

Education and Examination Regulation
2011 - 2012
for the
Applied Mathematics
Master of Science programme
University of Twente
(Section 7.13 of the Higher Education and Research Act)

Foreword

The Education and Examination Regulation specifies the content and set-up of the programme's curriculum. The Regulation is available for inspection at the Educational Affairs Office of Electrical Engineering, Mathematics and Computer Science and online on the programme website. The Regulation is adopted by the dean of the faculty (Section 7.13 of the Higher Education and Research Act)

Specific information on academic programmes and general information on interim examinations, final assessments, fraud and complaints-handling procedures is appended to this Regulation in ten appendices.

Both the general university section and the programme-specific section of the Student Charter of the University of Twente are available for inspection at the Educational Affairs Office of Electrical Engineering, Mathematics and Computer Science and online on the programme website, <http://onderwijs.math.utwente.nl/Onderwijs>.

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Section 1 General

Article 1 APPLICABILITY OF THE REGULATION

- a. This regulation applies to the curriculum and final assessments of the Applied Mathematics Master's Programme, hereafter referred to as: *the programme*.
- b. Responsibility for the programme lies with the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente (UT), hereafter referred to as: *the faculty*.
- c. Cases for which the Regulation does not provide shall be decided by the Board of Examiners of the programme.
- d. The Dean adopts the Regulation.

Article 2 DEFINITION OF TERMS

Terms taken from the Higher Education and Research Act maintain the meaning established in the Act.

In this Education and Examination Regulation, the following terms are understood to mean:

- a. WHW: Higher Education and Research Act (*Wet op het Hoger onderwijs en Wetenschappelijk onderzoek*) in effect since 1 September 2002, including all applicable amendments;
- b. UT: University of Twente.
- c. dean: head of the faculty appointed by the Executive Board in accordance with Section 9.12, subsection 1, and Section 9.13, subsection 1, of the WHW;
- d. faculty council: advisory board of the Faculty of EEMCS, the authorities of which are outlined in Sections 9.37, 9.38, 9.38a and 9.38b of the WHW;
- e. programme: the Applied Mathematics programme, a Master of Science programme as referred to in Section 7.3a, subsection 1 under b of the WHW;
- f. programme management: administrative body of the programme as appointed by the dean in accordance with Section 9.17 of the WHW; all UT Master of Science programmes are managed by the programme director;
- g. programme committee: a committee instituted in accordance with Section 9.18 of the WHW which has an advisory role regarding matters of education in the programme;
- h. Board of Examiners: the Board of Examiners of the programme established in accordance with Section 7.12 of the WHW;
- i. study adviser: member of staff appointed or nominated by the dean to support students with all general study issues not directly related to their specific field of study;
- j. student: individual who is enrolled for education at the UT (as either a student or extraneous 'external' student) and who can potentially sit interim examinations and/or be considered for final assessment;
- k. graduation supervisor: chairholder of the chair chosen by the student to graduate from;
- l. cohort: group of students enrolled in the same Master's programme who begin in the same year
- m. final assessment: method by which the Board of Examiners can determine whether a student has sat all interim examinations for the relevant Master's programme units of study and whether the examination results satisfy the requirements established by it (in accordance with Section 7.10 of the WHW)
- n. unit of study: smallest independent assessment component for which unique objectives have been established, educational activities organised and an examiner appointed
- o. interim examination: evaluation of the student's knowledge, understanding and skills with regard to a specific unit of study and its assessment by at least one examiner appointed by the Board of Examiners
- p. credit: unit used to measure a student's study load; one credit is equal to 28 hours of study in accordance with Section 7.4, subsection 1, of the WHW
- q. examiner: individual appointed by the Board of Examiners to administer examinations, in accordance with Section 7.12 of the WHW

Article 3 AIM OF THE MASTER'S PROGRAMME

The programme has the following aims.

- a. To teach students modern, advanced mathematical knowledge with an emphasis on its application to problems in their chosen field of specialisation (see Article 8.2 for the possible fields of specialisation).
- b. To give students an understanding of the methods and techniques of their field and of the position their field occupies within the broader fields of science.
- c. To help students acquire the skills and develop the attitude necessary to function at the academic level. This includes the skills that are needed to be able to communicate effectively and to collaborate with researchers in flanking disciplines both individually and as part of a team.

- d To raise students' awareness of the social context and social impact of research and developments in their field.
- e To give students the opportunity to acquire the knowledge, attitude and skills that will enable them to continue on an academic path leading up to a doctorate programme and degree (if willing and able).

In working to achieve these aims, attention is explicitly focused on alignment with both national and international standards, on reflection on science, technology and society (this is explored in the traineeship, for example, when students are expected to reflect on the working environment), on presentation and on the feasibility of the programme from the student's point of view.

The educational profile of the programme is characterised on the one hand by the four specialisations within the programme (see Article 8.2) and by the attention paid to mathematical modelling on the other. The four specialisations are engrafted on the corresponding four fields of research of the Applied Mathematics Department, which can be characterised by the following key words:

1. MPCM: Mathematical Modelling of Waves, Neurodynamics, Inverse Problems in Seismology, Integrated Optics, Numerical Analysis, Turbulent Flows, Computational Fluid Dynamics. The chairs of this specialisation are Applied Analysis and Mathematical Physics (AAMP) and Numerical Analysis and Computational Mechanics (NACM).
2. MASS: Nonlinear and Robust Control, Hamiltonian Modelling of Open Physical Systems, Hybrid Systems, Distributed-Parameter Systems, Stochastic Filtering and Control. The chairs of this specialisation are Stochastic System and Signal Theory (SST) and Mathematical System and Control Theory (MSCT).
3. FE: Pricing and Hedging of Financial Derivatives, Financial Econometrics, Computational Finance, Optimal Asset Allocation, Insurance Mathematics. The chairs of this specialisation are Stochastic System and Signal Theory (SST) and Statistics and Probability (SP).
4. IEOR: Combinatorial Optimisation, Mathematical Programming, Supply Chain Management, Queuing Theory, Telecommunications Networks, Industrial Statistics. The chairs of this specialisation are Stochastic Operations Research (SOR), Discrete Mathematics and Mathematical Programming (DMMP) and Statistics and Probability (SP).

