

**TEACHING AND EXAMINATION REGULATIONS  
(TER)  
(see Article 7.13 of the Higher Education and Research Act)**

**2014-2015**

**MASTER'S PROGRAMME  
EMBEDDED SYSTEMS**

**UNIVERSITY OF TWENTE**

<b>SECTION 1 - GENERAL</b> .....	<b>3</b>
ARTICLE 1 – DEFINITIONS OF TERMS USED .....	3
ARTICLE 2 – PROGRAMME COMPOSITION .....	4
ARTICLE 3 – THE PROGRAMME’S FINAL ATTAINMENT LEVELS .....	4
ARTICLE 4 – ADMISSION TO THE PROGRAMME .....	5
ARTICLE 5 – LANGUAGE .....	6
<b>SECTION 2 – INTERIM EXAMINATIONS</b> .....	<b>6</b>
ARTICLE 6 - NUMBER, TIMES AND FREQUENCY OF EXAMINATIONS .....	6
ARTICLE 7 – VALIDITY OF INTERIM EXAMINATIONS .....	6
ARTICLE 8 - THE FORM OF THE INTERIM EXAMINATIONS .....	6
ARTICLE 9 – ORAL INTERIM EXAMINATIONS.....	6
ARTICLE 10 – DETERMINING AND ANNOUNCING THE RESULTS .....	7
ARTICLE 11 – THE RIGHT TO INSPECT THE RESULTS .....	7
ARTICLE 12 – SUBSEQUENT DISCUSSION OF THE INTERIM EXAMINATION RESULTS .....	7
<b>SECTION 3 – STUDYING WITH A DISABILITY</b> .....	<b>8</b>
ARTICLE 13 – ADAPTATIONS TO ASSIST STUDENTS WITH A DISABILITY .....	8
<b>SECTION 4 – APPROVAL BY THE BOARD OF EXAMINERS</b> .....	<b>8</b>
ARTICLE 14 EXEMPTION FROM INTERIM EXAMINATIONS OR PRACTICALS.....	8
ARTICLE 15 ELECTIVE SUBJECTS.....	9
ARTICLE 16 FLEXIBLE STUDY PROGRAMME .....	9
<b>SECTION 5 – EXAMINATION</b> .....	<b>9</b>
ARTICLE 17 – THE TIMES AND FREQUENCY OF THE EXAMINATION .....	9
ARTICLE 18 – STUDENT SUPPORT AND GUIDANCE .....	9
ARTICLE 19 – MONITORING ACADEMIC PROGRESS.....	9
<b>SECTION 6 – APPEALS AND OBJECTIONS</b> .....	<b>9</b>
ARTICLE 20 .....	9
<b>SECTION 7 – CONTRAVENTION, CHANGES AND IMPLEMENTATION.....</b>	<b>10</b>
ARTICLE 21 – CONTRAVENING THE REGULATIONS.....	10
ARTICLE 22 – AMENDMENTS TO THE REGULATIONS .....	10
ARTICLE 23 – TRANSITIONAL REGULATIONS .....	10
ARTICLE 23 – PUBLICATION OF THE REGULATIONS.....	10
ARTICLE 25 – ENTRY INTO FORCE DATE OF COMMENCEMENT .....	10
<b>APPENDIX A</b> .....	<b>11</b>
ARTICLE 1 - STUDY LOAD .....	12
ARTICLE 2 - COMPOSITION OF THE DEGREE PROGRAM.....	12
ARTICLE 3 – CORE PROGRAM.....	12
ARTICLE 4 – SPECIALISATION SUBJECTS .....	12
ARTICLE 5 - HOMOLOGATION COURSES.....	14
ARTICLE 6 – INTERNSHIP AND MULTI-DISCIPLINARY DESIGN PROJECT.....	15
ARTICLE 7 – GRADUATION WORK .....	15
ARTICLE 8 – STUDY PROGRAM.....	15
ARTICLE 9 – BRIDGING COURSES .....	15

The Board of the Electrical Engineering, Mathematics and Computer Science Department of the University of Twente

in view of articles 9.15, first paragraph, subparagraph a, 7.13, first and second paragraph, 9.38, subparagraph b, and 9.18, first paragraph, subparagraph a, of the Higher Education and Scientific Research Act of the Netherlands

having heard the recommendations of the involved Education Committees

with due observance of the consent of the involved Department Councils

**hereby establishes**

Teaching and Examination Regulations for the Embedded Systems Master's degree programme.

