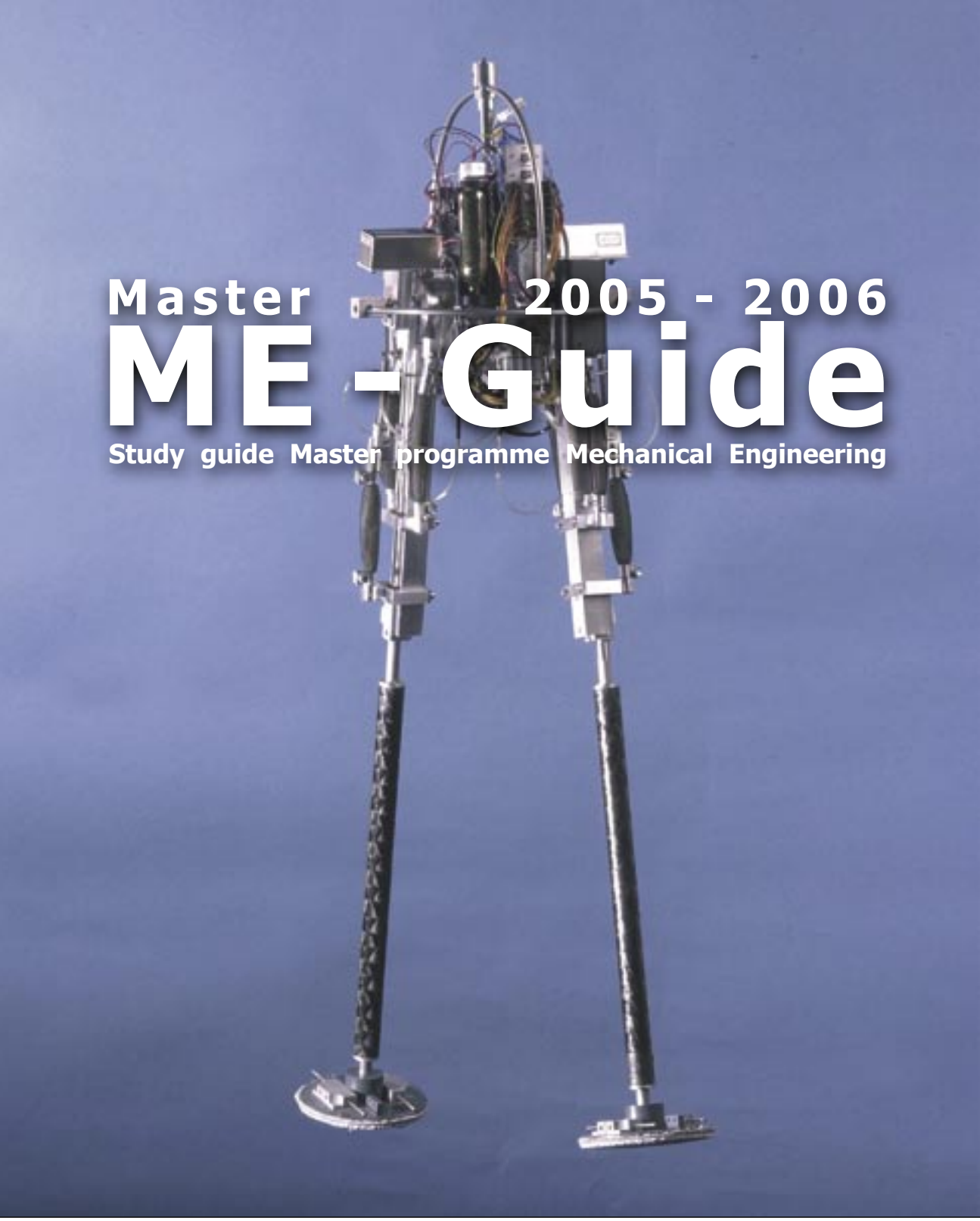

Master 2005 - 2006

ME-Guide

Study guide Master programme Mechanical Engineering

TU Delft

Faculty of Mechanical, Maritime and Materials Engineering

Delft University of Technology

Academic Calendar 2005-2006

ACTIVITY	WEEK		DATE
1a	1	36	05-09-05
	2	37	12-09-05
	3	38	19-09-05
	4	39	26-09-05
	5	40	03-10-05
	6	41	10-10-05
	7	42	17-10-05
	8	43	24-10-05
	9	44	31-10-05
1b	1	45	07-11-05
	2	46	14-11-05
	3	47	21-11-05
	4	48	28-11-05
	5	49	05-12-05
	6	50	12-12-05
	7	51	19-12-05
		52	26-12-05
		1	02-01-06
	8	2	09-01-06
	9	3	16-01-06
	10	4	23-01-06
	11	5	30-01-06
2a	1	6	06-02-06
	2	7	13-02-06
	3	8	20-02-06
	4	9	27-02-06
	5	10	06-03-06
	6	11	13-03-06
	7	12	20-03-06
	8	13	27-03-06
	9	14	03-04-06
2b	1	15	10-04-06
	2	16	17-04-06
	3	17	24-04-06
		18	01-05-06
2b	4	19	08-05-06
	5	20	15-05-06
	6	21	22-05-06
	7	22	29-05-06
	8	23	05-06-06
	9	24	12-06-06
	10	25	19-06-06
	11	26	26-06-06
	12	27	03-07-06
		28	10-07-06
		29	17-07-06
		30	24-07-06
		31	31-07-06
		32	07-08-06
		33	14-08-06
		34	21-08-06
		35	28-08-06

legenda	
1a	Lectures, projects
	Examinations
	Holiday
	White weeks

14-04-06	Easter Friday
17-04-06	Easter Monday
25-05-06	Ascensionday
05-06-06	Whitsuntide
18.8.06	1st day examination period
31.8.06	last day examination period

ME - Guide

Master 2005 - 2006

ME - Guide

Study guide Master programme Mechanical Engineering

Colophon

Text	Education Support Staff 3mE
Prepress	Multimedia Services TUD
Press	Deltahage, Den Haag
July 2005	Edition of 1000 pieces

Preface

The ME-Guide concerns the master programme Mechanical Engineering. It gives all information to enable students to plan their study effectively. This year the detailed course schedules are shown on the website "campus.3mE.TUDelft" only.

The study programme is now offered in 6 renewed variants:

- Biomechanical Design
- Control Engineering
- Production, Mechatronics and Microsystems
- Solid and Fluid Mechanics
- Sustainable Process and Energy Technology
- Transportation Engineering

The different specialisations within these variants offer the students a wide choice, all covering extremely interesting applications and fundamental aspects of Mechanical Engineering.

The editors of this guide wish all students a prosperous study year.

prof. Hans Klein Woud, MSc, FIMarEST.
Director of Education Mechanical Engineering.