Students choose a chair within a specialisation. By including subjects from other chairs of the selected specialisation, cohesion is created within the specialisations (see Article 8.3). During the final phase of the Master's programme, the students act as 'junior members' of the chair they have selected. It is during this phase that the students are given the greatest opportunity to demonstrate that they have acquired the qualities outlined in Article 4 by the time they complete their studies.

The focus on mathematical modelling is prevalent in various Master's courses (see Appendix 1), and especially in the traineeship and final project, combined or separately (see Appendices 6 and 7).

Article 4 ATTAINMENT TARGETS OF THE MASTER'S PROGRAMME

The knowledge, understanding and skills students must have acquired upon completion of the programme are as follows:

1. Graduates must have a broad knowledge of mathematics and an insight into its application in different fields such as engineering, economics and business sciences.
2. Graduates must be able to answer complex research questions with the help of different methodologies. When formulating and solving problems, graduates must be capable of determining whether the mathematical tools on hand suffice, and, if not, they must be able to extend theories and methods themselves or otherwise to be able to find such extensions in the professional literature.
3. Graduates must be able to transcend the boundaries of their selected mathematical specialisation to a reasonable degree so that they can collaborate on interdisciplinary projects and also be able to formulate new problems in a scientific manner and to arrive at verifiable solutions.
4. Graduates must be able to function in an engineering environment. Most importantly, they must be able to apply mathematical methods and techniques and they must have the capacity to integrate components from mathematics and different areas of application.
5. Graduates must be able to use computers to tackle the increasing complexity of the mathematical problems. Computer algebra, numerical methods and simulation techniques are central in this regard.
6. Graduates must be able to search through the vast literature available via different library networks using automatic search methods and find relevant information.

7. Graduates must be capable of effective written and oral communication with others in the field as well as with laymen.
8. Graduates must have an adequate comprehension of their role as academics in society.
9. Talented graduates must be able to choose to continue their studies by going for a PhD or another postgraduate programme (abroad if they choose).

Article 5 FULL-TIME OR PART-TIME ORGANISATION OF THE PROGRAMME

The Master's programme is full-time.

Article 6 ADMISSION REQUIREMENTS OF THE MASTER'S PROGRAMME

1. A confirmation of admission issued by the Board of Examiners must be submitted to be enrolled by the UT as a student of the programme.
2. Further details regarding the issuance of confirmations of admission as referred to in Article 6.1 are laid down by the Board of Examiners in the 'Examinations and Assessment Regulations' (RET).

Article 7 LANGUAGE

1. The language of the curricula of the Master's programmes is English. The interim examinations and final assessments are given in English.
2. In consultation with and with the approval of students, it may be decided to provide the curricula of a unit or an interim examination in Dutch.
3. The dean issues a regulation concerning the assessment of English language proficiency of staff members who teach courses in the programme, and of the support staff for the programme. All staff involved must meet the language requirements of the regulation. As necessary, courses to improve English proficiency of these staff members are provided.

Section 2 Curriculum and Final Assessment of the Master's Programme

Article 8 STRUCTURE OF THE MASTER'S PROGRAMME

1. The Master's programme is divided into four specialisations. Each student chooses a specialisation and – within that specialisation – a course programme consisting of units of study. Appendix 1 lists all the Master's subjects that are part of the programme.
2. Students can specialise in:
 - a. Mathematical Physics and Computational Mechanics (MPCM)
 - b. Mathematics and Applications of Signals and Systems (MASS)
 - c. Financial Engineering (FE)
 - d. Industrial Engineering and Operations Research (IEOR)
3. The Master's programme is a two-year programme.
The curriculum for transfer students (who have a Bachelor's in Technical Mathematics from a Dutch university) consists of the following elements:
 - a. A minimum of 18 ECs in common subjects (those with a tag 36 in the list in Appendix 1) wherein a minimum of 12 EC should be from the core subjects (with a tag 23).
 - b. A minimum of 15 ECs in subjects in the selected chair within the chosen specialisation.
 - c. A minimum of 10 ECs in subjects from other chairs, preferably, within the selected specialisation.
 - d. A minimum of 12 ECs in national courses (offered via <http://www.mastermath.nl>)
 - e. Enough electives added to the above subjects so that the total number of ECs adds up to at least 60.
 - f. 60 ECs, traineeship and final project.

The Master's programme for transfer students may contain a maximum of 10 ECs in subjects of bachelor level (from outside mathematics education) if expertise in that area is so desired, for example in the final project.

Appendices 2 to 5 inclusive provide further details on the Master's programme for each specialisation.

Students entering the programme through an alternative route may not use more than 20 ECs from Bachelor level courses to satisfy the programme requirements. They are explicitly encouraged to include common subjects in their study programme, which may be replaced by 'easier' versions from the Bachelor's programme.

National subjects are offered, co-ordinated by the Mathematics Co-ordination Group. See <http://www.mastermath.nl> for a list of these.

The examination rules and prerequisites are also posted on this website. These courses are offered in addition to the Master's courses offered as part of the programme. The courses mentioned in 8.3.a-e may be replaced by corresponding courses from the national curriculum.

Alternative academic programmes are permitted in the second year (contrary to provision 8.3.f):

- a. Combined traineeship and final project (60 ECs), subject to a minimum of 3 and a maximum of 7 external months.
- b. Two quarters of courses and a combined traineeship and final project (30 ECs).

