SECTION B - PROGRAMME-SPECIFIC SECTION SYSTEMS & CONTROL

CONTENTS

SECTION B - Programme-specific section Systems & Control 1
9 General Provisions 2
Article 9.1 Definitions 2
10 Programme objectives and final attainment targets 2
Article 10.1 Aim of the programme 2
Article 10.2 About the programme 2
Article 10.3 Final qualifications 2
Article 10.4 Specialisations 3
11 Further admission requirements 4
Article 11.1 Programme specific admission requirements 4
Article 11.2 Pre-Master's programme for students from a Dutch University of Applied Sciences 4
12 Curriculum structure 5
Article 12.1 Composition of programme 5
Article 12.2 Core programme 5
Article 12.3 Specialisation-linked subjects 5
Article 12.4 Electives 6
Article 12.5 Homologation courses 7
Article 12.6 Internship 7
Article 12.7 Master's final project (master's thesis) 7
Article 12.8 Sequence of examinations 7
13 Planning, procedures and guidance during the Master's study 8
Article 13.1 Specialisation and subject combination 8
Article 13.2 Practical exercises 8
Article 13.3 Internship 8
Article 13.4 Master's final project 8
Article 13.5 Study counselling 9
14 Special opportunities 9
Article 14.1 Extended examinations. 9
Article 14.2 Flexible Degree programmes 9
Article 14.3 Double/combined programme 9

9 General Provisions

Article 9.1 Definitions

In addition to the definitions in Section A, Article 1.2, the following definitions are used in this Section B:

a. **Programme mentor**: a staff member, who is appointed by the programme director for each specialisation to supervise students who joined the specialisation until they start their Master's Final project.
b. **Graduation committee**: the committee that supervises the master's final project and will carry out the assessment of the project.

10 Programme objectives and final attainment targets

Article 10.1 Aim of the programme

The programme aims to train master students in a spectrum of professional and personal competencies to enable them to expand their knowledge and methodology in design, through analysis and research, of innovative systems in the Systems & Control discipline.

Article 10.2 About the programme

1. The Master's degree programme in Systems and Control is a 4TU MSc programme. The programme is offered at TU/e (Eindhoven University of Technology), TUD (Delft University of Technology) and UT (University of Twente). The programmes have a similar structure and comparable core programme. The programmes are not the same, in the sense that the courses and specializations at each university are different.
2. If a student is admitted to the Systems and Control programme at one of the 3 universities, he/she is also admitted to the programme at the other universities.
3. After a student is enrolled in the MSc programme in Systems and Control at one of the 3 universities he/she will also obtain a secondary enrolment (neveninschrijving) at the 2 other universities.
4. The pre-Master's programmes in Systems and Control of the 3 universities are interchangeable, in the sense that a completed pre-master programme at one of the three universities grants admission to the MSc programme in Systems and Control at each of the three universities.
5. The core programmes of the 3 universities are interchangeable, in the sense that all credits for core courses obtained in the Systems and Control master programme at one university will be accepted when a student transfers to the MSc programme in Systems and Control at one of the other universities.

Article 10.3 Final qualifications

1. Competence in the scientific discipline Systems & Control
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) …apply advanced physics and measurement methods in systems and control.
   b) …design, carry out and evaluate experiments.
   c) …analyse and design high-performance measurement and control systems for a wide variety of processes.
   d) …relate scientific knowledge to dynamical systems considering their interaction with the environment.

2. Competence in doing research
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … study a topic by critically selecting relevant scientific literature.
   b) … write a scientific report about own research.
   c) … develop technologies to model, identify and control dynamical systems in an interactive, uncertain and noisy environment.
   d) … generate knowledge within the discipline of Systems & Control.

3. Competence in designing
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … systematically design controllers for complex dynamical systems.
   b) … generate innovative contributions to the discipline of Systems & Control.

4. A scientific approach
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … integrate knowledge and information to handle complexity at the systems level.
   b) … analyse problems and use modelling, identification, simulation, design and integration towards solutions.
   c) … solve technological problems in a changing environment considering ambiguity, incompleteness and limitations.
   d) … manage own scientific research independently.