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MSc programme

1 MSc Mechanical Engineering

1.1 Goal

The goal of the master programme Mechanical Engineering is to educate graduates in Mechanical Engineering to an academic engineering level. The level corresponds to the technological borders of a specific discipline. The graduates are capable:

- To identify, define and analyse problems, for the solution to which mechanical-engineering principles and techniques can contribute
- To develop and to produce a sound solution to the problem
- To present these solutions effectively

The graduated Master of Mechanical Engineering meets, to a sufficient level, the following qualifications:

1. Broad and profound knowledge of engineering sciences (applied physics and mathematics) and the capability to apply this knowledge at an advanced level in the variant-related discipline.
2. Broad and profound scientific and technical knowledge of the variant-related discipline and the skills to use this knowledge effectively. The discipline is mastered at different levels of abstraction, including a reflective understanding of its structure and relations to other fields, and reaching in part the forefront of scientific or industrial research and development. The knowledge is the basis for innovative contributions to the discipline in the form of new designs or development of new knowledge.
3. Thorough knowledge of paradigms, methods and tools as well as the skills to actively apply this knowledge for analysing, modelling, simulating, designing and performing research with respect to innovative variant-related systems, with an appreciation of different application areas.
4. Capability to independently solve technological problems in a systematic way involving problem analysis, formulating sub-problems and providing innovative technical solutions, also in new and unfamiliar situations. This includes a professional attitude towards identifying and acquiring lacking expertise, monitoring and critically evaluating existing knowledge, planning and executing research, adapting to changing circumstances, and integrating new knowledge with an appreciation of its ambiguity, incompleteness and limitations.
5. Capability to work both independently and in multidisciplinary teams, interacting effectively with specialists and taking initiatives where necessary.
6. Capability to effectively communicate (including presenting and reporting) about one's work such as solutions to problems, conclusions, knowledge and considerations, to both professionals and non-specialised public in the English language.
7. Capability to evaluate and assess the technological, ethical and societal impact of one's work, and to take responsibility with regard to sustainability, economy and social welfare.
8. Attitude to independently maintain professional competence through life-long learning.

1.2 Educational Concept and Assessment

The study programme consists of two course years, each with a study load of 60 EC (European credits). The total programme thus amounts to 120 EC. The study programme is divided in lecture courses and assignments:

Lecture courses (50-70 EC)

- Obligatory courses variant (at least 20 EC)
- Obligatory courses specialisation
- Elective courses (at least 15 EC)

As a minimum, the courses should include 6 EC social courses and 9 EC fundamental engineering courses.
In general, lecture courses are assessed by means of a written examination.

Assignments (50 - 70 EC)
In general the assignments are carried out individually, but some assigments are done in a group.
The requirements for assignments and lecture courses are specified in paragraph 1.5, depending on the specialisation.

The assignments may involve:

- An internship in industry or a project task defined in consultation with an external party (industry, research institute, etc.) of 15 EC. This may be combined with the MSc-thesis, if performed in cooperation with and at the office of an external party.
- MSc-thesis (30 - 60 EC)
- Other individual or group assignments.

The assignments are assessed, based on a written report and possible on an oral presentation.

MSc-thesis The MSc-thesis project is the final assignment in the MSc-programme. The student prepares this thesis as a report of his/her research project. The thesis work is evaluated through an oral presentation by the candidate and an oral examiniation before an MSc examination committee composed of at least three scientific staff members, including the thesis supervisor. The examination committee may also include examiners from external partners.

1.3 Study programme and general structure

Mechanical Engineering offers a Master of Science course of two years. Each course year is divided in two semesters. Every semester consists of two periods. In this study guide, these periods will be referred to as 1A, 1B, 2A and 2B. A period consists of seven weeks of lectures, followed by two or three weeks of tests. The student will get at least one opportunity per course year to do a resit. Resits generally take place in the first period

after the regular period for a certain examination. Resits for the tests given in period 2B take place in the second half of August.

The study load of a course is expressed in European Credits. The study load for one study year is 60 EC. These EC give an indication of the weight of the course. One EC involves 28 hours of study. These 28 hours include all time spent on the course: lectures, self study, internship, assignments, examinations, etc.
European credits are according the European Credit Transfer System (ECTS). This system encourages acknowledgement of study results throughout the European Union.

1.4 Admission to the programme

There are several ways to be admitted to the MSc-programme Mechanical Engineering. Usually the MSc-programme is a continuation of an academic BSc-programme (1.4.1), admission is however also possible after completing a BSc-programme of a polytechnic high school (1.4.2) or the "Royal Netherlands Naval College" (KIM, 1.4.3). Admission to the MSc-programme is described in the following three subsections.

Contact and information: Teunie Eden, Jaap van der Zanden or Ewoud van Luik.

1.4.1 Academic bachelor degree

Academic BSc-degree Mechanical Engineering (DUT, TUE, UT and IDEA-league)

Every student holding a academic BSc-degree Mechanical Engineering of a Dutch University of Technology (Delft, Eindhoven or Twente) or a University which belongs to the IDEA-league (ETH Zürich, Imperial College London or Technische Universität Aachen) can enter the MSc-programme without selection.
A student in the BSc-programme is permitted to do examinations of the MSc-programme, if the board of examiners approves. When the student has passed it's propaedeutic examination and has a study result of the second and third year of at least 100 EC, including the BSc-thesis. Final admittance is granted after completing the BSc-programme.

DUT Academic BSc-degree Marine Technology (MT), Civil Engineering (CI), Aerospace Engineering(AE), Industrial Design Engineering (IDE) or Applied Physics (AP), Chemical Engineering (CE)

Students in this category can enter the MSc-programme without selection. In order to enter the MSc-programme, additional courses have to be followed. These are courses of the BSc-programme Mechanical Engineering of in total 45 EC or less. 15 EC of these additional courses will be part of the elective courses and max 30 EC will be part of an additional programme. The total programme will amount to: 120 + max 30 = max 150 EC.

These additional requirements will ensure that the student has at least an entrance level comparable to the second-course year of the Mechanical Engineering BSc-programme. The lecturer of the concerning specialisation may require that also a number of third year courses of the BSc-programme is done additionally.

Courses are given in Dutch. A summary of additional courses and requirements is given below, in Dutch.

The additional courses are as follows:

Course code	Course name	Credits	AP	AE	CI	IDE	MT	CE
et3026wb	Elektrische aandrijvingen	3 EC	X		X			X
mk6051wb	Materiaalkunde 2	3 EC	X					X
wb1114	Statica 1	3 EC	X					X
wb1115	Sterkteleer 1	4 EC	X					X
wb1116	Dynamica A	4 EC						X
wb1212	Eindige Elementen Methode 1	3 EC	X			X		X
wb1213-03	Elasticiteitstheorie	2,5 EC	X			X		X
wb1214	Eindige Elementen Methode 2	1,5 EC	X			X		X
wb1216	Dynamica 2	3 EC	X		X	X	X	X
wb1220	Stromingsleer 2	3 EC				X		
wb1224	Thermodynamica 2	3 EC	X		X	X	X	
wb2104	Systeem- en Regeltechniek 1	3 EC			X			
wb2207	Systeem- en Regeltechniek 2	3 EC	X	X	X	X	X	X
wb3101	Ontw. Werktuigkundige Syst.	4 EC	X	X	X		X	X
wb4100	Thermodynamica 1	3 EC			X	X		
wb5104	Vervaardigingskunde	3 EC	X					X
wb5303	Tribologie	3 EC	X	X	X	X	X	X
wb6100	Materiaalkunde 1	3 EC	X					
wi1313wb	Lineaire algebra 1	3 EC				X		
wi1314wb	Lineaire algebra 2	3 EC				X		X
	Total additional credits (EC)		**42**	**10**	**25**	**31**	**16**	**43**

Other Academic BSc-degree Technical University

The contents of the BSc-degree and study results of each candidate will be evaluated. The intake-coordinator of the board of examiners is responsible for this selection. The selection procedure can result in:

- admission without additional requirements
- admission with additional requirements of no more than 15 EC. This case is comparable to that of BSc-degree Aerospace Engineering, as described above. The additional requirements will be part of the elective courses of the chosen variant.