The rules and procedures governing the traineeship and the final project are specified in Appendices 6 and 7.

4. Students can create part of their own course programme using the units of study offered, with due observance of the provisions of Article 8.3. The course programme must be approved by the study adviser and graduation supervisor. For students entering the programme through an alternative route, this is done at the beginning, while transfer students must have an approved course programme by the time they have earned 18 credits. The study adviser is entitled to approve a later change to the programme that is not to exceed 6 credits without the course programme approval procedure needing to be repeated.
5. The units of study comprising the course programmes are annually determined for new students and, if necessary, changed for students further along in the degree programme. Each specialisation handled separately. This includes the scope and interrelation of units of study and the schedule of interim examinations. If changes are made, a transitional arrangement will apply to cohorts further along in the degree programme, in accordance with the provisions in Article 22.
6. Contrary to the provisions of 8.1 – 8.5, students can compile their own course programme (independent Master's programme). Such course programmes require the approval of the study adviser, graduation supervisor and the Board of Examiners. Before approving this programme, the Board of Examiners will confer with the programme committee.

Article 9 FINAL ASSESSMENT OF THE MASTER'S PROGRAMME

1. The programme concludes with the Master's programme final assessment.
2. The Master's programme final assessment comprises a study load of 120 credits.
3. Once the Board of Examiners has approved the selected specialisation and corresponding course programme on the basis of the regulation referred to in Article 8, the student can access the Master's programme final assessment.

Section 3 Interim Examinations

Article 10 NUMBER, SCHEDULE AND FREQUENCY OF INTERIM EXAMINATIONS

1. Interim examinations will be scheduled immediately following the conclusion of each unit of study. If circumstances prevent a unit of study from being offered during an academic year, the relevant interim examination will nonetheless be scheduled.
2. The Board of Examiners may instruct the examiner to schedule interim examinations on certain dates in addition to those provided for in Article 10.1.
3. Written interim examinations for the Master's programme will be scheduled for each unit at least twice each academic year, barring any of the exceptions outlined in Articles 10.5, 10.6, 10.7 and 10.8. The first interim examination will be scheduled immediately following the period during which the unit of study is offered, in accordance with the provisions of Article 10.1.
4. Contrary to the provisions of Article 10.3, but in accordance with the provisions of Article 10.1, at least one written internal examination date will be scheduled in an academic year during which the unit of study is not offered.

5. The provisions governing interim examinations of Articles 10.1, 10.3 and 10.4 do not apply to units of study subject to a transitional arrangement as referred to in Article 8.5. In these instances, the transitional arrangement will outline the scheduling of interim examinations in accordance with the provisions of Article 22.
6. Departures from the provisions of Articles 10.3 and 10.4 are permitted for units of study for which the designated examiner is not a member of staff of the Applied Mathematics department. In those cases, the provisions of the Education and Examination Regulation of the faculty or programme of the examiner's degree course shall apply.
7. In exceptional circumstances, the Board of Examiners may adopt regulations to schedule written interim examinations in a manner departing from the provisions of Articles 10.3, 10.4 and 10.6.
8. A schedule of written interim examinations for a semester will be published at least one month in advance of the start of that semester.
9. Students may only sit interim examinations if they register for them. The examination schedule indicates closing dates for interim examination registration.
10. This Article's provisions governing written interim examinations do not apply to units of study not or not exclusively assessed by means of a written interim examination. In instances where the scheduling of interim examinations is not covered by this Article, the student can, after sitting an interim examination and receiving the results from the examiner, submit a request to re-sit the interim examination.
11. If a student has failed two or more units in the first year of the programme, the study adviser can apply to the Board of Examiners for a Make-up Study. This Make-up Study is a contract between the lecturers and student concerned, stipulating what requirements the student must meet to obtain satisfactory results for the specific units. It must be possible to complete these requirements in a four-week period during the summer, and seven is the maximum mark on the grading scale for the specific units of study.
12. The student can choose to accept or decline the offer of Make-up Study (as defined in section 11). If the student accepts the offer, the study adviser ensures that clear agreements are made between the student and examiner or examiners regarding the completion of the Make-up Study.
13. If a subject with a written interim examination is cancelled, another two written interim examinations must be offered the following academic year.

Article 11 SEQUENCE OF AND ELIGIBILITY FOR INTERIM EXAMINATIONS

1. Students who have a confirmation of admission as referred to in Article 6.1 may sit interim examinations.
2. If requested, the Board of Examiners may permit students to sit interim examinations for the programme even if the students have not been granted admission to the programme as referred to in Article 11.1.
3. The provisions of Articles 11.1 and 11.2 do not apply to students who complete a unit of study and sit an interim examination as part of a degree course other than the programme covered by this Education and Examination Regulation. For these students, the rules governing sitting interim examinations laid down in their own degree course's Education and Examination Regulation apply.
4. The Board of Examiners can adopt regulations governing basic knowledge requirements, barring students from interim examinations as long as they fail to successfully complete certain units of study. These regulations are laid down each year and posted in OSIRIS.
5. In individual instances, the Board of Examiners may prevent a student from sitting some or all interim examinations for a limited period of no more than one year if it feels a student has committed a serious breach of the rules governing sitting interim examinations. The relevant regulations and procedures are laid down in the 'Examinations and Assessment Regulations' (RET)..
6. A student who fails to register for a written interim examination may be refused entrance to the examination session and, consequently, be unable to sit the interim examination.

Article 12 VALIDITY OF INTERIM EXAMINATION RESULTS

1. The units of study completed have unrestricted validity.

2. If a unit of study's interim examination comprises individually graded sub-examinations (i.e. an interim examination sat in parts), the examiner will determine the term of validity of the relevant sub-results. If students have not been notified of the term of validity of sub-results by the time the unit of study starts, the sub-results will remain valid until such time as the specific unit of study is eliminated or modified to such an extent that a transitional arrangement as referred to in Article 22 becomes applicable.