## Section 1 - General

### Article 1 – Definitions of terms used

The terms used in these regulations should be interpreted as meaning the same as in the Higher Education and Scientific Research Act, insofar as they are defined in that Act.

The following terms are to be defined thus:

- a. the Act: the Higher Education and Scientific Research Act (in Dutch, the WHW), in the Dutch Bulletin of Acts, Orders and Decrees, number 593 and as amended since;
- b. the Dean If an institution that is fully or partly responsible for the programme has opted for a Joint Department Board, then "Dean" will also include the Department Board; where matters relate only to one of the departments named on the title page: the Dean of that department: for broader issues: the three Deans collectively;
- c. programme: paragraph 1, the Master's degree programme as denoted in Article 7.3a subparagraph b of the Act;
- d. student: anyone enrolled at Eindhoven University of Technology, Delft University of Technology or the University of Twente as a student or external student for the purpose of benefiting from education or for the purpose of sitting the interim examinations and undergoing the examination which form part of the programme;
- e. subject: a unit of study within the programme as referred to in Article 7.3, paragraphs 2 and 3 of the Act;
- f. practical: a practical exercise as intended in Article 7.13, paragraph 2, subparagraph d of the Act, taking one of the following forms:
  - writing a thesis
  - conducting a project or developing an experimental design
  - completing a design or research assignment
  - conducting a literature review
  - completing an internship
  - giving a public presentation

- participating in fieldwork or an excursion
  - conducting tests and experiments
  - writing a position paper
  - or participating in other educational activities aimed at enabling participants to attain certain knowledge, insights or skills;
- g. interim examination: an assessment of the student's knowledge, insight and skills in relation to a subject, as well as the marking of that assessment by at least one examiner, appointed for that purpose by the Board of Examiners;
- h. examination: an assessment by which the Board of Examiners, in accordance with Article 7.10 of the Act, establishes whether all examinations in the various subjects that constitute the Master's degree programme have been successfully completed;
- i. Board of Examiners: the programme's Board of Examiners, which has been installed in accordance with Article 7.12 of the Act;
- j. examiner: the individual who, in line with Article 7.12, paragraph 3 of the Act, has been appointed to set the examinations;
- k. credit: a credit awarded in accordance with the European Credit Transfer System (ECTS); one credit denotes a study load of 28 hours;
- l. working day: Monday to Friday with the exception of recognised national public holidays;
- m. study guide: a guide to the degree programme containing specific information pertaining to the various subjects;
- n. institution: Eindhoven University of Technology, Delft University of Technology or the University of Twente;
- o. disability: all conditions which are (at least for the period in question) chronic or lasting in nature and which form a structural limitation for the student in receiving education, sitting interim examinations or taking part in practicals.

## Article 2 – Programme composition

1. The following points regarding the programme are included in the Implementation Regulations in the appendix:

1. study load,
  2. composition of the degree programme.
  3. core programme,
  4. elective subjects,
  5. homologation courses,
  6. internship,
  7. graduation work,
  8. study programme,
  9. elective degree programme,
  10. the form of the interim examinations,
  11. The frequency, terms and sequence of interim examinations.
2. The appendix forms an integral part of these regulations.