– admission with additional requirements between 15 and 45 EC. In this case 15 EC are part of the 120 EC of the normal MSc-programme and 30 EC at most are additionally required above the standard MSc-programme.
– no admission. The candidate has to obtain the BSc-degree first. Within the BSc–programme exemption for some courses is possible, depending on earlier education.

The student can be conditionally admitted to the MSc-programme, when the student has passed it's propaedeutic examination and has a study result of the second and third year of at least 100 EC of the initial study. It is then possible to compose a final list of courses for approval to the board of examiners. Final admittance is granted after completing the additional courses.

1.4.2 Bachelor degree ME of Dutch polytechnic high school (TH) or "Hogere Zeevaartschool"

A candidatie with a TH-degree Mechanical Engineering, Vehicle Engineering (Automobieltechniek), Aeronautical Engineering (Luchtvaarttechniek) or a degree of "Hogere Zeevaartschool" can be admitted, if the candidate has completed the Bachelors-programme within 4 years, with good results. The intake-coordinator of the board of examiners is responsible for this selection. An additional number of courses, of the second year of the Mechanical Engineering BSc-programme has to be followed.
Candidates are admitted to the pre-MSc-programme. This means that both the pre-MSc-programme and MSc courses can be followed. Final admission to the MSc-programme is given after completing the pre-MSc-programme.

Courses are given in Dutch. A summary of additional courses and requirement is given below, in Dutch.
- The TH- and HZS-student can attend courses and tests of the chosen specialisation, while following the additional programme.
– The TH- and HZS-student is excempted from the internship (15 EC), keeping in mind the earlier study programme.
– The HZS-student is excempted from the 6 EC society oriented courses.
– In consult with the coordinator of the specialisation, a number of courses will be included in the programme to comply with the BSc- and MSc- level of the specialisation.
– The entire study programme for the TH-student amounts to 34 + 120 - 15 = 139 EC.
– The entire study programme for the HZS-student amounts to 40 + 120 - 15 -6 = 139 EC.

TH/HZS admission coordinator is ir. Jaap van der Zanden.
Secretary of the Board of Examiners is Ewoud van Luik.

Pre-Master programme

				Contact-uren p/w en tentamens of EC per semester						
Vakcode	**Vaknaam**	**Docent**	**EC**	**1A**	**1B**	**2A**	**2B**	**Herk**	**TV**	**BEO**
VOOR TH- EN HZS-STUDENTEN								**Aug.**		
WB201-03TH WISKUNDE			**15**							**ec**
wi1152th	Analyse 1 TH	Tholen	3	4t	ht				s	dc
wi1153th	Analyse 2 TH	Tholen	3		4t	ht			s	dc
wi1154th	Analyse 3 TH	Tholen	3			4t	ht		s	dc
wi2256th d1	Lineaire algebra 1 TH	Van Beek	3	2	2t	ht			s	dc
wi2256th d2	Lineaire algebra 2 TH	Van Beek	3			4t	ht		s	dc
WB202-03TH MECHANICA			**10**							**ec**
wb1212	Eindige elem. meth. 1	Paraschiv	3	4t	ht				s	dc
wb1213-03	Elasticiteitsleer	Paraschiv / Keulen v	2,5		3t	ht			s	dc
wb1214	Eindige elem. meth. 2	Paraschiv	1,5			2t	ht		s	dc
wb1216 **1)**	Dynamica 2	Woerkom v	3				4t	ht	s	dc
WB203-03TH FUNDAMENTELE WERKTUIGBOUWKUNDE			**9**							**ec**
wb2207 **2)**	Systeem- en regelt. 2	Dijkstra	3	4t	ht				s	dc
wb1224	Thermodynamica 2	Woudstra N	3		4t	ht			s	dc
wb1220	Stromingsleer 2	Delfos	3			4t	ht		s	dc
		Totaal TH	**34**	**9**	**11,5**	**10,5**	**3**			
AANVULLING VOOR HZS-STUDENTEN										
wb1116 **1)**	Dynamica A	Paraschiv	4				6t	ht	s	ec
wb2104 **2)**	Systeem- en regelt. 1	Dijkstra	3				4t	ht	s	ec
		Totaal HZS	**40**	**9**	**11,5**	**13,5**	**7**			

1) HZS studenten wordt aangeraden eerst Dynamica A te doen en in het volgende cursusjaar Dynamica 2

2) HZS studenten wordt aangeraden eerst Systeem- en Regeltechniek 1 te doen en in het volgende cursusjaar Systeem- en Regeltechniek 2.

Zie voor het collegerooster appendix 6.6.

Slaagregels / toelichting afkortingen

dc deelcijfer; wordt meegerekend voor eindcijfer (ec) indien cijfers >= 5 zijn.

ec eindcijfer (op heel getal afgerond) ; wordt toegekend indien het gewogen gemiddelde van de daaronder vallende vakken is >= 6,0.weegfactor is het EC. In het MSc-programma (dus in het programma dat aansluit op bovengenoemd pre-Master programma) mag 1 eindcijfer 5 in de vakken voorkomen.

EC European Credits. 1 EC komt overeen met 28 uur studielast.

s schriftelijk tentamen

xt x uren college per week, gevolgd door tentamen/toets

1.4.3 Bachelor degree of Royal Netherlands Naval College (RNNC)

RNNC 'KIM - Technische Dienst' graduates (5 year programme completed)

A selection of candidates will be made. Admission is possible, if the candidate has completed the RNNC-programme within 5 years, with good results. The intake-coordinator of the board of examiners is responsible for this selection. Depending on earlier (RNNC) education a study programme is made. This programme has to be approved by the board of examiners.

This programme should comply to the following requirements:
- total minimal amount of 60 EC, including obligatory variant part and MSc-thesis
- no internship
- no society-oriented courses
- MSc-thesis of minimal 40 EC

Candidates, that completed the fourth RNNC course year, including the practical operational introduction

After being selected by the intake-coordinator, the candidate can be admitted. The study programme consists of 100 EC, according to the demands of the chosen variant.

1.5 MSc-programme Mechanical Engineering

In order to enter the MSc-programme the student should compile a list of courses, which is to be approved by the lecturer of the chosen specialisation. This list should be submitted to the examination committie by means of a form, which can be acquired at the desk of the Education support staff and at the website.
In paragraph 1.2 the general requirements concerning the study programme are described.

Variants and specialisations 2005 - 2006

There are 6 different variants with 18 specialisations Mechanical Engineering:

1. Transportation Engineering (TE)
1.1 Transport Engineering and Logistics (TEL)
1.2 Production Engineering and Logistics (PEL)
1.3 Marine Engineering (ME)
1.4 Diesel Engines (DE)

2. Control Engineering (CE)

3. Sustainable Processes and Energy Technologies (SPET)
3.1 Energy Technology (ET)
3.2 Engineering Thermodynamics (ETh)
3.3 Process Equipment & Separation Technology (PS)
3.4 Fluid Dynamics (FD)

4. Production, Mechatronics and Microsystems (PMM)
4.1 Engineering Mechanics (EM)
4.2 Production Technology (PT)
4.3 Mechatronics (M)

5. Biomechanical Design (BMD)
5.1 Bio Robotics (BR)
5.2 Bio Compatible Design (BCD)
5.3 Intelligent Mechanical Systems (IMS)

6. Solid and Fluid Mechanics (SFM)
6.1 Fluid Mechanics (FM)
6.2 Engineering Dynamics (ED)
6.3 Mechanics of Materials (MM)
6.4 Structural Optimization & Computational Mechanics (SO)

Students who are already started in one of the variants 2004 - 2005 can complete their program, according these variants.

