APPENDIX TO TEACHING AND EXAMINATION REGULATIONS

IMPLEMENTATION REGULATIONS

2010-2011

3TU MASTER'S DEGREE PROGRAMME
EMBEDDED SYSTEMS

EINDHOVEN UNIVERSITY OF TECHNOLOGY
DELFT UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF TWENTE

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Article 1 - Study load

1. The Master's degree audit for the Embedded Systems 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. At Eindhoven University of Technology the programme is also taught part-time.
3. The programme has a duration of two years (120 credits) and starts each year in September. At Eindhoven University of Technology and at Delft University of Technology, 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 course in which the successor relationships are almost not violated. Students should realize, however, that starting in the second semester could take some extra effort.

Article 2 - Composition of the degree programme

1. 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 described in Article 6,
   e. Graduation work worth at least 30 credits described in Article 7,

Article 3 – Core programme

The core programme consists of the following courses:

TUD Code	TU/e Code	UT Code	Subject	Credits
IN4340	TBA	213024	Embedded Computer Architecture	5
IN4341	4C390	213050	Performance Analysis	5
IN4342	5KK03	TBA	Embedded Systems Laboratory	5
IN4343	2IN16	213020	Real-time Systems	5
IN4387	2IW26	214012	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 the following lists from the three universities in question. At Eindhoven University of Technology four courses are compulsory.

Subjects offered by the Eindhoven University of Technology:

Quartile	Code	Subject	Credits
Compulsory courses			
1-2	2II45	Architecture of distributed systems	5
1-2	5KK60	Systems on silicon	5
3-4	2IW15	Automated reasoning	5
3-4	5KK80	Multiprocessors	5
Elective courses			
1	2II65	Metamodeling and interoperability	5
1	5DD50	Advanced topics in multimedia coding	4
1	5L130	Electrophysiology	3
1	5ME00	Signal processing for communication	3
1	5ME10	Statistical signal processing	3
1	5MX00	Dynamical systems	3
1	5N280	Low-power Electronics	4
1	5P340	Information theory 2	4
1	5P450	Analogue/digital and digital/analogue converters	4
1	5P530	Video processing for multimedia systems	4
1	5P690	Advanced actuator systems	4
1	5SC21	Modeling and predictive control	3
1-2	2ID25	Information retrieval	5
1-2	2ID55	Adaptive systems	5
1-2	2IF25	Formal methods	5
1-2	2IF35	Formal modeling in cell biology	5
1-2	2II35	Web information systems	5
1-2	2II70	Constraint programming	5
1-2	2IL45	Advanced algorithms	5
1-2	2IS15	Generic language technology	5
1-2	2IS25	Distributed trust management	5
1-2	2IV05	Additional component computer graphics	5
1-2	2IV35	Visualization	5
1-2	2IW55	Algorithms for model checking	5
1-4	5P050	Selected topics in Electronics	4
2	2IW01	Embedded computer architecture 2[3]	5
2	5MC10	Combinatorial algorithms	3
2	5MD00	Computer architecture	3
2	5MG00	Mathematics for electromagnetism	3
2	5MH00	Computational electromagnetics	3
2	5MB30	Robust control	3
2	5MY10	Wireless communication I	3
2	5P500	Monitoring of respiration and circulation	3
2	5SC20	State space control	3
3	2IW03	Computer arithmetic[4]	5
3	2IW04	Knowledge based control systems[5]	4

[3] Telelecture offered by the University of Twente.

[4] Telelecture offered by Delft University of Technology.

[5] Telelecture offered by Delft University of Technology.