Article 13 SITTING INTERIM EXAMINATIONS

1. The procedures for sitting interim examinations reviewed as part of a Master's programme final assessment are laid down each year for each new cohort and, if necessary, changed for cohorts further along in the degree programme. A transitional arrangement will be established for any changes made for cohorts further along in the programme, in accordance with the provisions of Article 22.
2. The interim examinations procedure for the units of study is posted on OSIRIS.
3. The designated examiner may – unilaterally or on the instruction of the Board of Examiners – opt to use forms of examination other than those established and published in accordance with the provisions of Articles 13.1 and 13.2. The form of examination ultimately chosen, however, should serve to facilitate the progress of the student/students involved and not negatively impact the quality of the assessment.
4. If an interim examination comprises individually graded sub-examinations (i.e. an interim examination sat in parts), the examiner should – prior to or at the start of the subject – inform the students in writing or electronically how the sub-results will be used to determine the final interim examination result.
5. Students with a physical or sensory handicap will be given the opportunity to sit interim examinations and complete practical exercises in a manner appropriate to their ability. This can be achieved by, for instance, adjusting the type or duration of the interim examinations or providing practical tools, tailored to the student's situation. Students wishing to invoke these regulations should contact their study adviser or, in cases of dyslexia, the Educational Affairs Office.

Article 14 ORAL INTERIM EXAMINATIONS

1. The examiner may conduct oral examinations involving more than one student at a time, unless one of the students involved objects to this.
2. Oral interim examinations are open to the public, except in special cases when the Board of Examiners has decided otherwise.
3. If the student or the examiner wants the presence of a third person during the oral examination, the Board of Examiners must be informed about it at least 10 days before the day of the oral examination.
4. If the Board of Examiners wants the presence of one of her member or an observer on behalf of her during the oral examination, the student and the examiner must be notified about it at least one day in advance of the oral examination.

Article 15 DETERMINATION AND PUBLICATION OF RESULTS

1. Immediately after conducting the oral interim examination, the examiner determines the results, explains these and provides the student with a written confirmation of the results.
2. The examiner determines the official results of a written interim examination as quickly as possible, but no later than 15 working days after administering it, and informs the students immediately of the results. The examiner provides the Educational Affairs Office with the necessary information and ensures that the written statement is provided. The Educational Affairs Office ensures that the results are registered no later than 20 working days after the examination is sat. University holidays and public holidays recognised by the UT will not count as working days. The Board of Examiners can make an exception to the stated periods. Students must be informed before the examinations are administered.
3. If two written interim examination sessions for the same unit of study are scheduled shortly after each other, the term during which the examiner determines the result will be reduced so that the results from the first examination date will be announced before registration for the second examination date closes.

4. For other forms of evaluation (i.e. other than oral or written examinations), the examiner will – if requested – indicate how the result will be determined and when the student will be informed of the result. The Board of Examiners can – unilaterally or at the request of students – instruct the examiner to observe a term it establishes for the announcement of results.
5. If there are more than one valid results for a unit of study, the highest result will be considered valid.

Article 16 RIGHT OF INSPECTION

1. During a period of 12 months starting on the day after being informed of the results of a written interim examination, the examinee may request to inspect his/her marked interim examination. The examiner designated, if any, for the subject in question will bear responsibility for this. This provision also applies to the inspection of reports for practical exercises. The individual in charge of the practical exercise determines: a) whether the reports will be returned to the student involved after the 12-month period and b) whether the student may make photocopies or other copies of the graded reports.
2. During a period of 12 months starting on the day after the results of an interim examination are announced, interested individuals may inspect the questions and assignments included or given in the written interim examination administered and the standards on the basis of which the evaluation occurred. The examiner determines whether photocopies may be made.
3. The place and time of the inspection referred to in Articles 16.1 and 16.2 will be determined by the examiner in consultation with the examinee.

Article 17 MEETING TO DISCUSS INTERIM EXAMINATION RESULTS

1. If requested to do so, the examiner will meet with students to discuss a written interim examination, provided the request is submitted within 12 months of the day on which the results were announced. The examiner will determine a time and location for the meeting within a reasonable amount of time after receiving the request.
2. The Board of Examiners may grant exceptions to the provisions of Article 17.1.

Section 4 Exemption from Interim Examinations

Article 18 EXEMPTION FROM INTERIM EXAMINATIONS AND/OR PRACTICAL EXERCISES

1. The Board of Examiners may grant an exemption for one or more interim examinations and/or practical exercises on the basis of written certificates for higher education interim examinations or examinations the student has successfully sat in the past or certificates for competencies acquired previously in a non-higher education context. Exemptions are not granted for a Bachelor's programme. If compulsory Master's subjects have been completed already (for the most part) as part of a Bachelor's programme, these can be replaced by other subjects.
2. A request for an exemption from one or more interim examinations of a unit must be submitted in writing to the Board of Examiners. This request must be accompanied by copies of all relevant documents indicating the basis for the exemption being requested.

Section 5 Examinations

Article 19 SCHEDULE AND FREQUENCY OF FINAL ASSESSMENTS

1. Students will have at least three opportunities a year to have the programme's final assessment conducted.
2. Registration is required to have a final assessment conducted. The Board of Examiners' meeting schedule is set and published at the start of each academic year. The exact dates are made known at least 10 weeks before the meeting.
3. The rules governing registration for and performance of final assessments, determination of the results and the awarding of diplomas are laid down in the 'Examinations and Assessment Regulations' (RET).

Section 6 Student Support Services and Academic Advice

Article 20 STUDY PROGRESS REPORT

1. Each year, all students will receive at least one update in writing, outlining their study progress in the last period.

