APPENDIX TO TEACHING AND EXAMINATION REGULATIONS

IMPLEMENTATION REGULATIONS

2012-2013

3TU MASTER'S DEGREE PROGRAMME

Systems and Control

DELFT UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF TWENTE
EINDHOVEN UNIVERSITY OF TECHNOLOGY

Article 1 - Study load

1. The Master's degree audit for the Systems and Control programme has a study load of 120 credits. These 120 credits must not include any credits which constituted part of a previously passed Bachelor's audit.

2. The programme will be taught in full-time.

Article 2 - Composition of the degree programme

1. The composition of the study programme for the student generation 2011-2012 is as follows:

Part	Number of credits
Core programme, as described in Article 3	24
Specialisation-linked subjects,, as described in Article 4, Complemented with Elective subjects, as described in Article 5,	36
Internship / Literature study / Graduation work, as described in Article 6	60

2. Before being admitted to the programme on the basis of a Bachelor's degree awarded by a Dutch institute of professional education, students must also complete a bridging programme (preferably within a year of commencing their course of study) that includes the following subjects:

    At Delft University of Technology, an obligatory programma of 30 EC:

Code	Course	Credits
WI1909TH	Differentiaalvergelijkingen	3
WI1807TH1	Lineaire algebra 1,	3
WI1708TH1	Analyse 1,	3
WI1708TH2	Analyse 2,	3
WI1708TH3	Analyse 3,	3
WI3104TN	Statistiek	3
SC3011TN	Stochastische signaalanalyse	3
TN2545	Systemen en signalen	6
WB2207-07	Regeltechniek	3

    At the University of Twente, an obligatory programme of 29 EC (can be different in individual cases) :

Code	Course	Credits
191512001	Calculus A	4
191512021	Calculus B	3
191512041	Calculus C	3
191512061	Lineaire Algebra A	3
191512081	Lineaire Algebra B	2
191231490	Lineaire Systemen	6
191530062	Kansrekening	3
191157170	Statica voor WB[1]	2
191157180	Stijfheid en Sterkte 1[1]	3
191210001	Instrumentation for Embedded Systems[2]	5

[1] For students having an Electrical Engineering background
[2] For students having a Mechanical Engineering background

At Eindhoven University of Technology, an obligatory programme of 33 EC is complemented with at least 6 EC in elective courses:

Obligatory courses:,

Code	Course	Credits
2DL03	Basis Wiskunde	3
2DL04	Calculus A	3
2DL06	Linear Algebra	3
5ES00	Sensoren en actuatoren	6
	Trainingen 1	1
	(RSI, Arbo & milieu, Engelse toets, Matlab)	
4A551	Regeltechniek	3
5ESB0	Systems	5
	Schakel Eindproject	9

Elective Courses:

Code	Course	Credits
2S610	Kansrekenen en Stochastische processen	3
0HBO1	Onderzoeksorientatie	3
4B440	Thermodynamica voor HBO	3
4A460	Mechanische Trillingen	3
4CA00	Signaalanalyse	5
4C530	Analyse van fabricagesystemen	3
4EE12	Project programmeren	3
2DL05	Calculus B	3

The three bridging programmes are interchangeable.

Article 3 - Core programme

Students must complete one of the three core programmes shown below, totalling 24 credits. The three core programmes are interchangeable.

At Delft University of Technology:

Code	Course	Credits
SC4010	Introduction project SC	3
SC4025	Control theory	6
SC4092	Modelling and Nonlinear Systems Theory	4
SC4040	Filtering & identification	6
SC4050	Integration project SC	5

At the University of Twente:

Code	Course	Credits
201100178	Introduction project	4
191211110	Modeling: Modelling and Simulation	5
191571090	Identification: Time Series analysis	5
191210770	Control: Digital Control Engineering	5
191159000	Integration project	5

At Eindhoven University of Technology:

Code	Course	Credits
4K410	Introduction project (Digital Motion Control)	3
4K580	Control (System theory for control)	3
5SC20	Control (State space control)	3
4K150	Control (Advanced motion control)	3
4J520	Modeling (Non-linear dynamics)[*]	3
5MX00	Modeling (Dynamical Systems)[*]	3
4K560	Modeling (Physical modeling for S&C)	3
5MB40	Identification (System Identification)	3
4SC00	Integration project Systems and Control	3

[*] One of the two courses 4J520 or 5MX00 is to be chosen.