3	5DD40	Multimedia video coding and architecture	4
3	5MB10	Model reduction	3
3	5MB20	Adaptive information processing	3
3	5MB40	System identification	3
3	5MD20	Design automation	3
3	5MF00	EM waves and antennas	3
3	5MH20	EM theory of wave guides	3
3	5MH30	Optical communication technology	3
3	5P060	Nonlinear systems / neural networks	4
3	5P670	Advanced topics in multi-service data networks I	2
3	5TT40	RF transceiver Electronics	3
3-4	0T400	Academic skills in English 1[6]	3
3-4	2IC35	Physical aspects of computer security	5
3-4	2ID35	Database technology	5
3-4	2ID45	Advanced databases	5
3-4	2IF45	Process algebra	5
3-4	2IF65	Proving with computer assistance	5
3-4	2IF75	Quantitative formal methods	5
3-4	2II55	Business process management systems	5
3-4	2II75	Business process simulation	5
3-4	2IL35	I/O efficiënt algorithms	5
3-4	2IL55	Geometric algorithms	5
3-4	2IN35	VLSI programming	5
3-4	2IS35	Verification of security protocols	5
3-4	2IS55	Software evolution	5
3-4	2IV15	Simulation in computer graphics	5
3-4	2IV55	Interactive virtual environments	5
3-4	2IW45	Programming by calculation	5
3-4	5P220	Antennas and propagation	4
3-4	5P480	Knowledge systems and applications	4
3-4	5P630	Special topics in power electronics	4
3-4	5TT30	Photonic IC design	3
3-4	5TT50	Advanced CMOS design	4
4	2IW02	Real-time software development[7]	4
4	5N520	Statistical bioinformatics	2
4	5P680	Advanced topics in multi-service data networks II	2
4	5TT00	Optical communication networks	3
Seminars (second year)			
1-2	2ID95	Seminar databases and hypermedia	5
1-2	2IF95	Seminar formal methods	5
1-2	2II96	Seminar architecture of information systems	5
1-2	2IL95	Seminar algorithms	5
1-2	2IN95	Seminar systems architecture and networking	5
1-2	2IS95	Seminar software engineering and technology	5
1-2	2IV95	Seminar visualization	5
1-2	2IW95	Seminar design and analysis of systems	5
3-4	2IC95	Seminar security	5
Capita selecta (second year)[8]			

[6] For foreign students only, that have not participated in the TU/e summer course, or for students who have completed a polytechnic (*hbo*) programme of computer science.

[7] Telelecture offered by the University of Twente.

1-2	2IS99	Capita selecta software engineering and technology	5
	2IC99	Capita selecta security	5
	2ID99	Capita selecta databases and hypermedia	5
	2IF99	Capita selecta formal methods	5
	2II99	Capita selecta architecture of information systems	5
	2IL99	Capita selecta algorithms	5
	2IN99	Capita selecta systems architecture and networking	5
	2IV99	Capita selecta visualization	5
	2IW99	Capita selecta design and analysis of systems	5
Preparation thesis (second year)			
1-2	5T514	Preparation graduation project ES	10

Subjects offered by the Delft University of Technology:

Suggested profile Embedded Circuits and Systems:		Credits
ET4054	Methods and Algorithms for System Design	5
ET4272	System Design with HDLs	2
ET4293	Digital IC Design	4
ET4351	VSLI Systems on Chip	4
ETXXXX	Introduction to Interconnection Networks	
IN4026	Parallel Algorithms and Parallel Computers	6
Suggested profile Embedded Computer Architecture:		
ET4078	Computer Architecture (Special Topics)	4
ET4170	Computer Arithmetic	5
ET4171	Processor Design Project	5
IN4026	Parallel Algorithms and Parallel Computers	6
IN4303	Compiler Construction	5
Suggested profile Embedded Control Systems:		
SC4020	Control Theory	6
SC4060	Model Predictive Control	4
SC4081	Knowledge Based Control Systems	
SC4091	Optimization in Systems and Control	
SC4160	Modelling and Control of Hybrid Systems	3
WB2414-09	Mechatronical Design	4
Suggested profile Embedded Networking:		
ET4036	Transmission Systems Engineering	4
ET4284	Ad-hoc Networks	4
ET4285	Measuring and Simulating the Internet	4
ET4359	Advances in Networking	5
IN4150	Distributed Algorithms	6
Suggested profile Embedded Software:		
IN4027	Seminar Algorithms	5
IN4073	Embedded Real-Time Systems	6
IN4077	Computational Logic and Satisfiability	6
IN4090	Embedded Systems Diagnosis	5
IN4091	Systems Specification Models	5
Other ES-specialisation courses:		
ET4076	VLSI Test Technology & Reliability	4
ET4147	Signal Processing for Telecommunication	4
ET4161	Information Theory	4
ET4174	System Programming in C	3

[8] The capita selecta can be followed only by permission of the responsible lecturer.

