.

2. He[1] is capable of analysing the functional behaviour of complex embedded systems in a structural way using appropriate abstractions.

3. He is able to describe and study the non-functional aspects of embedded systems, e.g. resource boundedness and dependability.

4. He has a thorough knowledge of state-of-the-art methods and techniques for embedded systems design such as requirements engineering, hardware-software integration, performance modelling and analysis, validation and testing.

5. He is able to design embedded systems that satisfy the functional and non-functional requirements, taking into account the performance of the system during its lifetime. He is also aware of costs and environmental issues making optimal use of the available resources.

6. He has the ability and attitude to include other disciplines or involve practitioners of these disciplines in his work, where necessary. As an engineer he is therefore able to work in a multidisciplinary setting.

7. He is able to conduct research and design independently and has a scientific approach to complex problems and ideas.

8. He possesses intellectual skills that enable him to reflect critically, reason and form opinions.

9. He has the ability to communicate the results of his learning, thinking and decision-making processes at an international level.

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[1] "He", "his" or "him" is referring to graduates of either gender.

10. He is aware of the temporal and social context of science and technology (comprehension and analysis) and can integrate this context in his scientific work.

3. Further admission requirements

Article 3.1 Additional admission requirements

1. Students in possession of a Bachelor degree in Electrical Engineering (*Elektrotechniek*) or Computer Science (*Technische Informatica*, *Telematica* or *Informatica*) from a Dutch university are eligible for direct admission to the programme.

2. Students in possession of another Bachelor's degree issued by a Dutch university are eligible for admission to the programme if their knowledge and skills are comparable to section 3.1.1 after following a pre-master programme.

3. Students in possession of a relevant Dutch Bachelor's degree issued by a School of professional education (Dutch: HBO) can gain admission after first successfully completing a pre-master programme.

Article 3.2 Pre-Master's programme

For students with an 'HBO degree' Elektrotechniek the pre-master programme is:

Course code	Name	Credits	Period
201500291	Calculus A	5	Semester 1
201500293	Calculus B	4	Semester 1
191512061	Linear Algebra A	3	Semester 1
191231490	Linear Systems	6	Semester 1
191512041	Calculus C	3	Semester 1
201400315	Digital Logic and Computer Organization	4	Semester 1
201500051	Self-tuition project (programming)	5	Quarter 1B

For students with an 'HBO degree' Technische Informatica, Computertechniek the pre-master programme is:

Course code	Name	Credits	Period
201500291	Calculus A	5	Semester 1
201500293	Calculus B	4	Semester 1
191512061	Linear Algebra A	3	Semester 1
191231490	Linear Systems	6	Semester 1
191512041	Calculus C	3	Semester 1
201400315	Digital Logic and Computer Organization	4	Semester 1
191210001	Instrumentation for Embedded Systems	5	Quarter 1B

4. Curriculum structure

Article 4.1 Composition of programme

The 120 EC programme consists of the following components:

- a. compulsory courses
- b. homologation
- c. electives
- d. internship (optional, not for students with Dutch institute of professional education (HBO)) / Multi-Disciplinary Design Project (optional)
- e. final project preparation and final project

Article 4.2 Compulsory units of study

The compulsory courses are:

Year 1

Course code	Name	Credits
192130240	Embedded Computer Architecture 1	5
192140122	System Validation	5
201200006	Quantitative Evaluation of Embedded Systems	5
192130200	Real-time Systems	5
201000168	Embedded Systems Laboratory	5

Year 2

Course code	Name	Credits
201600017	Final Project Preparation	10
192199978	Final Project	30

Article 4.3 Homologation

Due to the interdisciplinary character of the Embedded Systems programme, most students will not have all necessary prior knowledge. A maximum of 15 EC may be included in the individual study programme.

1. Students who have completed a Dutch university Bachelor's degree programme in computer science are required to include the following course in the homologation part of the master programme:

Course code	Name	Credits
191210001	Instrumentation for Embedded Systems	5

Students may additionally also follow a part of a 15 EC TEM (Twente Educational Model) module (if possible) of the bachelor Electrical Engineering. Approval by the examination board is required.

Missing knowledge can also be obtained with the course Self-tuition project (192191500)

2. Students who have completed a Dutch university Bachelor's degree programme in electrical engineering are required to include the following course in the homologation part of the master programme:

Course code	Name	Credits

191210760	Advanced programming	5

Students may additionally also follow a part of a 15 EC TEM (Twente Educational Model) module (if possible) of the bachelor Computer Science. Approval by the examination board is required.