Section 7 Provisions Regarding Implementation

Article 21 REGULATION AMENDMENTS

1. Amendments to this Education and Examination Regulation will be adopted by the dean by means of a separate decision.
2. Amendments affecting the current academic year may be implemented, provided they do not unreasonably impinge on the students' interests.
3. Amendments may not negatively impact decisions taken – pursuant to this Education and Examination Regulation – by the Board of Examiners with regard to a student.

Article 22 TRANSITIONAL ARRANGEMENTS

1. If substantive changes are made to the degree course's structure and composition, including situations in which one of the articles of the Education and Examination Regulations is amended, the dean will establish and announce a transitional arrangement. This arrangement will be posted on the TW website.

This transitional arrangement will in any event:

- a. outline a scheme governing the granting of exemptions for previous results of interim examinations
 - b. indicate the number of times interim examinations for the units of study of the old degree course may be re-sat
 - c. indicate the term of the transitional arrangement
2. The following applies to establishing and announcing a transitional arrangement for amendments to a unit of study:
 - a. If a unit of study reviewed by means of a written or oral examination is terminated, a student must have at least one more opportunity to sit the interim examination for the unit of study in question in the academic year after the unit of study is offered for the last time.
 - b. If the curriculum or learning objective of a unit of study reviewed by means of a written or oral examination undergoes substantial change or the form of examination involved is significantly changed, a student must have at least one more opportunity to sit the interim examination for the unit of study in question in the 'old' manner in the academic year after the unit of study is offered in its unmodified form for the last time.
 - c. If a unit of study to be terminated is reviewed on the basis of the quality of participation in activities and any work produced (particularly project-oriented subjects) and not or only partially based on a written or oral examination, the Board of Examiners will determine how a student will be able to satisfy the interim examination requirements if he has not yet completed the unit of study in question.

Article 23 PUBLICATION

1. The dean adopts this Education and Examination Regulation after consulting with the programme committee and after approval from the faculty council.
2. The dean and the programme committee regularly evaluate the implementation and effectiveness of this Education and Examination Regulation.
3. The dean ensures that this Education and Examination Regulation and any interim amendments are made known.

Article 24 ENTRY INTO FORCE

This Education and Examination Regulation takes effect on 01 September 2011.

Adopted by the dean of the Faculty on
as proposed by programme management and Boards of Examiners,
after receiving the recommendations of the programme committee (29 April 2011),
approved by the Faculty Council on
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Appendix 1 Overview of Master's Programme Subjects 2011--2012

The table below lists the Master's programme subjects offered by the chair as chair subjects. These subjects are given at UT or offered nationally with the involvement of a UT lecturer. Besides the subjects listed in the table below, there are other national subjects that can be taken as electives as part of a Master's programme. The total range of national subjects offered can be found at www.mastermath.nl

Code	Course	Quartile				EC	Chair
		1	2	3	4		
191506302	Applied functional analysis	23, 36				6	AAMP ¹
191509103	Advanced modelling in science			2N		6	AAMP
191511430	Seminar mathematical physics	X	X	X	X	5	AAMP
191550105	PDV uit de mathematische fysica		X			5	AAMP
191560371	Applied analytical methods				X	5	AAMP
191560430	Nonlinear Dynamics			X		5	AAMP
191520751	Grafentheorie		X			5	DMMP
191521800	Game theory	X				5	DMMP
191580800	Scheduling			2N		6	DMMP
191581100	Discrete optimization	2N, 36				6	DMMP ¹
191581200	Continuous optimization	2N, 36				6	DMMP ¹
191581420	Optimization modelling			X		5	DMMP
191581500	CS discrete mathematics and math. progr.				X	5	DMMP
191560671	Robust control			X		5	MSCT
191561560	Systems and control	2N				6	MSCT
191561620	Optimal control			X		5	MSCT
191561680	Nonlinear control	-	-	-	-	5	MSCT
191561770	Nonlinear systems theory			2N		6	MSCT
191571200	Hybrid dynamical systems				X	5	MSCT
191511151	Numerical linear algebra	2N				8	NACM
191551091	Mathematical theory of finite element methods				X	6	NACM
191551150	Numerical techniques for pde		X			5	NACM
191551161	Applied finite element methods for pde			2N		6	NACM
191551200	Scientific computing			23, 36		6	NACM ¹
191521800	Game theory	X				5	SOR
191531701	Introduction to stochastic processes	X				4	SOR
191531750	Stochastic processes	23, 36				6	SOR ¹
191531870	Queueing theory			2N		6	SOR
191531920	Markov decision theory and algorithmic methods		X			5	SOR
191531940	Network of queues				X	5	SOR
191531960	Capita selecta stochastic operations research				X	5	SOR
191515101	Introduction to risk theory			X		5	SP
191515501	Life insurance				X	5	SP
191531350	Statistical techniques	X				5	SP
191531400	Applied statistics			2N		6	SP

¹ A subject cannot be chosen both as a common subject as well as a chair subject.

Code	Course	Quartile				EC	Chair
		1	2	3	4		
191531450	Linear statistical models				X	5	SP
191531550	Nonparametric statistical methods	X				5	SP
191531650	Capita selecta statistics and probability			X		5	SP
191536101	Mathematical theory of probability and statistics	X					
191570350	Financial econometrics			X		5	SP
191570401	Measure and probability	36				6	SP ¹
191515201	Mathematical finance		X			5	SST
191515301	Continuous time finance	X				5	SST
191515401	Computational methods in finance	X				5	SST
191515900	Interest rate and credit derivatives		X			5	SST
191561750	Infinite dimensional linear systems	-	-	-	-	6	SST
191570300	Structured products				X	5	SST
191571080	Random signals and systems			X		5	SST
191571090	Time series analysis	X				5	SST
191571160	Stochastic filtering and control				X	5	SST
191571501	Stochastic differential equations				2N	6	SST

23	choice of 2 out of 3 (3TU core programme)
36	choice of 3 out of 6 (common subjects)
2N	choice of 2 from the national courses (to be found at http://www.mastermath.nl)
AAMP	Applied Analysis and Mathematical Physics
DMMP	Discrete Mathematics and Mathematical Programming
MSCT	Mathematical System and Control Theory
NACM	Numerical Analysis and Computational Mechanics
SOR	Stochastic Operations Research
SP	Statistics and Probability
SST	Stochastic System and Signal Theory

¹ A subject cannot be chosen both as a common subject as well as a chair subject.