ET4235	Digital Signal Processing	4
ET4255	Electronic Design Automation	4
ET4256	Reliability Engineering	4
ET4257	Silicon Sensors & Systems	4
ET4258	Displays and Actuators	4
ET4260	Microsystem Integration	4
ET4262P	Lab. course Microprocessors	3
ET4269	Multimedia Compression	6
ET4270	Statistical Signal Processing	4
ET4276 P	Introduction to Microprocessors	2
ET4283	Advanced Digital Image Processing	6
ET4287	Advanced Mobile and Wireless Networking	4
ET4370	Reconfigurable Computing Design	5
ET8030	Operating Systems Project	3
ETYYYY	High Performance Interconnection Network Architectures	
IN4012	Real-time Artifical Intelligence and Automated Speech Recognition	6
IN4013	Expert Systems in a Technical Environment	6
IN4015	Neural Networks	6
IN4049	Introduction to High Performance Computing	6
IN4082	Local (Heuristic) Search Methods	6
IN4084MSc	Programming with C++	3
IN4085	Pattern Recognition	6
IN4182	Digital Audio and Speech Processing	6
IN4191	Security and Cryptography	5
IN4314	Seminar Selected Topics in Multimedia Computing	5
IN4315	Seminar Software Exploration	6
IN4316	Seminar Wireless Sensor Networks	5
IN4350	Embedded Computer Architectures 2[9]	5
IN4351	Real-Time Software Development[10]	5
IN4352	Automated Reasoning[11]	5
IN4353	Multiprocessors[12]	5
SC4025	Control Theory	6
SC4032	Physical Modelling for Systems and Control	4
SC4040	Filtering and Identification	6
SC4050	Integration Project	5
SC4070	Practical Control Systems	4
WM0201TU	Technical Writing	2
WM0203TU	Oral Presentation	2
WM0781TU	Patent Law and Patent Policy	3
WM1101TU	Upper-intermediate English	3
WM1102TU	Written English for Technologists	3

[9] Telelecture offered by the University of Twente
[10] Telelecture offered by the University of Twente
[11] Telelecture offered by Eindhoven University of Technology
[12] Telelecture offered by Eindhoven University of Technology

Subjects offered by the University of Twente[13]*:*

Quartile	Code	Subject	Credits
1	121079	Transmission media	5
1	121087	Integrated circuits and systems for mixed signals	5
1	121090	Introduction to Biometrics	5
1	121108	Systems Engineering	5
1	121159	System on Chip for ES	5
1	211094	Secure Data Management	5
1	211133	Design of software architectures	5
1	211170	Computability and computational complexity	5
1	213002	Design of digital systems	5
1	213009	Fault tolerant digital systems	5
1	213531	Modeling and analysis of concurrent systems 1	5
1	265400	Network Security	5
1-2	121077	Digital control engineering	5
1-2	121078	Transmission systems	5
1-2	121110	Mechatronic design of motion systems	5
1-2	121111	Modelling and Simulation	5
2	121096	Signal processing in acoustics and audio	5
2	213011	Distributed systems	5
2	213012	Hardware/software co-design	5
2	213025	Embedded computer architectures 2	5
2	213532	Modeling and analysis of concurrent systems 2	5
2	213540	Advanced design of software architectures 1	5
2	262000	Telematics networks	5
2	121073	Technology	5
3	121085	Advanced analog IC electronics	5
3	121095	Implementation of Digital Signal Processing	5
3	121034	Physical modeling of Embedded Systems	5
3	121103	Mobile wireless communication	5
3	121107	Intelligent control	5
3	156056	Introduction to mathematical system theory	5
3	156162	Optimal control	5
3	211130	Ubiquitous computing	5
3	211140	Introduction to Coding Theory	5
3	213020	Real-time systems 1	5
3	213545	Advanced design of software architectures 2	5
3	217001	Test techniques	5
3-4	121091	Imaging processing	5
3-4	121092	Optimal estimation in dynamic systems	5
3-4	121106	Modern Robotics	5
3-4	121132	Testable design and test of nano systems	5
3-4	211028	Advanced programming concepts	5
4	121084	A/D Converters	5
4	121097	Computer-aided design tools for VLSI	5
4	121094	Advanced digital signal processing	5
4	121109	Real-time software development	5
4	121133	Digital VLSI circuit design for SoC	5

[13] Please note: At the University of Twente all course codes will be changed in September 2010. Currently the codes have a length of 6 digits. In the new format the code for the current courses is "19" followed with the old 6 digit code and an extra digit. At the date of publication of these regulations, the extra digit is not yet publicly available.