Missing knowledge can also be obtained with the course Self-tuition project (192191500)

3. Students with a Bachelor's degree awarded by a Dutch institute of professional education (HBO) are required to include the following course in the homologation part of the master programme:

Course code	Name	Credits
192130122	Energy Efficient Embedded Systems	5

Students may additionally also follow a part of a 15 EC TEM (Twente Educational Model) module (if possible) of the bachelor Computer Science or Electrical Engineering. Approval by the examination board is required.

Missing knowledge can also be obtained with the course Self tuition project (192191500)

4. For admitted students not mentioned in paragraph 1, 2 and 3 an individual homologation programme is made by the examination board.

Article 4.4 Electives

Specialization courses totaling at least 15 credits should be selected. An individual study programme containing courses that are not in the list, e.g. relevant courses from the TU-Delft and TU-Eindhoven, require approval from the examination board. See Article 5 for approval of the Individual Study Programme.

Course code	Name	Credits
192135310	Modelling & Analysis of Concurrent Systems	5
191211590	System-on-chip-Design for Embedded Systems	5
	Internet of Things	5
191210780	Modern Communication Systems	5
191210750	System-on-chip-Design	10
192130112	Distributed Systems	5
191210760	Advanced programming	5
192130250	Embedded Computer Architectures 2	5
192130122	Energy Efficient Embedded Systems	5
191210900	Introduction to Biometrics	5
201000231	Computer Arithmetic	5
201000232	Knowledge-Based Control Systems	4
192130022	Design of Digital Systems	5
191210950	Implementation of Digital Signal Processing	5
191210910	Image Processing and Computer Vision	5
192111301	Ubiquitous Computing	5
192620010	Mobile and Wireless Networking	5
192170015	Testing Techniques	5

191210850	Advanced Analog IC electronics	5
191211090	Real-time software Development	5
192130210	Real-Time Systems 2	5
201400170	Best Practices in Software Development	5
201100254	Advanced Computer Vision and Pattern Recognition	5
	Ad-Hoc Networks	5
191211060	Modern Robotics	5
191210840	A/D Converters	5

Article 4.5 Internship and Multi-Disciplinary Design Project

1. An internship (191211208) may only be chosen by students whose prior education included 30 credits or less worth of work experience.
2. The students can complete an internship worth 20 credits, or a multi-disciplinary design project (191211650) worth 10 credits, but not both, only after an agreement with the programme mentor.

Article 4.6 Thesis Project

1. A student will carry out the thesis project to the accountability of the chair ICD, SCS, CAES, DACS, PS, RaM or FMT.
2. The thesis project cannot be carried out in the same organization as the internship.
3. The thesis project of 40 credits consists of a Final Project Preparation (201600017) and a Final project (192199978).
4. The Final Project Preparation consists of literature survey, feasibility study and detailed planning for the graduation project. The preparation has to be finished before the start of the graduation project.
5. A student can only start with the thesis project if at most 10 EC of courses is not passed. This does not include the final project preparation.
6. The graduation committee is formed by a minimum of 3 persons, at least one of whom is a full or associate professor of the chair, mentioned in paragraph 1. The second member of that chair is a full, associate or assistant professor, postdoc or PhD candidate. The third member is a full, associate or assistant professor from a different chair related to the embedded system master. This third member may also be from a chair of the TU Delft or TU Eindhoven. Additional members, e.g. from a company or research institute, must have at least a Master's degree.

5. Study Programme

1. Students must draw up their individual study programme and submit this to the examination board for approval before the start of the third quarter of their first year.
2. The composition of the thesis committee and the thesis description have to be submitted to the examination board within a month of starting their final thesis project.
3. Each individual amendment to an approved study programme or an approved thesis committee must be resubmitted to the examination board for approval.

6. Degree

Students who have successfully completed their Master's final examination are awarded a Master of Science degree. The degree awarded is stated on the diploma.

7. Transitional and final provisions

Article 7.1 Transitional provisions

Notwithstanding the current Teaching and Examination Regulations, the following transitional provisions apply for students who started the programme under a previous set of Teaching and Examination Regulations:
- A maximum of 20 EC of homologation may be included in the individual study programme for students that started this master programme prior to September 2017.
- The individual project (191211749) year 2015-2016 is equivalent with the final project preparation (201600017)

Article 7.2 Publication

1. The dean will ensure the appropriate publication of these Regulations and any amendments to them.
2. The Teaching and Examination Regulations will be posted on the faculty website.

Article 7.3 Effective date

These Regulations enter into force with effect from 1 September 2017

Thus drawn up by the ….. on …2017….

Advice from Board of Studies,
……, on [date] …...
…..., on [date] …...
…..., on [date] …...

Approved by authorised Faculty Council on [date] …....
Adopted by: the dean on [date] ……… 20….