## Article 3 – The programme's final attainment levels

Embedded Systems graduates:

- 1. Have a holistic view on embedded systems, their development, and their embedding in larger systems
- 2. Are able to master complex embedded systems
- 3. Can describe and study structure and behaviour of embedded systems
- 4. Possess knowledge of contemporary techniques
- 5. Are proficient in the Design of embedded systems
- 6. possess knowledge of requirement engineering, modelling, testing and implementation techniques
- 7. Have a flexible and inquisitive mind with regard to developments in the field
- 8. Invent own specific tools, theories and techniques if unavailable
- 9. Are aware of their own position and that of embedded systems in society
- 10. Can present and communicate their ideas and visions on embedded systems
- 11. Can work in a multidisciplinary design team

#### Article 4 – Admission to the programme

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 as under 1) after following a pre-master programme.
3. Students in possession of a Dutch Bachelor's degree issued by a School of professional education (Dutch: HBO, HTS) can gain admission after first successfully completing a bridging programme; to be admitted to the bridging programme, tests of English and mathematics have to be passed.
4. Students who are not in possession of the diploma mentioned in paragraph 1, 2 or 3 will require a certificate of admission issued by the Dean.
5. Notwithstanding the provisions of paragraph 1, 2 and 3, the Dean may under special circumstances admit a student to one or more interim examinations or practicals of the programme before the student has passed the Bachelor's examination. A limited period of validity may be set for such permission.
6. A student that is in the possession of a non-Dutch Bachelor degree is eligible for admission to the programme if:
  - 1) The field and the level of the Bachelor degree are comparable to those of the Dutch Bachelor degrees that give admittance to the Master's programme.
  - 2) As a guide-line for admission: student must have a Grade Point Average (GPA) of at least 75% of the maximum available points.
  - 3) Student provides one of the following proofs of English language proficiency:
    - An IELTS (academic version) overall Band score of at least 6.5,
    - a TOEFL (Test of English as a Foreign Language) score of at least 90 (internet-based test),
    - or a proof that he/she has passed the University of Cambridge 'Certificate of Proficiency in English' or the University of Cambridge 'Certificate in Advanced English'
 Nationals from the USA, U.K., Ireland, Australia, New Zealand and Canada are exempt from the proof of English language proficiency requirement.
7. For admission to the EIT-ES track the student should satisfy the admission rules of the ES program, specified in Article 4. In addition, an admission committee appointed the EIT-ICT Labs technical major will review the applications both for technical and entrepreneurial and innovative qualities.

## Article 5 – Language

Education shall be provided in English. Students shall sit interim examinations and undergo the examination in English. The Dean has the authority to adapt language criteria under certain circumstances.

## **Section 2 – Interim examinations**

### Article 6 - Number, times and frequency of examinations

1. There are at least two opportunities in each academic year to sit interim examinations.
  - the first opportunity is immediately after the teaching period for the course to which the interim exam in question relates,
  - the second opportunity is at the end of the subsequent teaching period during the same academic year, or else during the resit period in August.
2. A time table of all opportunities for sitting written interim examinations is drawn up before the start of each semester and details are published. If absolutely necessary, changes can be made to this interim examinations time table but only with approval of the Board of Examiners and if the changes are communicated to students through the official means of communication at least 4 weeks in advance. In case of force majeure, deviation from this period is allowed, only by decision of the Board of Examiners.
3. Notwithstanding the provisions of paragraph 1, there will be at least one opportunity in a year to sit interim examinations relating to subjects not taught in that academic year.
4. If a subject is removed from the study programme, there will be two resits in the following academic year.
5. In exceptional cases, the Board of Examiners may permit a deviation from the standard number of times and the way in which certain interim examinations may be administered in favour of the student.

### Article 7 – Validity of interim examinations

1. The result of an interim examination is valid for an unlimited period.
2. However, in cases where the interim examination result dates from over six years ago, the Board of Examiners may impose an additional or substitute interim examination.

### Article 8 - The form of the interim examinations

1. Interim examinations will be administered in accordance with the details set out in the prospectus of the subject in question.
2. Interim examinations held within the framework of another programme are administered in accordance with the procedure set out in, or pursuant to, the Teaching and Examination Regulations of that other program.