4	152025	Theory of complex functions	5
4	211035	Compiler techniques	5
4	213021	Real-time systems 2	5

Article 5 - Homologation courses

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

At Eindhoven University of Technology:

Quartile	Code	Subject	Credits
1	5DD17	Circuit analysis	3
2	TBA	Digital signal processing	3
3-4	5HH00	Electronics for embedded systems	3

At Delft University of Technology:

Code	Subject	Credits
For a student with a Computer Science bachelor degree of TUD, track Software Technology:		
IN2405-A	Specialisation MKT 3: Signal Processing	4
SC4180ES	Modelling and Control	6
For a student with a Computer Science bachelor degree of TUD, track Media and Knowledge Engineering:		
IN2305-A	Specialisation ST 3: Digital Systems	4
IN2305-B	Specialisation ST 3: Embedded Programming	4
SC4180ES	Modelling and Control	4

At the University of Twente[14]:

Code	Subject	Credits
156080 (or 156180)	Systems and Transformation	5
121000	Instrumentation of Embedded Systems	5
and one of the courses		
121044	Control Theory	5
121034	Physical modeling of Embedded Systems	5
121059	Embedded Signal Processing	6

2. Students who have completed a Bachelor's degree programme in electrical engineering are required to include some subjects in the homologation part of the master program:

At Eindhoven University of Technology:

Quartile	Code	Study component	Credits
3	2IP25	Software engineering	3
3-4	2IL05	Data structures	6
3-4	5HH00	Electronics for embedded systems	3

At Delft University of Technology:

Quartile	Subject	Credits
ET4174	System Programming in C	3
IN2305-B	Apecialisation ST 3: Embedded Programming	4
IN2611WI	Software Engineering	6
IN3205	Software Testing and Quality	4

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At the University of Twente[15]:

Code	Subject	Credits
211045	Operating systems	5
213505	Programming	5
and one of the courses		
213520	Formal methods for software engineering	5
213510	Software Engineering Models	5
211205	Functional Programming	5
121109	Real time software Development	5

3. Students who have completed a polytechnic programme of computer science or electrical engineering taking the pre-master programme for polytechnic graduates are required to include some subjects as homologation subjects in the Master's degree programme.

At Eindhoven University of Technology:

Quartile	Code	Subject	Credits
3	5JJ50	Computational networks	3
3-4	2IL05	Data structures	6
3-4	5HH00	Electronics for embedded systems	3

Those taking the pre-master programme for polytechnic graduates may be given permission to take part in some of the units of the Master's degree programme. A necessary condition for permission is that the student has at least scored 15 credit points from the pre-master programme.

Those taking an adapted or individually composed pre-master programme in the Bachelor's programme may be given permission to take part in some of the subjects of the Master's degree programme, or may be allowed to follow altered or entirely different subjects from the Master's degree programme.

The students that wish to take subjects from the Master's degree programme must submit a request to this effect as a contracting party to the TU/e. The form needs to be signed the pre-master coordinator or the study advisor.

If the request is granted, then the period of enrolment is set; this may be a maximum of one year on the condition that it is not longer than the enrolment of the student in the Bachelor's degree programme.

At Delft University of Technology:

Code	Subject	Credits
For a student with an 'hbo degree' *Technische Informatica*:		
ET3115	Embedded Systems	5 EC
ET3155	Algorithms and Datastructures	5 EC
IN3205	Software Engineering 2: Software Testing and Quality	4 EC
For a student with an 'hbo degree' *Elektrotechniek*:		
ET2308	Programmatuurontwikkeling	5 EC
ET2608	Computer Architecture and Organisation	5 EC
ET3115	Embedded Systems	5 EC
ET3155	Algorithms and Datastructures	5 EC
IN3205	Software Engineering 2: Software Testing and Quality	4 EC

Those taking the pre-master programme for polytechnic graduates may be given permission to take part in some of the units of the Master's degree programme. This permission is granted for a 1 year period. The students must submit a request to get this permission at the Educational Affairs Bureau of the faculty.

[15] Please note: At the University of Twente all course codes will be changed in September 2010. Currently the codes have a length of 6 digits. In the new format the code for the current courses is "19" followed with the old 6 digit code and an extra digit. At the date of publication of these regulations, the extra digit is not yet publicly available.

At the University of Twente[16]:

For students that completed successfully the premaster (hbo-bachelors) an individual homologation programme is made upon instruction of their individual programme mentor.

Article 6 – Internship

1. At the University of Twente, students can complete an internship worth 20 credits (121120[17]). At Delft University of Technology, students can complete an internship worth 12 to 20 credits (ET5S). At Eindhoven University, students who have entered the Master's degree programme on basis of a Bachelor's programme at a Dutch university can complete an internship worth 15 credits (2IM02/5L990[18]).
2. Students may not commence an internship until they have:

   - completed courses from their individual study programme amounting to at least 45 credits,

   - completed a bridging course (in the event that such a course was required in accordance with Article 2, paragraph 2),

Article 7 – Graduation Work

1. The graduation work of 40 credits consists of an individual literature survey of 10 credits and a final project of 30 credits. At Eindhoven University of Technology, the literature survey is optional.
2. Graduation work consists of a graduation project, a graduation report, a summary of the report, and a presentation. At Delft University of Technology and at the University of Twente, it also includes an individual literature study of 10 credits. This has to be finished before the student can start the core graduation project.
3. Students may not commence graduation work until they have:

   - completed all of the remaining components of the study programme to within 10 credits,

   - completed a bridging course (in the event that such a course was required in accordance with Article 9).