1.5.1 Variant Transportation Engineering (TE)

Coordinator Ir. T.C.A. Mensch tel. + 31 15 2786737, t.c.a.mensch@3me.tudelft.nl

Free mobility and excellent transportation and handling systems for people and goods are corner stones of the accomplished welfare in the industrialized world. Ships transport worldwide more then 90% of all goods, from raw materials to consumer goods. For inland, hinterland and internal transport reliable, cost effective, efficient, fast and flexible transport systems are essential, and require integrated control of all processes in the chain.

Today however, limits in transport capacity and accessibility of cities, an experienced reduction of transport safety and reliability, increased ambient pollution and the occupation of scarce areas and energy resources by marine and transport systems put an ever increasing pressure on society and industry. To ensure future accessibility of cities, new transport systems, like underground transport systems, play an important role. To ensure future profitability of industry, new logistic concepts that influence the organisation of all processes involved, are required.

To ease the scarcity of ground and to reduce their environmental impact on society, occupants of large areas, like airports, may be moved offshore, either on large floating structures or on artificial islands. Marine and transport equipment both operate in a vulnerable environment and sometimes handle vulnerable objects. Safety, sustainability and reliability are therefore main issues, also due to increasing public awareness and decreasing public acceptance of the consequences of large accidents at sea and on land.

Energy efficiency, air pollution and acoustic emission are major issues considering the large share in the world's energy consumption and ambient pollution. Advanced, smart, fast, sustainable and safe marine and transport systems are therefore required to sustain the welfare, to maintain an acceptable mobility and freedom of transportation, and to strengthen the position of the Dutch marine and transport companies on the world market.

The essence of Transportation Engineering is to develop, design, build and operate marine and transport systems and their equipment as an indivisible part of a supply chain. In the past decades many new concepts and systems have been developed in this sector. Due to strong public pressure for more efficient and safer transport and in order to improve the competitive position of the Netherlands and European marine and transport sector, it can be expected that this trend will continue at increased speed.

New generation transport, marine and industrial systems have to be based on new concepts, using distributed intelligence, combined with the application of smart components. This requires the further development of the knowledge of the dynamics and the physical processes involved in

transport, marine and industrial systems, the logistics of the systems and the interaction between the equipment and control systems.

The variant Transportation Engineering has four specialisations, as listed in next table:
- Transport Engineering & Logistics (TEL)
- Production Engineering & Logistics (PEL)
- Marine Engineering (ME)
- Diesel Engines (DE)

The former specialisation Dredging Engineering will be offered as a specialisation of the MSc programme Offshore Engineering from course year 2005-2006 on.
Main topics of the specialisations Transport Engineering and Logistics and Production Engineering and Logistics are design, operation and control of transport and production systems and the design, operation and control of transport equipment and machinery.
Main topics of the specialisations Marine Engineering and Diesel Engines are the design and operation of propulsion systems.

A student in Transportation Engineering has to take 60 EC on courses during the first year of the programme. The final year of the programme consists of one or more projects.

The lists of obligatory courses and elective courses of the first year of the programme are shown in next tables.

Obligatory courses for variant and specialisations

Course code	Course name	Lecture hours	Specialisations				EC
			TEL	PEL	ME	DE	
wb3420-03	Introduction transport engineering and logistics	2/2/0/0	o	o	o	o	5
et3026wb [1)]	Electrical power drives	0/3/0/0	o	o	o	o	3 1)
wb3410-03	Large scale transport systems	0/0/2/0	o				3
wb3417-04	Discrete systems: modelling, prototyping, simulation and control	2/2/0/0	o	o			5
wb3419-03	Characterisation and handling of bulk solid materials	2/2/0/0	o				6
wb3421-04	Automation and control of transport and production systems	0/0/2/2	o	o			6
wb3422-03	Design of transport equipment	0/0/2/2	o				5
ct4330	**OR** Harbours and shipping ways	0/2/2/0	o				4
ct4811	**OR** Design and control public transport systems	0/4/0/0					
wb3423-04	Modeling of industrial systems	2/0/0/0		o			3
wb3424-04	Production organisation principles	0/2/0/0		o			2
wb3425-04	Production engineering practical			o			5
wb5421-03	Modelling of manufacturing	0/0/0/2		o			3

1) The course et3026wb Electrical Power Drives has to be taken if the course has not been part of a previous programme

Obligatory courses for variant and specialisations							
Course code	Course name	Lecture hours	Specialisations				EC
			TEL	PEL	ME	DE	
in4050tu	Java and object oriented design	2/2/0/0		o			6
mt212	Marine engineering B	2/0/0/0			o	o	3
mt213	Marine engineering C	0/2/0/0			o	o	2
mt216	Introduction combustion engines	0/2/0/0	o		o	o	3
wb4408A	Diesel engines A	0/0/4/0			o	o	4
wb4408B	Diesel engines B	0/0/4/4			o	o	4
mt215	Marine engineering A	0/3/0/0			o		2
mt518	Resistance and propulsion 1	0/0/4/0			o		2
mt518p	Tests resistance and propulsion 1	0/0/x/0			o		1
mtp205	Project Design propulsion plant	0/0/0/x			o		4
mtp301	Project Design auxiliary systems	x/0/0/0			o		3
wb4429-03	Thermodynamics of mixtures	0/4/0/0				o	3
wb4431-05	The evaluation of processes and energy systems					o	4
wb4302	Thermodynamics of energy conversion	4/0/0/0				0	4
	Total obligatory courses		40	39	36	35	

Recommended elective courses			
Course code	Course name	Lecture hours	EC
ae4-490	Maintenance management	0/4/0/0	4
ae4-496	Maintenance engineering	0/0/4/0	3
ct3751	Urban development	0/0/0/4	4
ct4330	Harbours and shipping ways	0/2/2/0	4
ct4811	Design and control public transport systems	0/4/0/0	4
ide5131	Business marketing for engineers		3
in2410	Introduction databases	0/0/4/0	4
in3010tu	Introduction virtual reality		4
in4005tu	Industrial automation		4
in4013tu	Expert systems	0/2/2/0	4
in4028tu	Business systems engineering	0/0/4/0	4
in4050tu	Object oriented programming with Java	2/2/0/0	6
ms4091	Joining Techniques	0/4/0/0	3
mp1700	Ingenieursgeologie		2
mt212	Marine engineering B	2/0/0/0	3
mt213	Marine engineering C	0/2/0/0	2
mt215	Marine engineering A	0/3/0/0	2
mt216	Introduction combustion engines	0/0/0/4	3
mt518	Resistance and propulsion 1	0/0/4/0	2

[1)] Dredging Engineering is one of the specialisations of the MSc Offshore Engineering