Appendix 2 Mathematical Physics and Computational Mechanics Programme 2011-2012

Chair: Numerical Analysis and Computational Mechanics.

Intended for: transfer students who start the Master's programme in the 2011 – 2012 academic year.

Programme requirements: the course section of the Master's programme will certainly consist of:

- three common subjects (C),
 - three chair subjects (NACM),
 - two other subjects within the specialisation (AAMP),
- plus electives so the entire course programme adds up to at least 60 ECs and at least two of the national courses (2N) are selected.

These programme requirements result in the following (compulsory) course programme.

Code	Course	Quartile				EC	Remarks
		1	2	3	4		
191506302	Applied Functional Analysis	X				6	C
191551200	Scientific Computing			X		6	C
191531750	Stochastic Processes	1/3				6	C
191570401	Measure and Probability	1/3				6	C
191581200	Continuous Optimization	1/3				6	C
191551150	Numerical Techniques for PDE		X			5	NACM
191551161	Applied Finite Element Methods for PDE's			X, 2N		6	NACM
191551091	Mathematical Theory of FEM				X	6	NACM
191560371	Applied Analytical Methods				X	5	AAMP
191509103	Advanced Modelling in Science			X, 2N		6	AAMP

1/3	Choice of 1 out of 3
2N	Choice of 2 from the national courses

The electives are applied physics/technology subjects or other mathematical subjects that may be offered nationally. These subjects are determined in consultation between the student and the chair holder Prof. J.J.W. (Jaap) van der Vegt. The choice depends on the student's interests and the topic of the final project. It is also possible for the traineeship (20 ECs) to be used to delve more deeply into specific subject matter.

Students entering the programme through an alternative route: They are asked to contact the study adviser, Dr Pranab Mandal as soon as possible in order to determine a suitable programme that is feasible from the student's point of view.

Chair: Applied Analysis and Mathematical Physics

Course programme for transfer students

- three common subjects (C),
 - three chair subjects (AAMP),
 - two (relevant) specialisation subjects,
- plus electives so the entire course programme adds up to at least 60 ECs.

Code	Course	Quartile				EC	Remarks
		1	2	3	4		
191506302	Applied Functional Analysis	X				6	C
191531750	Stochastic Processes	X				6	C
191581200	Continuous Optimization	X				6	C
191560371	Applied Analytical Methods				3/4	5	AAMP
191511430	Seminar Mathematical Physics	3/4	3/4	3/4	3/4	5	AAMP
191509103	Advanced Modelling in Science			3/4, 2N		6	AAMP
191560430	Nonlinear Dynamics			3/4		5	AAMP
191551161	Applied Finite Element Methods for PDE's			1 ⁺ /2, 2N		6	NACM
191551150	Numerical Techniques for PDE		1 ⁺ /2			5	NACM
191571090	Time Series Analysis	1 ⁺ 2				5	SST
191571501	Stochastic Differential Equations			1 ⁺ 2, 2N		6	SST

3/4	Choice of 3 out of 4
1 ⁺ /2	At least 1 out of 2.
1 ⁺ 2	At least 1 out of 2.
2N	Choice of 2 from the national courses

The electives to bring the credit total to 60 ECs are applied physics/technology subjects from Optics, Fluid Dynamics, Biomathematics, etc. A minimum of 2 subjects from the national courses (2N) that are offered must be selected. The electives are determined in consultation between the student and the chair holder, Prof. S.A. (Stephan) van Gils. The choice depends on the student's interests and the topic of the final project.

Students may take one advanced subject as part of the final project (40 ECs). In addition, students may also opt to combine the traineeship and final project (60 ECs) with a limited time working off-campus.

Appendix 3 Mathematics and Applications of Signals and Systems Programme 2011-2012

Chairs: Mathematical Systems and Control Theory (MSCT) and Stochastic System and Signal Theory (SST)

We offer a two-year MSc programme. The programme is designed for students with an undergraduate degree in fields such as mathematics, physics, engineering, econometrics or computer sciences. The first year consists of courses, while most of the second year is dedicated to a traineeship and a graduation project.

The first year is divided into 4 quartiles and entails 10–12 courses of 5 or 6 ECs per course. The number of courses in the second year is flexible (possibly zero). Some of the courses are compulsory.

Code	Course	Quartile				EC	Chair
		1	2	3	4		
191561560	Systems and Control	56, 2N				6	MSCT
191560671	Robust Control			56		5	MSCT
191571200	Hybrid Dynamical Systems				56	5	MSCT
191571090	Time Series Analysis and System Identification	56				5	SST
191571160	Stochastic Filtering and Control				56	5	SST
191571501	Stochastic Differential Equations			56, 2N		6	SST
191506302	Applied Functional Analysis	23, 36				6	AAMP
191531750	Stochastic Processes	23, 36				6	SOR
191551200	Scientific Computing			23, 36		6	NACM
191570401	Measure and Probability	36				6	SP
191581100	Discrete Optimization	36, 2N				6	DMMP
191581200	Continuous Optimization	36, 2N				6	DMMP
191509103	Advanced Modelling in Science			2N		6	AAMP
191551161	Applied Finite Element Methods for PDE's			2N		6	NACM
191531400	Applied Statistics			2N		6	SP
191531870	Queueing Theory			2N		6	DMMP

23	Choice of 2 out of 3
2N	Choice of 2 from the national courses
36	Choice of 3 out of 6
56	Choice of 5 out of 6

Other courses may be chosen from the tentative list below. This list is not complete but gives a good indication of what is available. The choice depends on your background and preferences and the content of the graduation project.