Article 4 – Specialisations and specialisation-linked subjects.

For each specialisation, courses are selected from the list of elective courses as described in Article 5.3, after consultation with the graduation supervisor of one of the chairs of the specialisation, and to be approved by the Board of Examiners.

1. No specialisations are offered at Delft University of Technology

2. The following specialisations are/will be offered at the University of Twente:
   1. Robotics and Mechatronics
   2. Control Theory

   Obligatory courses for Robotics and Mechatronics (can be different in individual cases)**:**

Code	Course	Credits
191211100	Mechatronic Design of Motion Systems	5
191131360	Design Principles for Precision Mechanisms	5
191210930	Measurement Systems for Mechatronics	5
191616040	Philosophy of Engineering	5

   Obligatory courses for Control Theory (can be different in individual cases)**:**

Code	Course	Credits
191561560	Systems and Control	5
191561620	Optimal Control	5
191560671	Robust Control	5
191616040	Philosophy of Engineering	5

3. The following specialisations are/will be offered at the Eindhoven University of Technology:
   1. Control Systems
   2. Control Systems Technology

3. Dynamics and Control
4. Electromechanics and Power Electronics
5. Systems Engineering
6. Hybrid and Networked Systems

For each of these 6 specialisations elective courses, worth 9 credits, are chosen from the lists described in Article 5.3, after consultation with the graduation supervisor of the specialisation.

Article 5 – Elective subjects

1. The number of credits obtained in specialisation-linked courses, as explained in Article 4, is complemented to a total of 36 credits with Elective subjects, selected from the in Article 5.3 mentioned lists from the three universities in question. In consultation with the graduation supervisor courses from all three universities can be chosen. These lists can be expanded and the total programme of 36 credits has to be approved by the Board of Examiners.

2. At the TU Delft the following extra regulations hold:

    a. Students need to include at least 3 and maximally 13 credits in technical courses on Master's level, that are not contained in the lists mentioned in Article 5.3.

    b. Students need to include at least 3 and maximally 6 credits in non-technical courses on Master's level, that are related to the final exit qualifications of the MSc programme, as described in Article 3.7 of the Teaching and Examination Regulations.

3. Lists of Elective courses:

Explanation of research theme abbreviations:

Fu:	Fundamentals	Ma:	Mathematics
ST:	System Theory	RM:	Robotics & Mechatronics
CT:	Control Theory	CS:	Computer Science
PC:	Process Control	ES:	Embedded Systems
BT:	Biotechnology	MC:	Motion Control
MT:	Mechatronics	NC:	Non-linear Control
Tr:	Transportation	AM:	Automotive
Ae:	Aerospace		

Offered at Delft University of Technology:

| Course code | Course name | EC | Research Themes | | | | | | | |
			Fu	ST/CT	PC	BT	RM	Tr	Ae	AM
AE3202	Flight dynamics 1	4							x	
AE4301	Automatic flight control system design	3							x	
AE4307	Flight and space simulation	4							x	
AE4313	Spacecraft attitude dynamics and control	3							x	
CI4801	Transportation and spatial modeling	6						x		
CI4821-09	Traffic flow theory and simulation	6						x		