Course code	Course name	Lecture hours	EC
mt518p	Tests resistance and propulsion 1	0/0/x/0	1
mtp205	Project Design propulsion plant	0/0/0/x	4
mtp301	Project Design auxiliary systems	x/0/0/0	3
oe4625	Dredging and slurry	4/0/0/0	4
oe4626	Dredging processes 1	0/0/2/2	4
oe4671	Dredging design	0/0/0/2	4
sc4020	Control theory	4/0/0/0	6
sc4080	Knowledge based control systems	0/0/2/0	3
sc4150	Fuzzy logic and engineering applications	3/0/0/0	3
tn3713	Advanced thermodynamics		3
wb1310	Multibody dynamics A	0/0/0/4	3
wb1406	Experimental mechanics	0/0/2/2	3
wb1412	Non-linear vibrations	0/0/2/2	3
wb1413-04	Multbody dynamics B	0/0/2/2	4
wb1416	Numerical methods for dynamics	0/0/2/2	3
wb1427-03	Advanced fluid dynamics A	2/2/0/0	5
wb1428	Computional Fluid Dynamics	0/0/2/2	3
wb2303	Measurement techniques	0/0/2/2	3
wb2306	Cybernetical ergonomics	0/0/0/4	3
wb2311	Introduction modelling	0/4/0/0	3
wb2400	Process control	0/0/2/2	3
wb2402	Hydraulic servo systems	2/2/0/0	3
wb2404	Man-machine systems	2/2/0/0	4
wb2414	Mechatronics	2/2/0/0	3
wb3303	Mechanisms	2/2/0/0	3
wb3404A	Vehicle dynamics A	0/0/2/2	3
wb3404B	Vehicle dynamics B	0/0/2/2	3
wb3410-03	Large scale transport systems	0/0/2/0	3
wb3415-03	Simulation of transport systems with ADAMS	-/x/-/x	3
wb3416-03	Design with Finite Element Method	0/0/0/2	3
wb3417-04	Discrete systems	2/2/0/0	5
wb3418	Pro Engineer	-/-/-/x	2
wb3419-03	Characterisation and handling of bulk solid materials	2/2/0/0	6
wb3421-04	Automation and control of transport and production systems	0/0/2/2	6
wb3422-03	Design of transport equipment	0/0/2/2	5
wb3423-04	Modeling of industrial systems	2/0/0/0	3
wb3424-04	Production organisation principles	0/0/2/0	2
wb4300B	Introduction to pumps and compressors	0/0/2/0	2
wb4302	Thermodynamics of energy conversion	4/0/0/0	4
wb4303	Energy in society	0/4/0/0	3

[1)] Dredging Engineering is one of the specialisations of the MSc Offshore Engineering

Course code	Course name	Lecture hours	EC
wb4401	Deeltjestechnologie-W	2/2/0/0	3
wb4405	Fuel conversion	2/2/0/0	3
wb4408A	Diesel engines A	0/0/2/2	4
wb4408B	Diesel engines B	2/2/0/0	4
wb4410A	Refrigeration A1	0/0/2/2	3
wb4416	Nuclear Engineering	0/0/4/0	3
wb4420	Gas turbines	2/2/0/0	3
wb4421	Gas turbines, simulation and application	0/0/2/2	3
wb4422	Thermal Power Plants	0/0/4/0	3
wb4429-03	Thermodynamics of mixtures	0/4/0/0	3
wb4430-03	Process flow scheme	0/0/x/x	6
wb4431-05	The evaluation of processes and energy systems		3
wb4435-05	Equipment of heat transfer	4/0/0/0	3
wb4436-05	Equipment of mass transfer	2/2/0/0	3
wb4438-05	Energy society and sustainabilty	0/0/4/0	3
wb5414-03	Design of machines and mechanisms	2/2/0/0	3
wb5420-03	Design of production systems	4/0/0/0	3
wb5421-03	Modelling of manufacturing	0/0/0/2	3
wi4014tu	Numerical analysis C2 (exercise 30 h.)	2/2/0/0	4
wi4019	Non-linear differential equations		3
wi4051tu	Introduction operations research	2/2/0/0	4
wi4052	Risk analysis		6
wm0301tu	Introduction philosophy of technology		3
wm0304tu	Philosophy of science	0/2/0/0	4
wm0324lr	Ethics and technology		3
wm0401tu	History of engineering	0/0/4/0	3
wm0504tu	Industrial organisation A	4/0/0/0	3
wm0505tu	Industrial organisation B	0/0/4/0	3
wm0604tu	Commercial economics	0/0/2/2	3
wm0605tu	Business economics for engineers	2/2/0/0	4
wm0621tu	Innovation management	x/x/0/0	3
wm0771	Technisch milieurecht		3
wm0781	Octrooirecht en octrooibeleid		3
wm0801tu	Introduction safety engineering	0/4/0/0	3
wm0903tu	Technology and global development		4

Description of specialisation Transport Engineering & Logistics (TEL)

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Transport and logistic systems grow in terms of size, capacity, complexity and ambient pollution. People however expect transport systems to be safe, flexible, efficient, reliable, and labor extensive. To meet the public demand future transport systems will have to be designed in a different way. The central problem is to determine (1) how to control and manage future transport systems, (2) how to power their components and (3) to what extend they should be automated.

Control systems used in transport systems today are centralized, mostly rigid systems. The applied intelligence is installed at system level and not at equipment or component level. It is therefore impossible to achieve the safety, mobility, flexibility and the increase in capacity essential for tomorrows systems. To achieve this, new tools for design, control, simulation and optimization need to be developed that are based on fundamental innovations and new insights gained into the physics of continuous transport phenomena, as well as the development of agile logistic control systems for discrete (event driven) transport systems using distributed intelligence.

Most components of continuous transport systems are centrally driven. The structure of those components therefore not only carries its weight and external loads, but transfers the drive force as well. This leads to heavy equipment and a continuous requirement of a large amount of power. Distributed drive systems that supply power where it is required significantly reduce the structural weight and power consumption. To enable the application and full utilization of these drive systems load detection systems and intelligent drive control systems need to be developed. Most components of discontinuous transport systems are locally driven. The flexibility and capacity of discontinuous long distance transport systems can be significantly improved by the application of trains of (hybrid) components. A proper assessment tool needs to be developed to determine the optimum drive configuration (centrally vs locally driven, electrical vs combustion engine) and the corresponding intelligent control system.

Future automation of transport systems is determined by costs, capacity, reliability and safety considerations, as well as by labor extensity and information requirements. Central questions are to what extend systems need to be automated, what is the effect on the operator and the user, what kind of information is required to adequately control the system and provide user requested information, how is that information gathered, what sensors are required. The interaction between equipment on one hand and the operator and the environment on the other hand is crucial for the safe and reliable operation of a transport system. The challenge is to optimize the operational performance of transport systems accounting for human limitations in knowledge of complex systems and their ability for deductive and inductive reasoning. It is also possible to use knowledge of the active status of components to automate maintenance procedures and to optimize the system's lifecycle and performance. Considering the complexity of transport systems this is required to assist the operator to ensure safe and sound operation of the transport system and its equipment.

Obligatory courses	40 EC
Elective courses	20 EC
Assignments and projects	60 EC
Total	120 EC

Description of specialisation Production Engineering & Logistics (PEL)

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Production Engineering and Logistics aims at preparing future engineers to play an analyzing, integrating and innovating role in new developments in:

- production and logistic techniques; to master and pilot new techniques including automation
- existing systems; to analyze production and logistic processes and control
- the integration of processes, techniques and control, thereby perceiving the multidisciplinary character of these processes, and becoming aware of the restrictions of the engineering discipline
- new organizational structures for the integration of production and transportation

The notion of the "specialist" has gradually been replaced by notions of process, integration and a systems view on supply chains. The use of these new notions in industry and service has created the need for a course programme based on a methodology, which offers a coherent and integrated approach for technology, organization and information. An executive engineer has to master all the different aspects of productivity: knowledge of tools, machinery, equipment, information, operations, control systems and perception of human resources, as well as the capacity for contributing to and evaluating of new industrial situations.