### Article 9 – Oral interim examinations

1. Oral interim examinations will be held in public, unless determined otherwise by the Board of Examiners in a special case or unless the student has formally objected to the public nature of the interim examination.
2. As a rule a second examiner will be present at an oral interim examination, but not at the University of Twente.

3. Prior to an oral interim examination, the examiner must ask the student to provide proof of identity.

#### Article 10 – Determining and announcing the results

1. The examiner is required to determine the result of an oral interim examination as soon as the interim examination is finished and to supply the student with a written statement of the result.
2. In the case of written interim examinations, the examiner is required to determine the result as soon as possible after the interim examination but within 15 working days at most. Taking due account of the student's right to privacy, the student administration then ensures that the results are registered and published within 20 working days of the interim examination date. If the examiner is unable to meet these criteria due to extenuating circumstances, the examiner must inform the Board of Examiners, stating reasons for the delay. The Board of Examiners will then pass this information on to the student or students without delay, and a new date for announcing exam results will simultaneously be made known.
3. Interim examinations taken in other than oral or written form are usually taken by delivering a report or an elaboration of exercises, here referred to as a deliverable. In case several pieces of work need to be delivered, the last piece of work is meant. The examiner will determine the result of such an interim examination as soon as possible, but within 15 working days after the final delivery date that has been determined by the examiner and has been communicated to the student, provided that the piece of work has been delivered by the student before the set deadline.
4. When receiving the result of an interim examination, the student will be made aware of his or her right to inspect the results as referred to in Article 10, the opportunity for a subsequent discussion as referred to in Article 11 and the opportunity to lodge an appeal with the Examination Appeals Board.

#### Article 11 – The right to inspect the results

1. For a period of at least 20 working days after notification of the results of any written interim examination, the student has the right to inspect his or her marked work, on request. If requested, he or she will be supplied with a copy of the marked work.
2. During the period referred to in paragraph 1, all interested individuals may acquaint themselves with the questions and assignments set in the interim examination in question, as well as with the criteria used for marking.
3. The Board of Examiners may determine that the right to inspection as referred to in paragraphs 1 and 2 will be exercised at a location specified beforehand and at no less than two specific times, also to be decided in advance.  
If the student can prove that he/she is or was unable to be present at the location at the set time due to circumstances beyond his or her control, then another opportunity will be provided, if possible within the period stated in paragraph 1.  
The location and times mentioned in the first sentence will be announced within five working days.

#### Article 12 – Subsequent discussion of the interim examination results

1. As soon as possible after the results of an oral interim examination have been announced, an opportunity will be arranged for the examiner to discuss the results with the student, if so requested by the student or at the instigation of the examiner. At this meeting, the rationale behind the marks awarded will be explained.

2. For a period of 20 working days after the results have been announced, students who have taken a written interim examination may submit a request to discuss the results with the relevant examiner. The discussion will take place within a reasonable time span and at a place and time determined by the examiner.
3. In cases where a collective discussion is organised by or on the instructions of the Board of Examiners, a student may only submit a request, as referred to in the preceding paragraph, if the student was present at the collective discussion and if the student provides a good reason for the request or if, due to circumstances beyond the student's control, the student was unable to attend the collective discussion.
4. The provisions of paragraph 3 are similarly applicable if either the Board of Examiners or the examiner first gives the student the opportunity to compare his/her answers with model answers.
5. The Board of Examiners may permit deviations from the provisions of paragraphs 2 and 3.