Course code	Course name	EC	Fu	ST	Ma	RM	CS	ES	CT
CI4822-09	Traffic management and control	6					x		x
CI5804-09	Innovations in dynamic traffic management	4					x		x
ET4245ME	Electromechanics in mechatronic systems	3					x		
LM3512TU	Systems biology	6			x	x			
ME1100	Automotive Crash Safety; Active & Passive Safety Systems	3					x		x
ME1200	Robust Multivariable Control Design	6	x	x					
SC4045	Control of High Resolution Imaging	3		x			x		
SC4060	Model predictive control	4		x	x	x	x	x	
SC4081-10	Knowledge based control systems	4			x	x	x		
SC4091	Optimization in Systems and Control	4			x	x	x		
SC4110	System identification	5		x	x		x		
SC4120	Special topics in signals, syst. and contr.	3		x					
SC4160	Modeling and control of hybrid systems	3		x		x	x	x	
SC4210	Vehicle mechatronics	4					x	x	x
SC4230TU	Vehicle dyn.B–Antilock Braking Systems	3					x	x	x
SC4240TU	Control methods for robotics	3		x			x		
SC4250	Probabilistic Models in the Life Sciences	2	x		x	x			
WB2303-10	Measurement in Engineering	3					x		
WB2305	Digital control	3			x	x	x	x	x
WB2414-09	Mechatronic system design	4					x		
WB2427	Predictive modeling	3					x		
WI4209	Systems and Control	6	x	x					
WI4218	Convex optimization and systems theory	6	x	x					
WI4221	Control of discrete-time stochastic systems	6	x	x					

Offered at the University of Twente:

Course code	Course name	EC	Research Themes						
			Fu	ST	Ma	RM	CS	ES	CT
191560671	Robust Control	5		x	x				x
191561620	Optimal Control	5		x	x				x
191211060	Modern Robotics	5				x			
191211110	Modeling and simulation	5		x					
191131700	System identification and parameter estimation	5		x					
191210760	Advanced Programming	5					x	x	
191211080	Systems Engineering	5		x				x	
191211090	Real-Time Software Development	5					x	x	
191211100	Mechatronic Design of Motion Systems	5				x			
191561750	Infinite Dimensional Linear Systems	6		x	x				
191561770	Nonlinear System Theory	5		x	x				
191571200	Hybrid Dynamical Systems	5		x			x		
191211070	Intelligent Control	5		x					
191571501	Stochastic Differential Equations	6		x	x				
191571160	Stochastic Filtering and Control	5		x					

191131720	Advanced motion and vibration control	5							x
191131730	Dynamics of machines	5		x		x			
191131360	Design Principles for precision mech.	5		x		x			
191210930	Measurement Systems for Mechatronics	5				x			
191157740	Advanced Dynamics	5							
191210920	Optimal Estimation in Dynamic Systems	5		x					
191561560	Systems and Control	6	x	x	x				x

Homologation courses

Course code	Course name	EC	Research Themes						
			Fu	ST	Ma	RM	CS	ES	CT
191157170	Statics	2							
191157140	Dynamics 2	3.5							
191157110	Introduction to the Finite Element Method	3,5							
196700120	Dynamical Systems	6							
191210001	Instrumentation for embedded systems	5							
191210430	Engineering System Dynamics	3							
191157150	Mechanics of Materials 2	3.5							

Offered at Eindhoven University of Technology:

Course code	Course name	EC	Research Themes						
			Fu	ST	MC	NC	MT	PC	AM
4C660	Dynamics and Control of hybrid manufacturing systems	3				x		x	x
4J100	Control of nonlinear mechanical systems	3		x		x			
4J400	Multi-body dynamics	3	x		x	x	x		x
4J530	Engineering optimization: concepts and applications	3			x	x	x	x	x
4J570	Advanced vehicle dynamics	3							x
4J580	Humanoid robotics	3			x	x	x		
4J590	Performance of nonlinear control systems	3		x		x			
4J820	Applied nonlinear control	3			x	x	x		
4K140	Capita Selecta in control	3		x					
4K160	Modeling, analysis and control of hybrid dynamical systems	3	x	x					
4K420	Supervisory machine control	3						x	
4K450	Embedded motion control	3			x		x		
4K480	Control and Operation of Tokamaks	3				x		x	
4K490	Advanced control for fusion plasmas	3				x		x	
4L160	Introduction robotics	3			x	x	x		
4L810	Fundamentals of systematic low noise design	3					x		x
4T500	Modeling and control of manufacturing systems	3						x	
4T700	Engineering optimization: advanced topics	3			x	x	x	x	x
5EE90	Electrical Components	3					x		
5EP10	Design and application of industrial linear motors	3			x		x		