Production Engineering and Logistics prepares for line and staff positions in operations management in industry and engineering consultancy. Great emphasis is put on modelling as an aid to analyse operational problems and to find acceptable solutions. The final assignment is directed to a real problem in a company or organisation.
Applied studies concern the automation and intelligent control of supply, production and distribution networks. Another rapidly developing area for projects and assignments is predictive modelling with simulation of industrial processes.

The complexity of production organisations increased tremendously during the last decades due to changing customer demands, increased automation possibilities, the real-time availability of information and rigid environmental conditions. The challenge for an engineer is to find solutions combining all these possibilities and conditions. The design of a production organisation is considered to be a multidisciplinary project.

The combination of organisation and logistics offers a unique opportunity to study the complete value adding chain in industry, composed of transformation and transportation processes. Students broaden their technological knowledge by always including the organisational and informational aspects within the human business environment. They will also learn the restrictions of their knowledge and recognize the need for economical, sociological and/or psychological contributions.

The program offers varied teaching methods to achieve these objectives:
- diversified lectures on technology, industrial systems approach, information systems, operations research, simulation and business economics
- a seminar to study, discuss and evaluate real life cases with fellow students under the expert guidance of staff members
- lab work to experience with real life systems and situations internships in industry

Obligatory courses	39 EC
Elective courses	21 EC
Assignments and projects	60 EC
Total	120 EC

Description of specialisation Marine Engineering (ME)

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Marine Engineering is the discipline that covers the design, installation and operational use of ship machinery and electrical plants. It covers a wide variety of systems, such as: ship propulsion plants, electric power generation, refrigeration and climate control, auxiliary systems for cooling and lubrication, cargo handling, loading and unloading. The discipline is also very relevant for the design of land based power plants and process plants.
The main issue is "installation technology": integration of different equipment to well functioning, efficient and cost effective systems. It requires extensive knowledge of machinery and electrical equipment (principle of operation and characteristics such as controllability and maintainability) as well as of fluid dynamics, mechanical vibrations and strength, thermodynamics, reliability and maintainability. The design of the equipment to be installed is not a main topic of study.
The students specialising in marine engineering have a wide choice with regard to elective courses. A number of courses, according to the variant rules, is mandatory. Next to that the students are expected to follow a number of specialisation courses. About one third of the credit points of the first year of the programme can be used for elective courses.
The master thesis covers 60 EC and will frequently be performed in co-operation with industry or an external research institute. The specialisation has good contacts with universities abroad, which gives the opportunity to perform a part of the study (courses or the master thesis) abroad.

The master thesis will be performed on one of the research topics on which the section is active:
- Investigation in the dynamic behaviour of machinery systems. To realise this, much effort is paid to the development simulation models of equipment and systems and the dynamic simulation of complete systems.

- Maintenance engineering. Work is done on the development of cost effective and safe maintenance plans as well as on intelligent condition monitoring. Use is made of artificial intelligence and also system simulations
- Development of new design tools and innovative system designs.

The master thesis may have a practical as well as a more fundamental theoretical nature. Eeamples of recent master thesis projects are:

- Development of a simulation model of a dredging pump.
- Technical and economical investigation into an all-electric ship (AES) concept for a chemical tanker.
- Model development and simulation of the dynamic behaviour of a complete propulsion system (engine, propeller and ship) in a heavy seaway.
- Sensor monitoring with the help of neural networks.
- Development of an economical decision model for spare parts to be carried on board

Obligatory courses	36 EC
Elective courses	24 EC
Assignments and projects	60 EC
Total	120 EC

Description of specialisation Marine Diesel Engines (DE)

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Marine Diesel Engines is a specialisation within Transportation Engineering with emphasis on the interaction between the components and subsystems that make up the engine (system approach). Apart from a strong emphasis on the thermodynamic side, the attention is also focussed on the (marine) application of the diesel engine and on the user aspects (maintenance).

Diesel Engines as a subject for a master degree programme covers a wide field, not only because of the wide application of the diesel engine but also because all basic disciplines of mechanical engineering, such as construction and fluid mechanics, thermodynamics, materials, design and engineering, control theory etc., are necessary in an approach to make the diesel engine an environmentally friendly, low cost and low maintenance element in mechanical installations.

Research is inspired by (but not limited to) the marine application and covers:
- Dynamic behaviour and control in relation to sea state and manoeuvring in ships
- Sustainability in terms of low fuel consumption and low emissions
- Maintenance and reliability
- Cost and economics

Obligatory courses	35 EC
Elective courses	25 EC
Assignments and projects	60 EC
Total	120 EC

Description of specialisation Dredging Engineering (MSc Offshore Engineering)

From course year 2005-2006 Dredging Engineering will be offered as a specialisation of the MSc-programme Offshore Engineering. Students interested in Dredging Engineering have to subscribe as a MSc student Offhore Engineering.

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Machinery for the treatment of soil and/or bulk goods are constituting an interface between mechanical engineering and civil engineering. Within this framework one must think of dredging machinery, tunnel drilling machines and equipment for the treatment of bulk goods. This field comprises excavation, transport and sedimentation processes of soil, rock and bulk goods that are brought about by human intervention and controlled by means of the appropriate machinery. The purpose in this is to realize or maintain "constructions" and to mine, transfer or treat building materials or ores. Examples of the constructions mentioned above are: ports, channels, land reclamation, cores of dykes and (drilling) tunnels. Examples of the treatment of materials are: soil treatment, mixed heap systems and the separation of materials when mining minerals. Examples of transference are: the transhipment of bulk materials, conveyor belts in the mining industry and hydraulic transport of solids. An important development in this is the drilling of tunnels in "feeble" ground. The designing of and working with the equipment mentioned above is primarily determined by physical processes, such as loosening up rock, soil or bulk materials, vertical and horizontal transport, positioning in the means of transport, treatment and positioning of the material in a desired geometry. When designing machinery, a large number of restrictions play an important part. They all relate to local circumstances, such as the availability of facilities, the condition of the soil or bulk goods, the availability of resource-rich areas for the purpose of elevation, dumping sites for the removal of materials from digged-in constructions, wind and weather conditions, environmental requirements, available energy and a large number of other technical, administrative and economic restrictions. Furthermore, it is required to possess a profound insight into the availability of highly sophisticated mechanical constructions that

often have to operate under heavy and dynamic load conditions due to the aggressive environment.
The dredging and sea-mining industry moves to deeper waters. Although operation depths do not exceed 150 m today, it is expected that within 10 years, dredging and sea-mining will reach 500 to 1000 m and incidental the ultra deep waters to fulfil the requirements of the offshore industry. This means the development of new concepts for deep-sea operations, the development of monitoring and control systems for the excavation process and a sufficient level of reliability, all based on the knowledge of the physical processes.

1.5.2 Variant Control Engineering (CE)

Coordinator MSc variant Dr. Sjoerd Dijkstra, tel. + 31 15 2785606, s.dijkstra@dcsc.tudelft.nl

The field of control engineering is directed towards the analysis and design of reliable and high-performance measurement and control strategies for a wide variety of technological dynamical processes. It focuses on the fundamental aspects of modeling dynamical systems and developing algorithms for controller design. Within this MSc variant, particular emphasis is laid on two fields of industrial applications, namely advanced process control as well as motion control for electro-mechanical and servo-hydraulic systems.

All these aspects are reflected in the course program, which offers lectures on fundamental techniques for physical and experimental modeling of dynamical systems, as well as on modern approaches to optimization-based controller synthesis for multivariable systems. This is supplemented by courses on hardware and software aspects concerning the technical implementation of control systems, including the required practical training in lab experiment projects. Students have the opportunity to choose between the two application areas Mechanical Systems and Processes. These interdisciplinary courses cover advanced control techniques for high-performance mechatronic or hydraulic systems (such as a wafer-stage or a flight-simulator), as well as complex chemical or industrial processes (such as crystallizers or transportation systems).