## Section 3 – Studying with a disability

### Article 13 – Adaptations to assist students with a disability

1. Students who have a physical or sensory disability are entitled to adaptations in teaching, interim examinations and practicals. If possible, the student must submit a written request to the Dean at least three months before the student is due to participate in coursework, interim examinations or practicals. These adaptations will be geared as much as possible to a student's individual needs, but they must not affect the quality or the degree of difficulty of a subject or an interim examination programme. The facilities provided to this end may involve adapting the form or duration of interim examinations or practicals to the student's individual situation or making practical aids available. At Eindhoven University of Technology, this request should be submitted to the STU/International Relations Office. At Delft University of Technology and at the University of Twente, this request should be submitted to either a university student counsellor or the department student counsellor.
2. The request referred to in paragraph 1 should be accompanied by a recent medical certificate from a doctor or a psychologist. If there is evidence of dyslexia, for example, the request should be accompanied by a document issued by a recognised dyslexia-testing bureau (i.e. registered with BIG, NIP, or NVO). If possible, this certificate should also give an estimation of the extent of the disability.
3. The Dean will decide on requests for adaptations to the educational environment. The Board of Examiners will decide on requests for adapting interim examinations. The decision must be announced within four weeks.

## Section 4 – Approval by the Board of Examiners

### Article 14 Exemption from interim examinations or practicals

1. After having been advised by the relevant examiner, the Board of Examiners may decide to exempt students from an interim examination or practical. Conditions for exemption are to be specified in the Rules and Regulations of the Board of Examiners.
2. The Board of Examiners may exempt a student from a specific interim examination only on the grounds of the content, level and quality of interim examinations successfully completed earlier or on the grounds of the student's prior knowledge, insights and skills developed outside of higher education.



## Article 15 Elective subjects

Criteria for approval of elective subjects to be followed by the student, are contained in the Implementation Procedures (appendix A).

## Article 16 Flexible study programme

1. Students can compile their own degree program, with an associated degree audit. The degree program, which requires prior approval by the Board of Examiners, must consist wholly or largely of components taught at one of the three universities within the framework of, or in support of, the program. It may be supplemented by components taught within the framework of, or in support of, other degree programs.
2. When applying to the Board of Examiners for the prior approval referred to in paragraph 1, students must provide details of their reasons for making this request.

## **Section 5 – Examination**

### Article 17 – The times and frequency of the examination

There shall be an opportunity to undergo the Master's final examination at least twice a year. The dates set by the Board of Examiners are to be published before the start of the academic year.

### Article 18 – Student support and guidance

Responsibility for student support and guidance lies with the Dean. This includes informing students about study options within the programme or elsewhere. One or more study advisers may be appointed for this purpose.

### Article 19 – Monitoring academic progress

1. The Dean is responsible for the registration and timely publication of the exam results of individual students in the institution's virtual learning system.
2. The Dean is responsible for facilitating discussion of the results between the student and the study adviser, when appropriate.

## **Section 6 – Appeals and objections**

### Article 20

1. Decisions by the Board of Examiners based on these regulations may be appealed within four weeks after the announcement of the decision to the student in question. Appeals should be lodged with the Examination Appeals Board.
2. Decisions by the Dean based on these regulations may be appealed within six weeks after the announcement of the decision to the student in question. Objections are to be lodged with the Dean.

## Section 7 – Contravention, changes and implementation

### Article 21 – Contravening the Regulations

If the study guide or any other regulations relating to the study programme or the interim examination programme prove to contravene these Regulations and the accompanying appendix, precedence will be given to the provisions of these Regulations with which the appendix forms an integral whole.

### Article 22 – Amendments to the regulations

1. Any amendments to these regulations will be made by special resolution of the Dean.
2. No amendments will affect the current academic year unless it is reasonable to suppose that the interests of students will not be adversely affected.
3. Amendments to these regulations may not retroactively affect a decision by the Board of Examiners to the detriment of the student.

### Article 23 – Transitional regulations

1. If the composition of the study programme undergoes intrinsic changes or if these regulations are amended, the Dean will draw up transitional regulations that will be incorporated into appendix of these Regulations.
2. If and when appropriate, such transitional regulations are required to include:
  - a. a provision concerning the exemptions that can be given on the basis of the interim examinations already passed;
  - b. a provision specifying the validity of the transitional regulations.

### Article 24 – Publication of the regulations

The Teaching and Examination Regulations and the appendix, which forms an integral whole with the Regulations, shall be published on the institution's website.