Course	Quartile				EC	Comment
	1	2	3	4		
Optimal Control			X		5	Applied Math course
Random Signals and Systems			X		5	Applied Math course
Modeling and Analysis of Concurrent Systems 1	X				5	Computer Sciences course
Modeling and Analysis of Concurrent Systems 2		X			5	Computer Sciences course
System Validation				X	5	Computer Sciences course
Advanced Digital Signal Processing				X	5	Electrical Engineering course
Control Engineering			X			Electrical Engineering course
Digital Control Engineering		X			5	Electrical Engineering course
Engineering System Dynamics			X		3	Electrical Engineering course
Modeling and Simulation		X				Electrical Engineering course
Modern Robotics				X	5	Electrical Engineering course
Biological Control Systems	X					Technical Medicine course
Infinite Dimensional Systems						National (if available)
Nonlinear Systems Theory						National (if available)

Appendix 4 Financial Engineering Programme Generation 2011

Transfer students

1 st year	Quartile 1	Quartile 2	Quartile 3	Quartile 4			
194110010 Corporate Finance	5	191515201 Mathematical Finance	5	191570350 Financial Econometrics	5	191570300 Structured Products	5
191506302 Applied Functional Analysis			6	191860181 Risk Management	5	191515501 Life Insurance or 191571160 Stochastic Filtering and Control	5
191570401 Measure and Probability			6	191515101 Introduction to Risk Theory			5
191531750 Stochastic Processes			6	191571501 Stochastic Differential Equations			6
2 nd year	Quartile 1	Quartile 2	Quartile 3	Quartile 4			
191515301 Continuous Time Finance	5	191515900 Interest Rate and Credit Derivatives	5	191508309 Combined Traineeship and Final Project	30		
191860651 Micro-economics or Choice	5	191550105 Theory of PDE or Choice	5				
National Course, e.g., 191581200 Continuous Optimization 101561560 Systems and Control			6				
191515401 Computational Methods in Finance			5				

This is the program for the 2011 cohort.

Students entering the programme through an alternative route

1st year	<i>Quartile 1</i>	<i>Quartile 2</i>	<i>Quartile 3</i>	<i>Quartile 4</i>			
194110010 Corporate Finance	5	191515201 Mathematical Finance	5	191570350 Financial Econometrics	5	191570300 Structured Products	5
191515603 Introduction to Investment Theory	5	191550105 Theory of PDE	5	191860181 Risk Management	5	191515501 Life Insurance or 191571160 Stochastic Filtering and Control	5
191506302 Applied Functional Analysis			6	191515101 Introduction to Risk Theory			5
191536101 Mathematical Theory of Probability and Statistics			6	191571501 Stochastic Differential Equations			6
2nd year	<i>Quartile 1</i>	<i>Quartile 2</i>	<i>Quartile 3</i>	<i>Quartile 4</i>			
191515301 Continuous Time Finance	5	191515900 Interest Rate and Credit Derivatives	5				
National Course, e.g., 191581200 Continuous Optimization 191561560 Systems and Control			6	191508309 Combined Traineeship and Final Project		30	
191531750 Stochastic Processes			6				
191515401 Computational Methods in Finance			5				

This is the programme for the 2011 cohort.

Appendix 5 Industrial Engineering and Operations Research Programme 2011-2012

Industrial Engineering is offered in different Master's programmes. The department of Applied Mathematics offers a Master's programme in Applied Mathematics. Within this programme, the chairs Discrete Mathematics and Mathematical Programming, Statistics and Probability, and Stochastic Operations Research offer the track Industrial Engineering and Operations Research focusing on Mathematics of Operations Research and Statistics.

IEOR 2011-2012 Master's programme

The track consists of a one-year course programme, followed by one year of practical training (traineeship), and graduation (final project). It is possible to include some courses in the programme for the second year.

Requirements

Course load : 60 ECs
 Traineeship : 20 ECs
 Thesis : 40 ECs

Courses:

Three courses from the 3TU mathematics core programme

23	Choice of 2 out of 3
2N	Choice of 2 from the national courses
36	Choice of 3 out of 6

Code	Course	Quartile				EC
		1	2	3	4	
191570401	Measure and Probability	36				6
191506302	Applied Functional Analysis	23, 36				6
191531750	Stochastic Processes	23, 36				6
191551200	Scientific Computing			23, 36		6
191581100	Discrete Optimization	2N, 36				6
191581200	Continuous Optimization	2N, 36				6

Five courses from the IEOR programme selection list

Code	Course	Quartile				EC
		1	2	3	4	
191531400	Applied Statistics			2N		6
191531450	Linear Statistical Models				X	5
191531550	Nonparametric Statistical Methods	X				5
191531650	Capita Selecta Statistics and Probability			X		5
191521800	Game Theory	X				5
191531940	Networks of Queues				X	5
191531920	Markov Decision Theory and Algorithmic Methods		X			5
191531960	Capita Selecta Stochastic Operations Research				X	5
191531870	Queueing Theory (LNMB)			2N		6
191580800	Scheduling (LNMB)			2N		6
191581100	Discrete Optimization (LNMB)	2N, 36				6
191581200	Continuous Optimization (LNMB)	2N, 36				6
191581420	Optimization Modelling			X		5
191581500	Capita Selecta Discrete Mathematics and Mathematical Programming			X		5

Remaining course load:
Free selection from
Industrial Engineering Master's courses
National mathematics Master's courses (mastermath)
Master's courses at other universities
PhD courses

Appendix 6 The Traineeship

TRAINEESHIP

The 20-credit traineeship is completed over at least a three-month period. The student spends the time in an off-campus work setting. UT is only eligible as a traineeship host in exceptional cases, at the discretion of the study adviser, graduation supervisor and Board of Examiners. During the traineeship, the student performs work determined by the host organisation and in line with the organisation's aims. The work must also be related to the programme both in terms of substance and level. The primary aims of the traineeship are for the student to:

- discover how to practically apply the knowledge and skills gained from the programme
- learn how to work with colleagues within an organisation and work in accordance with the rules and preconditions applicable to and deemed important by the organisation

At the conclusion of the traineeship, the student submits a written report about his/her traineeship.