Article 8 – Study Programme

1. Students must draw up their study programme and submit this, together with details of the composition of their thesis committee, to the Board of Examiners for approval before the start of the 4th quarter of their first year.
2. 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 of *Technische Informatica*)nif they first complete a bridging course (preferably within a year of commencing their course of study) that includes the following subjects:

   At Eindhoven University of Technology:

Quartile	Code	Programme unit	Credits
Start in semester A			
1	2DL03	Basic mathematics	3
1	2DL06	Linear algebra	3
1-2	2IT05	Logic and set theory	6

[16] Please note: At the University of Twente all course codes will be changed in September 2010. Currently the codes have a length of 6 digits. In the new format the code for the current courses is "19" followed with the old 6 digit code and an extra digit. At the date of publication of these regulations, the extra digit is not yet publicly available.

[17] Please note: At the University of Twente all course codes will be changed in September 2010. Currently the codes have a length of 6 digits. In the new format the code for the current courses is "19" followed with the old 6 digit code and an extra digit. At the date of publication of these regulations, the extra digit is not yet publicly available.

[18] In case the internship is done within the Mathematics and Computer Science department the code is 2IM02. In case the internship is done within the Eletrical Engineering departmet the code is 5L990.

1-2	2IT15	Automata and process theory	6
2	2DL04	Calculus A	3
2	2DL07	Statistics A	3
2	TBA	Digital signal processing	3
3	5DD17	Circuit analysis	3
Start in semester B			
3	2DL03	Basic mathematics	3
3	2DL06	Linear algebra	3
3	2IT16	Finite automata and processes	3
3	5DD17	Circuit analysis	3
3-4	2IT05	Logic and set theory	6
4	2DL04	Calculus A	3
4	2DL07	Statistics A	3
4	2IT19	Computability and feasibility	3
2[19]	5????	Digital signal processing	3

At Delft University of Technology:

Code	Subject	Credits
WI1708TH1	Analyse deel 1	3
WI1708TH2	Analyse deel 2	3
WI1807TH1	Lineaire Algebra 1	3
WI1807TH2	Lineaire Algebra 2	3
TI1300	*Redeneren en Logica*	4
ET2505-A	Stochastische processen	3
For students with an 'hbo degree' *Technische Informatica*		
EE1405 or IN2305-A	Digitale systemen	5
SC4180ES	Modelling and Control	6
For students with an 'hbo degree' *Elektrotechniek*:		
ET2308	Programmatuurontwikkeling	5
IN2611WI	Software Engineering voor wiskundigen	6

These bridging programmes are valid for two years. If a programme has not been completed within two years, students have to transfer to the new bridging programme, with the understanding that credits earned for courses that are identical in the old and the new bridging programme remain valid.

At the University of Twente[20]:

Quartile	Code	Subject	Credits
1	151200	*Calculus A*	5
1	151206	*Lineaire Algebra A*	3
1	151202	*Calculus B*	3
2	151204	*Calculus C*	5
2	123140	*Inleiding Systeem- en Signaaltheorie*	6
2	151208	*Lineaire Algebra B*	2
2	121000	*Instrumentatie van Embedded Systems*	5

2. The three bridging courses are interchangeable.

[19] In the next academic year.

[20] Please note: At the University of Twente all course codes will be changed in September 2010. Currently the codes have a length of 6 digits. In the new format the code for the current courses is "19" followed with the old 6 digit code and an extra digit. At the date of publication of these regulations, the extra digit is not yet publicly available.

Article 10 - Elective degree programme

1. Students can compile their own degree programme, with an associated degree audit. The degree programme, 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 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 11 - 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 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 12 – The frequency, terms and sequence of interim examinations

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

2. Written interim examination resits are held as follows:
   - interim examination after quartile 1: resits after quartile 2
   - interim examination after quartile 2: resits after quartile 3
   - interim examination after quartile 3: resits after quartile 4
   - interim examination after quartile 4: resits after quartile 1 or in August,

   Unless indicated differently in the yearly published time-schedule of interim examinations.