5. Basic intellectual skills
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … analyse and solve technological problems in a systematic way.
   b) … identify and acquire lacking expertise.
   c) … critically reflect on own knowledge, skills and attitude.
   d) … plan and execute research in changing circumstances.
   e) … integrate new knowledge in an R&D project, considering ambiguity, incompleteness and limitations.
   f) … remain professionally competent.

6. Competence in operating and communicating
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … work both independently and in multidisciplinary teams.
   b) … explain and defend systems and control outcomes to academia and industry, to specialists and laymen.
   c) … present and report in good English.

7. Considering the temporal and social context
   The graduated Master of Systems and Control Engineering is able to a sufficient level to …
   a) … evaluate and assess the technological, ethical and societal impact of own work.
   b) … act responsibly with regard to sustainability, economy and social welfare.

Article 10.4 Specialisations

The following specialisations are offered at the University of Twente:

Specialisation	Participating chairs	Faculty
Robotics and Mechatronics (RM)	Robotics & Mechatronics Mechanical Automation & Mechatronics	EEMCS ET
Control Theory (CT)	Systems Theory, Applied Analysis and Computational Science (SACS)	EEMCS
Biomechatronics (BM)	Biomechanical Engineering	ET
Unmanned Aerial Vehicles (UAV)	Earth Observation Science Robotics & Mechatronics Industrial Engineering & Business Information Systems (IEBIS)	ITC EEMCS BMS

11 Further admission requirements

See Section A, Chapter 2, for general regulations regarding admission and enrolment.

Article 11.1 Programme specific admission requirements

Students in the possession of a diploma which shows that they have passed the final examination for one of the Bachelor's programmes, mentioned below, obtained at a Dutch Technical University (Delft, Eindhoven, Twente), are eligible for admission. For admission the conditions, mentioned in the table apply.

BSc	University D: Delft E: Eindhoven T: Twente	Free admittance	After additional programme (max. 30 EC)
Advanced Technology	T		X
Aerospace Engineering	D	X	
Automotive	E	X	
Biomedical Technology	E, T		X
Chemical Engineering	E, T		X
Civil Engineering	D, T		X
Creative Technology	T		X
Electrical Engineering	D, E, T	X	
Industrial Design	T		X
Mechanical Engineering	D, E, T	X	
Technical Computer Science	D, E, T		X
Technical Physics	D, E, T		X
Technical Mathematics	D, E, T	X	

Article 11.2 Pre-Master's programme for students from a Dutch University of Applied Sciences

See Section A, Article 2.7, for general regulations regarding pre-master's programmes.

1. Students seeking admission on the basis of a Bachelor's degree awarded by a Dutch University of Applied Sciences must complete a bridging programme that includes the following subjects:

Code	Course	Study load (EC)
201500291	Calculus A	5

201500292	Linear Algebra	3
201400315	Digital Logic and Computer Organization	4
201500293	Calculus B	4
191231490	Linear Systems	6
201500340	Control Engineering*)	4
201400279	Academic Research Skills	4
	Total	**30**

*) part of the Electrical Engineering module 201500286 Systems and Control

2. The programme assumes a minimal knowledge level VWO-B in mathematics and a VWO-level in English. (VWO being the Dutch preparatory secondary school for the universities).
3. The conditions for admission to the master's programme are as stipulated in Section A, Article 2.7.
4. Students from a Dutch University of Applied Sciences may be allowed by the Admission Committee to follow the pre-Master's programme as a part of their bachelor's programme.

12 Curriculum structure

Article 12.1 Composition of programme

The curriculum consists of the following elements:

Year	EC	Topic
First	25	Core programme
	35	Specialisation-linked and elective subjects
Second	20	Internship
	40	Master's thesis project

Article 12.2 Core programme

Students must complete the core programme shown below, totalling 25 credits.

Code	**Course**	**Study load (EC)**
191211110	Modelling and Simulation	5
191131700	System identification and parameter estimation	5
191210770	Digital Control Engineering	5
200900012	Integration project	5
201100137	Philosophy of Engineering: Ethics	2.5
191616043	Philosophy of Engineering: Science	2.5

Article 12.3 Specialisation-linked subjects

Subjects are selected by the programme mentor from the course list as described in Article 12.4, after consultation with the student. Subjects taught in the Systems & Control programmes at the technical Universities of Eindhoven and Delft are eligible to be included as a specialisation-linked subject.