In consultation with the MSc-students advisor, the MSc student chooses a graduation project, either related to fundamental aspects of systems and control, or to one of the application areas dealing with mechanical systems (mechatronics, microsystems, MEMS, robotics), or process control (biotechnological and (petro)chemical and production processes). Typically, MSc-thesis projects are completed within the scope of any of the ongoing research projects of the Delft Center for Systems and Control (DCSC). Supervision is taken care of by one of the staff members of DCSC, while one of the DCSC professors will act as the MSc thesis advisor. Alternatively, the program offers the opportunity to complete an MSc-thesis project in collaboration with the group "Advanced Mechatronics", with the heading professor J. van Eijk acting as the MSc-thesis advisor.

Curriculum

Course code	Course name	Lecture hours	EC
1st Msc Year			
Obligatory:			
sc4020	Control Theory	4/0/0/0	6
sc4050	Integration Project SC	no lectures	5
sc4110	System Identification	0/0/4/4	5
wb2305	Digital Control	0/4/0/0	3
wb2421	Multivariable Control	0/4/0/0	6
wb2423	Introduction project	no lectures	3
wb2440	Modelling of Dynamic Systems	0/4/4/0	6
		Obligatory courses Subtotal	**34**
Elective courses Mechanical Systems			
wb1406-05	Experimental Dynamics	0/0/2/2	4
wb1413-04	Multibody Dynamics	0/0/2/2	4
wb1418	Engineering Dynamics	2/2/0/0	3
wb1440	Engineering Optimizatiopn	2/2/0/0	3
wb1442	Introduction to microsystems	2/2/0/0	3
wb2303	Measurement theory and praxis	0/0/2/2	3
wb2400	Process Control	0/0/2/2	3
wb2402	Hydraulic Servo Systems	2/2/0/0	3
wb2413-04	Instrumentation in process industry	0/0/0/4	2
wb2414	Mechatronics	2/2/0/0	3
wb2426	Chemistry and chemical plant	0/0/2/2	3
wb2428-03	Mechanic Constr. Principles	2/2/2/0	5
wb3404A	Vehicle Dynamics A	0/0/2/2	3
wb5420-03	Design of Production Systems	4/0/0/0	3
wb5421-03	Modelling of production mach.	0/0/0/2	3
wb5422-03	Industrial assembling	0/0/4/0	3
		Subtotal	**42**
Elective courses Processes			
st2442	Process Systems Analysis		4
st 7011	Elements of Chemical Process		2
wb3421-04	Automatic Transport systems	0/0/2/2	6
wb4417	Design of Process Equipment	0/2/0/0	3
wb2400	Process Control	0/0/2/2	3
wb2426	Chemistry and chemical plants	0/0/2/2	3
wb2413-04	Instrumentation in process industry	0/0/0/4	2
		Subtotal	**23**
Elective courses Fundamentals:			
sc4060	Model predictive control	0/0/3/0	4

Course code	Course name	Lecture hours	EC
sc4090	Optimization in systems and control	4/0/0/0	3
sc4130	Modern Robotics	0/0/4/0	3
sc4150	Fuzzy Logic & Engineering Applications	3/0/0/0	3
sc4160	Modeling and control of hybrid systems	0/0/4/0	3
wb2415	Robust Control	0/0/4/0	6
wb2416	Linear matrix inequality in control	0/0/0/4	6
		Subtotal	**28**

1st Msc Year		
35 EC Obligatory Courses		34
9 EC Mechanical Systems or 9 EC Processes		9
9 EC Fundamentals		9
8 EC Free Elective Courses		8
	Subtotal	**60**
2nd Msc Year		
Industrial internship		(10)
Literature study		15
MSc thesis work		(45)
	Subtotal	**60**
	TOTAL	**120**

MSc "Systems and Control" versus Specialisation "Control Engineering" within MSc Mechanical Engineering

A student's perspective:
If you have a BSc diploma Mechanical Engineering, and if you would like to pursue an MSc within the area of systems and control engineering, there are in principle two options for you to follow:

1) You can enter the independent MSc programme Systems and Control
2) You can enter the MSc programme Mechanical Engineering and choose for the variant "Control Engineering".

We will highlight the difference between these two options, and provide arguments for choosing either one of them.

First the main lines:

– In the MSc Systems and Control, the technological area of systems and control engineering is taken as a starting point. The area is approached from its generic themes (system theory, control theory, signal analysis), and its strong multidisciplinary character is exposed in different application fields in which systems and control engineering plays its role: high-precision motion control systems (mechatronics, robotics, microsystems), industrial process systems,

traffic and transportation systems, and physical imaging systems. You take a limited number of compulsory courses (24 ECTS) that are directed towards the generic components of the field: modelling, control theory, signal analysis and laboratory projects. Additionally you complete the programme with elective courses, to be chosen from an extensive list. Your MSc project will be executed under the responsibility of one of the professors of DCSC, or of one of the affiliated groups (Advanced Mechatronics, Man-Machine Systems, Process Systems Engineering (TNW), Control and Simulation (LR), Mathematical System Theory (EWI), Bioprocess Technology (TNW), Dynamic Traffic Management (CiTG)). Upon successful completion, you will receive an MSc diploma Systems and Control.

- In the variant "Control Engineering" of the MSc programme Mechanical Engineering, the area of mechanical engineering is taken as a starting point. Attention is given to the development and application of system and control engineering concepts in mechanical engineering problems, such as high-precision motion control systems (mechatronics, robotics, microsystems) and industrial process systems. You take a more extensive number of compulsory courses with an emphasis on mechanical engineering subjects, as well as systems and control courses that partly overlap with the courses within the MSc programme Systems and Control. Your MSc project will be executed under the responsibility of one of the professors of DCSC or Advanced Mechatronics. Upon successful completion, you will receive an MSc diploma Mechanical Engineering, with the addition that you graduated within the MSc variant "Control Engineering".

Both options provide you with an excellent professional position after your graduation. When choosing between the two options it is also relevant to consider with which profile you would like to position yourself professionally.

If you want to be recognized as a systems and control engineer, then a combination of a BSc diploma Mechanical Engineering and an MSc diploma Systems and Control is an excellent choice. Your degrees indicate that you have a solid mechanical engineering background, that you have crossed the classical borders of mechanical engineering in your MSc specialisation, that you have mastered the abstract area systems and control engineering, and that you have included a strong multidisciplinary component in your education.

If you feel strongly committed to mechanical engineering, and if you would like to be recognized professionally as a mechanical engineer, then a combination of a BSc Mechanical Engineering and an MSc Mechanical Engineering is the best option to choose.

1.5.3 Variant Sustainable Processes And Energy Technologies (SPET)

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There is widespread agreement that human activities, and specifically industrial processes, are sustainable if they promote a development that "meets the needs of the present without compromising the ability of future generations to meet their own demands". This of course poses formidable and urgent technical challenges and this master program offers to the motivated student an entry to play a fundamental role in this primal human enterprise. The knowledge that students acquire by obtaining a master degree in SPET gives them the required technological preparation and skills (theoretical, numerical and experimental) necessary for the development of the energy and process technologies of the next generation. Furthermore, students become aware of the importance of a sustainable development of our society and acquire the tools to promote it.