Code	Name	EC							
5MB10	Model reduction	3		x	x		x	x	
5MB30	Robust control	3		x	x		x	x	
5ME10	Statistical Signal processing	3	x	x					
5P060	Nonlinear systems/neural networks	4				x			
5SC21	Modeling and predictive control	3		x					x
0C903 *)	Energy and consumer	3							
0EM70 *)	Ethics and the risk	3							
0EM81 *)	Innovation and intellectual property	3							

*) at least one of the courses 0C903, 0EM70, 0EM81, needs to be added to the programme.

Article 6 – Internship/ Literature study/ Graduation Work

1. At the TU Delft student can optionally do an internship worth 15 credits. Students must complete a literature study worth 15 credits and a graduation work worth 30 (if an internship is completed) or 45 credits.

2. At the TU Eindhoven students need to complete an internship or a literature study, each worth 15 credits, complemented with a graduation work worth 45 credits.

3. At the UT students need to complete an internship worth 20 credits, complemented with a graduation work worth 40 credits.

4. Graduation work consists of a graduation project, a graduation report, a summary of the report (Twente and Eindhoven), a poster (Eindhoven), one intermediate presentation (Delft), participation in MSc workshops (Delft) and a final presentation.

5. Students may not commence a literature study or an internship until they have:

   - completed a bridging programme (in the event that such a programme was required in accordance with Article 2, paragraph 2),
   - passed the Bachelor's audit referred to in Article 4 paragraph 1 of the Teaching and Examination Regulations (if applicable).

   Furthermore:
   In Twente: completed the core programme referred to in Article 3,
   In Delft: completed at least 54 EC of the first year programme
   In Eindhoven: completed at least 30 EC of the first year programme, of which at least
                     15 EC from the core programme

6. Students may not commence graduation work until they have:
   In Delft and Twente:
        -completed all of the remaining components of the study programme.
   In Eindhoven:
        -completed at least 69 EC of the remaining components of the study programme. The graduation supervisor can permit deviations of this stipulation, after consulting with and permission of the Board of Examiners

Article 7 – Study Programme

1. Before commencing graduation work, students must draw up their study programme and submit this to the Board of Examiners for approval.

2. Each individual amendment to an approved study programme must be resubmitted to the Board of Examiners for approval.

Article 8 - Free degree programme

1. Students can compile their own degree programme, with an associated degree audit. The degree programme, which requires <u>prior</u> 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 programme. It may be supplemented by components taught within the framework of, or in support of, other degree programmes.

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.

Article 9 – Practical exercises

1. Practical exercises, as described in Article 1 subsection f of the Teaching and Examination Regulations, are taught in accordance with the method described in the prospectus of the subject in question.

2. Any students who fail to complete the practical exercises will be barred from sitting the examination, unless stated otherwise in the prospectus of the subject in question.

Article 10 - The form of the examinations

1. Examinations will be administered in accordance with the details set out in the prospectus of the subject in question.

2. Examinations held by another programme 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 programme.

Article 11 – The frequency, terms and sequence of examinations

1. Written and oral examinations are held immediately after the teaching period for the course to which the examination in question relates.

2. Written examination resits are held as follows:
   - examination after teaching period 1: resits after teaching period 2
   - examination after teaching period 2: resits after teaching period 3
   - examination after teaching period 3: resits after teaching period 4
   - examination after teaching period 4: resits after teaching period 1 (Eindhoven)
                                          resits during the August resit period (Delft and Twente)

3. Participation in practical exercises is governed by the timetables drawn up for this purpose.

Article 12 - Transitional regulations
Not applicable.