### Article 25 – Entry into force Date of Commencement

These regulations will come into effect on September 1, 2014.

Approved by the Executive Board of the University of Twente on dd.mm.yyyy.

# APPENDIX A

## IMPLEMENTATION REGULATIONS

2014-2015

3TU MASTER'S DEGREE PROGRAM  
EMBEDDED SYSTEMS

UNIVERSITY OF TWENTE

## Article 1 - Study load

1. The Master's degree audit for the Embedded Systems programme has a study load of 120 credits.
2. The programme can be followed in full-time.
3. The programme has a duration of two years and starts each year in September. It is also possible to start the Master's degree programme in the second semester. In that case, however, students might experience some problems due to dependencies between some of the course taught in the first semester and some of the courses in the second semester. Nevertheless, the courses in the master programme will be scheduled in such a way that it is possible to compose an individual study programme consisting of a limited choice of courses, in which the successor relationships are hardly violated. Students should realize, however, that starting in the second semester could take some extra effort.

## Article 2 - Composition of the degree program

The composition of the study programme is as follows:

- a. Core programme worth 25 credits described in Article 3,
- b. Specialisation subjects worth at least 15 credits, as described in Article 4,
- c. Homologation courses worth at most 20 credits described in Article 5,
- d. An optional internship worth at most 20 credits or a multi-disciplinary design project worth 10 credits, but not both, described in Article 6, and
- e. A graduation work (40 EC), further described in Article 7, comprising preparation for the graduation project worth 10 credits, and the graduation project worth 30 credits.

## Article 3 – Core program

The core programme consists of the following courses:

TUD Code	TU/e Code	UT Code	Subject	Credits
IN4340	5KK73	192130240	Embedded Computer Architecture	5
IN4390	2IN27	201200006	Quantitative Evaluation of Embedded Systems	5
IN4342	5KK03	201000168	Embedded Systems Laboratory	5
IN4343	2IN26	192130200	Real-time Systems	5
IN4387	2IW26	192140122	System Validation	5

If the content of a compulsory course corresponds to the course contents of a preliminary education course, the compulsory course has to be replaced by a course, with the same amount of credit points, from the specialisation part.

## Article 4 – Specialisation subjects

Specialisation subjects totalling at least 15 credits should be selected from relevant courses of the three universities in question. See Article 8 for approval of the Individual Study Programme.

*Subjects offered by the University of Twente:*

Code	Subject	Credits
191210870	Integrated circuits and systems for mixed signals	5
191210900	Introduction to Biometrics	5
191211080	Systems Engineering	5
191211590	System-on-Chip for embedded systems	5
192110940	Secure Data Management	5
192111332	Design of software architectures	5
201300042	Limits to Computing	5
192130022	Design of digital systems	5
192130092	Fault tolerant digital systems	5
192135310	Modeling and analysis of concurrent systems 1	5
192620000	Telematics networks	5
192654000	Network Security	5
201000075	Wireless Sensor Networks	5
191210760	Advanced programming	5
191210770	Digital control engineering	5
191211100	Mechatronic design of motion systems	5
191211110	Modelling and Simulation	5
192135400	Advanced design of software architectures – Product Line Engineering	5
201400050	Signal Processing for Acoustics and Vibrations	5
192130112	Distributed systems	5
192130122	Energy Efficient Embedded Systems	5
192130250	Embedded computer architectures 2	5
192135320	Modeling and analysis of concurrent systems 2	5
192620010	Mobile and wireless networking 1	5
201000231	Computer arithmetic <sup>1</sup>	5
201000232	Knowledge based control systems <sup>2</sup>	4
191210850	Advanced analog IC electronics	5
191210950	Implementation of Digital Signal Processing	5
191561620	Optimal control	5
192111301	Ubiquitous computing	5
192130200	Real-time systems 1	5
192135450	Advanced design of software architectures-Model Driven Engineering	5
192170015	Testing techniques	5
191210910	Image processing and computer vision	5
191210920	Optimal estimation in dynamic systems	5
191211060	Modern robotics	5
191211320	Testable design and test of integrated systems	5
192620020	Mobile and wireless networking 2	5
191210840	A/D Converters	5