PRIOR TO THE TRAINEESHIP

1. The student contacts the traineeship co-ordinator at least six months before the student wants to start the traineeship in the Netherlands. For traineeships abroad, the student must contact the traineeship co-ordinator about 1 year before the traineeship is required.
2. The traineeship co-ordinator can assist in finding an appropriate placement, taking into consideration – as much as reasonably possible – the student's wishes in terms of, for instance, the type of assignment, type of company, regional placement and term of the traineeship. The traineeship will be geared as much as possible to the student's chair.
3. Lecturers may assist the student in finding a suitable placement or the student may find one by himself/herself.

TRAINEESHIP ADMISSION

The programme has a Traineeship Office to handle the various issues relevant to traineeships. The traineeship must be reported to and registered with this office. The following matters must be arranged by the graduation supervisor (or someone designated by the supervisor).

1. The supervisors, TW traineeship mentor and company mentor are designated (see Supervision).
2. The traineeship job description has been assessed and approved by the TW traineeship mentor.
3. Prior to starting the traineeship, the student must have a Bachelor's diploma, a course programme signed by the study adviser and a minimum of 40 credits of the programme completed.

SUPERVISION

Two supervisors are designated before the student leaves for the traineeship location:

the company mentor: a member of the staff of the company who assists and evaluates the student at the company.

the TW traineeship mentor: the traineeship lecturer, who assists with and evaluates the curricula of the traineeship.

EVALUATION

THE TW traineeship mentor determines a grade for the traineeship after receiving the report. The company evaluation is also taken into consideration. The traineeship co-ordinator verifies whether the report meets the requirements.

Appendix 7 The Final Project

FINAL PROJECT

There are two types of final projects. The final project is either carried out separately (40 ECs) or in combination with the traineeship (min. 30, max. 60 ECs). The traineeship is completed over a period of at least three months but no more than seven months. Students complete traineeships off-campus. Only in exceptional cases students may work as trainees at the University of Twente, such to be decided by the study adviser, the graduation supervisor and the Board of Examiners.

The final project must enable the student to apply the expertise gained during prior courses, projects and practical training sessions to solve well-defined problems of sufficient academic difficulty. In completing the final project, students must be allowed to make their own decisions. Students must be able to address the problem systematically, achieve clear results and formulate clear conclusions. Students are expected to report, both orally and in writing, on their findings and read and process relevant literature critically.

Students who choose the combined traineeship and final project may use part of their credits to focus on the project theme before leaving and work on their report after their return.

At the beginning of the final project, the student and the graduation supervisor make work agreements. The graduation supervisor ensures that the assignment is in line with the 'mission' of the student's chosen specialisation and arranges for adequate supervision.

The student will meet with the supervisors regularly to discuss the progress of the final project. These meetings focus on both the content and the implementation of the final project (comparable to the job appraisal interviews students will encounter later in their career).

To complete the final project, the student must submit a written report and hold a public presentation. The report should also contain a text reflecting upon the relevance of the research work of the final project in the society.

GRADUATION COMMITTEE AND EVALUATION COMMITTEE

The regulations about the composition of the graduation committee and the evaluation committee are laid down by the Board of Examiners in the 'Examinations and Assessment Regulations' (RET).

FINAL PROJECT ADMISSION AND ELIGIBILITY

The student contacts a chair willing to take responsibility for the development, organisation and supervision of the project and/or an external organisation where the project can be performed. The study adviser can help find a chair. The chair can be of assistance in making arrangements with external organisations. The following conditions must be met prior to definitive admission to the final project:

- The study adviser has approved the student's course programme.
- A chair/chairs willing to take responsibility for the organisation, supervision and assessment of the graduation project has/have been found.
- Outside of the final project or combined traineeship and final project, the student requires no more than 10 credits to be eligible for the Master's programme final assessment.

RULES FOR SUPERVISING AND EVALUATING FINAL PROJECT

The graduation supervisor is responsible for ensuring that there is proper supervision and evaluation during the course of the final project.

One part of supervising would-be graduates is to create a graduation file where correspondence between the student and graduation committee is saved, along with the agreements made as a result. The student ensures that his or her file includes reports of any obstacles beyond the student's control that he or she has encountered while working on the final project, such as special personal circumstances, changes at the company where the student is performing his/her project, inadequate facilities or requisite information not being available on time. The graduation committee and supervisors ensure that work schedules and all additional agreements with the student are kept in the file. In particular, the file also includes work done in advance of the student's departure for the traineeship location as part of a combined traineeship and final project. During the final evaluation of the final project, explicit consideration is given to the work included in the file but the report does not necessarily have to describe that work in detail.

No later than 5 weeks before the final project is due, the student and graduation committee confer on the project's status. A report of this meeting is saved in the file and states the project due date (rescheduled if necessary), as well as any corrective changes to the project description and supervision. The student confirms that he or she approves of the report and the updated agreements.

Any time an extension of more than a month is granted (not including holiday periods), a new report is inserted in the file no less than three weeks before the extension is to expire.