Article 12.4 Electives

The number of credits obtained in specialisation-linked subjects, as explained in Article 12.3, is complemented to a total of 35 credits with elective subjects. Available courses at the University of Twente are listed in the table below. It is also allowed to choose subjects taught in the Systems & Control programmes at the technical Universities of Eindhoven and Delft. Lists of available courses at these universities are maintained in their Implementation Regulations and are made public at their website. The total programme of 35 credits has to be approved by the Examination Board.

Courses, not on one of the course lists, can be chosen but should be explicitly approved by the Examination Board.

List of available specialisation-linked and elective subjects

Course code	Course name	EC	RM	CT	BM	UAV	Quarter
201400040	Dynamics & Control	5	x		x		1A
191157750	Engineering Acoustics	5				x	1A
201700171	Aerodynamics and Flight Dynamics	5	x			x	1A
191561560	Systems and Control[1)]	6		x			1A
191211080	Systems Engineering	5	x				1A
191571090	Time Series Analysis	5		x			1A
191210930	Measurement Systems for Mechatronics	5	x		x		1A/1B
191211100	Mechatronic Design of Motion Systems	5	x				1A/1B
201700169	2D and 3D scene analysis	5	x		x	x	1B
191210760	Advanced Programming	5	x				1B
201700167	Positioning and imaging technology	5	x			x	1B
201300004	Robotics for Medical Applications	5			x		1B
201700172	Applications of UAVs	2,5	x			x	1B
191131360	Design Principles for precision mech.	5	x				2A
191131730	Dynamics of machines	5	x		x		2A
191150480	Human movement control	5			x		2A
191210910	Image Processing and Computer Vision	5	x			x	2A
191561750	Infinite Dimensional Linear Systems[1)]	6		x			2A
WIMCCNES12	Modelling and control of complex nonlinear engineering Systems[2)]	5		x			2A
191561620	Optimal Control	5	x	x			2A
201200135	Random Signals and Filtering	5	x		x		2A
201700168	Regulating robotics and drones	2,5	x			x	2A
191560671	Robust Control	5	x	x	x		2A
201400575	Technolab	7				x	2A
201200133	Biomechatronics	5			x		2B
191571200	Hybrid Dynamical Systems	5		x			2B
193810070	Identification of human motor control	5			x		2B
201700170	Laser scanning	5	x			x	2B

191211060	Modern Robotics	5	x			x	2B
201200215	Motion and vibration control	5	x	x			2B
191210920	Optimal Estimation in Dynamic Systems	5	x		x	x	2B
191211090	Real-Time Software Development	5	x			x	2B
201700173	Control for UAVs	5	x			x	2B
201500140	Introduction Project	5	x	x	x	x	Year

1: This course is taught in Utrecht within the framework of the Mastermath programme.
2: This course is taught at the University of Groningen.

Article 12.5 Homologation courses

The rules for homologation courses are stipulated in Section A, Article 2.5.3.

Article 12.6 Internship

The general regulations for the internship are stipulated in section A, Article 3.4 and 3.5.

1. The Examination Board can decide that the internship will be replaced by an individual research project in one of the research groups participating in the programme. The study load such a project is 10EC. The remaining 10EC of the internship will be spent to elective courses. This decision will be taken if during the bachelor's programme the student acquired substantial working experience from one or more internships and the student lacks project experience in a research group.

Article 12.7 Master's final project (master's thesis)

The general regulations for the master's final project are stipulated in section A, Article 3.7.

1. A student will carry out the final project subject to the accountability of the chair responsible for the student's specialisation programme.
2. A description of the Master's project that a student will do must have been drawn up and approved by a member of the graduation committee.
3. The graduation committee is formed by a minimum of 3 persons, at least two of whom are members of the scientific staff and have a permanent position in the Systems & Control programme. Of these two members, one is a full or associate professor of the chair subject to whose accountability the project will take place. The graduation committee shall also include one member of the permanent scientific personnel of a different chair than that under which the student is studying.
4. The graduation committee appoints a daily supervisor.
5. The Master's final project shall take place according to a planning as stipulated in section A, Article 3.7 and this section Article 13.4.