<sup>1</sup> Telelecture offered by Delft University of Technology

<sup>2</sup> Telelecture offered by Delft University of Technology

191210940	Advanced digital signal processing	5
191211030	Mobile Radio communication	5
191211060	Modern Robotics	5
191211090	Real-time software development	5
191211330	Digital electronic circuit design for SoC	5
191520252	Theory of complex functions	5
192130210	Real-time systems 2	5
201100254	Advanced computer vision & pattern recognition	5

### Article 5 - Homologation courses

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

*At the University of Twente:*

Code	Subject	Credits
191210001	Instrumentation of Embedded Systems	5

Students may also follow a 15 EC TEM (Twente Educational Model) module, or a part of this module (if possible) of the bachelor Electrical Engineering. Approval by the board of examiners is required (see Article 8).

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 subjects in the homologation part of the master program:

*At the University of Twente:*

Code	Subject	Credits
191210760	Advanced programming	5

Students may also follow a 15 EC TEM (Twente Educational Model) module, or a part of a module (if possible) of the bachelor Computer Science. Approval by the board of examiners is required (see Article 8).

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

3. Students who have completed a polytechnic programme of computer science or electrical engineering taking the bridging courses for polytechnic graduates are required to include some subjects as homologation subjects in the Master's degree program. This is determined by the Board of Examiners.

4. For admitted students not mentioned in paragraph 1 and 2 an individual homologation programme is made by the Board of Examiners.

#### Article 6 – Internship and Multi-Disciplinary Design Project

1. At the University of Twente, students can complete an internship worth 20 credits, or a multi-disciplinary design project worth 10 credits, but not both, only after an agreement with the programme mentor.
2. Students may not commence an internship or multi-disciplinary design project until they have completed courses from their individual study programme amounting to at least 45 credits,

#### Article 7 – Graduation Work

1. The graduation work of 40 credits consists of a preparation for graduation. These projects are Individual project (191211749) and a Final project (192199978) .
2. Preparation for graduation project consists of literature survey, feasibility study and detailed planning for the graduation project. The preparation has to be finished and marked before the start of the graduation project.
3. Graduation project consists of performing the project, writing a graduation report and its summary, and preparing and giving a presentation.
4. Students may not commence the graduation project until they have successfully completed at least 70 credit units of their study program

#### Article 8 – Study Program

1. Students must draw up their study programme and submit this, together with the name of their supervisor to the Board of Examiners for approval before the start of the 4<sup>th</sup> quarter of their first year.
2. The composition of the thesis committee has to be submitted to the Board of Examiners 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 Board of Examiners for approval.

#### Article 9 – Bridging Courses

1. In addition to the programme referred to in Article 2, students will only be admitted to the programme on the basis of a relevant Bachelor's degree awarded by a Dutch institute of professional education (*HBO: Elektrotechniek, Embedded Systems or Technische Informatica*) if they first complete a programme of bridging courses (preferably within a year of commencing their course of study) that includes the following subjects:

*At the University of Twente:*

Quartile	Code	Subject	Credits
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1	191512001	<i>Calculus A</i>	4
1	191512021	<i>Calculus B</i>	3
1	191512061	<i>Lineaire Algebra A</i>	3
2	191231490	<i>Lineaire Systemen</i>	6
2	191512041	<i>Calculus C</i>	3
2	191512081	<i>Lineaire Algebra B</i>	2
For students with an 'HBO degree' <i>Elektrotechniek</i> :			
1	192191500	Self tuition project (programming)	5
For students with an 'HBO degree' <i>Technische Informatica, Computertechniek</i>			
2	191210001	<i>Instrumentation for Embedded Systems</i>	5

Students with a Bachelor's degree awarded by a Dutch institute of professional education must follow the course Energy Efficient Embedded Systems (192130122) in their master's programme.