Article 12.8 Sequence of examinations

1. There are no general conditions regarding the sequence in which the course units have to be followed. Prior knowledge requirements may be given in the individual course descriptions that can be found in the online study prospectus. The student should take them into account when planning the study programme.
2. In addition to section A, Article 3.8.2, the internship can only take place if the core programme has been completed.
3. Conditions for starting the master's thesis are stipulated in Section A, Article 3.7.1.

13 Planning, procedures and guidance during the Master's study

Article 13.1 Specialisation and subject combination

1. Before starting the master's study, students choose one of the specialisations of the programme. The student determines his package of subjects, together with the programme mentor of the chosen specialisation, and draws up a schedule for attending the subjects, and for carrying out the internship and the final project.
2. The consultation referred to in Paragraph 1 results in a study plan that will be signed by both the student, and the programme mentor.
3. The package of subjects should be approved by the programme mentor and then submitted to the registry of the examination board, at the latest by three months after the start of the master's study.
4. An alteration in the package of subjects may only be made with the programme mentor's agreement. If the package of subjects has already been submitted to the registry of the examination board then any alterations should be reported to the registry immediately.

Article 13.2 Practical exercises

1. The study prospectus states which units include a practical exercise. If a unit involves a practical exercise, the examiner will give an assessment, by the latest, at the end of the period in which the subject is scheduled. This will be used to arrive at the final grade for that unit. If the results for the practical exercise are unsatisfactory, then the student has time available until the end of the next quarter to complete the exercise with a satisfactory result. If satisfactory results have still not been obtained, then the student can only obtain satisfactory results for the exercise by doing it over in full.
2. The assessments of the practical exercises can only be obtained after the student has participated in the exercise concerned.

Article 13.3 Internship

The rules for the internship are stipulated in Section A, Article 3.4

Article 13.4 Master's final project

1. The student and the daily supervisor of the chair must make an agreement about the starting and finishing dates of the Master's project.
2. The finishing date is obtained on the basis of a study plan, whereby time shall be set aside not only for the Master's project but possibly also for attending subjects and for taking resits.
3. The study plan must be approved by the supervisor and signed by the student.
4. No more than the nominal amount of time may be planned for working on the Master's project.
5. Students should report illness immediately to the secretariat of the chair. Time that is missed due to illness shall be added to the time available for the Master's project in the study plan.
6. The student should add any extra time, required for re-taking an interim examination, to the study plan and submit this to the daily supervisor for approval.
7. In the study plan the student and the supervisor should make appointments about how the student should spend his time during any academic holiday periods.
8. Sufficient time should be added to the study plan to compensate any delays that arise due to reasons beyond the student's control.
9. Immediately after the final date of the project as recorded in the study plan (including any adjustments as described in paragraphs 5 to 8), the graduation committee shall issue an opinion on how the project was carried out and determine the final grade.

10. If this final grade is a fail then the student must carry out a supplement to the project within a period of two months, after which the graduation committee will state its opinion again, which will lead at the most to a 6.
11. This new final grade will be regarded as the result of a resit.
12. If the result of a resit is a fail, then the student shall have to carry out a new Master's project.

Article 13.5 Study counselling

Regulations for study counselling are stipulated in Section A, Chapter 5.

14 Special opportunities

Article 14.1 Extended examinations.

1. Whosoever, either before or after passing the final examination of an Systems & Control master's study, has successfully taken interim examinations for units that are not or were not considered part of this study or a different study, but which could have been part of the said master's studies, will be examined, upon request, subject to the approval of the examination board, in the form of an extended examination.
2. As proof that the extended examination has been completed successfully, the examination board can, upon request, issue a separate statement.

Article 14.2 Flexible Degree programmes

Regulations for a flexible degree programme are stipulated in Section A, Article 3.5

Article 14.3 Double/combined programme

Regulations for a double/combined programme are stipulated in Section A, Article 3.6