This curriculum gives the opportunity to pursue a career in both the industry, where design and development play a major role, and academia, where science has a larger share. Most SPET graduates find employment in process and energy related jobs.

The master program is subdivided in 4 parts, which are also summarized in the *Curriculum* Table:

- A first obligatory set of courses (41 EC) trains the students in the major common disciplines, e.g. thermodynamics, fluid dynamics, process modeling and simulation, and process equipment design. This set of courses guarantees a solid theoretical basis in both Process and Energy Engineering. All these courses take into consideration the sustainability requirement and are complemented by two sustainability-specific courses that provide the skills and the attitude necessary to contribute to more sustainable Process and Energy solutions.
- The common part of the program includes a Process Modeling and Simulation Project (12 EC) that is scheduled in the second year of the master studies. Since software skills are very important for an engineer at the beginning of his career, this project includes training in the use of Process and Energy related computer programs. Teams of students collaborate in the development of this project.
- Another set of courses (25 EC) is elective and allows the student to choose one of the 4 SPET specialisations, namely:
  - ET - Energy Technology
  - ETh - Engineering Thermodynamics
  - PS - Process Equipment & Separation Technology
  - FD - Fluid Dynamics

The student selects these courses from the list reported in the *Elective Courses* Table, after consultation with the coordinator for the chosen specialisation.

- The individual projects include an internship with a company (12 EC) and the Final Project (30 EC). During the internship, the student can obtain an indication about the demand on expertise from companies. The final project is linked to the research programs running within the Process and Energy Department, is tuned to

industry demands and includes a mix of fundamental and applied research. Students following the SPET curriculum are encouraged to obtain the 'Technology in Sustainable Development' additional certificate. In order to accomplish this, the student must participate to a colloquium (4 EC) and obtain at least 5 EC points in 'sustainable development' related courses. Moreover their final project must include an evaluation of the contribution given by their final research topic to sustainable development. Details of this additional qualification can be found in the following.

Curriculum

Course code	Course name	Period	EC
Obligatory Courses			
FUNDAMENTAL COURSES			
wb1427-03	Advanced Fluid Dynamics	2/2/0/0	5
wb4302	Thermodynamic Evaluation of Processes and Systems	4/0/0/0	4
wb4429-03	Thermodynamics of Mixtures	0/4/0/0	3
Modeling, Analysis And Synthesis			
wb4431-05	Modeling of Processes and Energy Systems	0/2/2/0	4
wb1428	Computational Fluid Dynamics	0/0/2/2	3
wb4433-05	Conceptual Process Design and Optimization	0/0/0/4	4
wb4432-05	Process Dynamics and Control	0/0/0/4	3
Sustainable Processes And Energy Technologies			
wb4435-05	Equipment for Heat Transfer	4/0/0/0	3
wb4436-05	Equipment for Mass Transfer	2/2/0/0	3
wb4300b	Fundamentals of Fluid Machinery	0/0/0/2	2
wb4400-03	Intr. to Sustainable Processes and Energy Technologies	0/0/0/0	1
Sustainabilty Courses			
st4871	Sustainable Design 1	2/2/0/0	3
wb4438-05	Energy Society and Sustainability	0/0/4/0	3
	Obligatory courses		41
	Elective courses		25
me03spt01	Process modeling and simulation Project		12
me03spt02	Internship		12
me03spt03	Final Project		30
	Total		**120**

Course code	Course name	Period	EC	ET	PE/ ST	ETh	FD
Elective Courses							
Fundamental Courses							
tn3710	Advanced Thermodynamics	2/2/0/0	3	r			r
tn3782	Multiphase Flow		6	r	r	r	s
wb1424Atu	Turbulence A	0/0/2/2	6		r	r	s
wb1424B	Advanced Turbulence		3				r
tn3753	Physical Transport Phenomena II		6		r	r	r
wi4017	Non Linear Differential Equations		6		r		r
tn3513	Systems and Signals C	0/0/2/2	6				r
Technology Oriented Courses							
wb4422	Thermal Power Plants	0/0/4/0	4	s		r	
wb4405	Fuel Conversion	4/0/0/0	3	r		r	
wb4416	Nuclear Engineering	0/0/4/0	3	r		r	
wb4425	Fuel Cell Systems	no lectures	2	r		r	
wb4420	Gas Turbines	2/2/0/0	3	r	r	r	
ae4-140	Gas Dynamics I		3	r			r
wb4421	Gas Turbines, Application and Simulation	0/0/2/2	3	r		r	
wb4403	Separation Processes	0/0/4/0	4		s	r	r
wb4402	Project Engineering	2/2/0/0	6	r	r	r	
wb4417	Mechanical & Hydraulic Design of Process Equipment	-	3		s		
wb1408A	Mechanics of Pressure Vessels	0/0/4/0	3		r		
st2452	Process Technology	2/2/0/0	3		r		
wb4418	Gas and Oil Processing Off Shore	0/0/4/4	4		r	r	r
wb1429-03	Microfluidics	0/0/2/2	3				r
wb4410A	Refrigeration Fundamentals	4/0/0/0	3	r		s	
wb4427	Refrigeration Design & Applications	0/0/2/2	4	r		r	
wb4426	Indoor Climate Control Fundamentals	4/0/0/0	3	r		r	
wb4424	Indoor Climate Control Design	0/0/2/2	4	r		r	
tn3703	Radiative Heat Transfer	2/2/0/0	6				r
tn3733	Turbulent Reacting Flows		6				r
Economics And Management Courses							
wm0605tu	Business Economics for Engineers		4				
wm0621tu	Innovation Management		3				
"Technology In Sustainable Development" Certificate							
wm0922tu	Colloquium in Technology in Sustainable Development		4	r	r	r	r

Course code	Course name	Period	EC	ET	PE/ ST	ETh	FD
Cluster A: Design, Analysis And Tools							
id5151	Technical Environment Analysis	0/2/0/0	3				
st4571	Energie en Milieu Besparende Technologie	Essay	3				
st4781	Industrial Ecology	0/0/2/2	3				
st4881	Sustainable Design 2	Design assign.	3				
tn3901	Environmental Physics	2/2/0/0	6				
ct5147	Wind Energy Conversion Systems	0/0/2/2	3				
et4149	Solar Cells	0/0/2/2	3				
id5281	Sustainable Product Design	0/0/0/2	3				
Cluster B: Management, Policy And Society							
wm0801TU	Introduction to Safety Science	0/4/0/0	3				
id5351	Applied Environment Design	0/0/0/2	3				
wm0321TU	Milieufilosofie	2/0/0/0	3				
wm0615TU	Economics of Innovation	2/2/0/0	4				
wm0903TU	Technology Assessment	0/0/2/2	4				

r= recommended course
s= strongly recommended course

Description of Specialisation Energy Technology (ET)

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Secretary: mw. J.M.A. Ammerlaan, +31 (0)15 27 86734, J.M.A.Ammerlaan@3me.TUDelft.nl

Energy is the vital force powering business, manufacturing, and the transportation of goods and services to serve the world economies. Its demand is growing at an impressive pace: the U.S. Energy Information Administration forecasts an increase of 54% in the next two decades. Connected to this, the environmental impact of pollutants involved in energy conversion processes is one of the major problems facing humanity. The so-called green house effect is possibly the worst environmental menace related to anthropogenic energy conversion. Moreover, energy supply and demand plays an increasingly vital role in the national security of developed and developing countries included the Netherlands. One of the fundamental challenges of the future is the sustainable production of energy and a gradual emancipation from fossil fuels because of their increasing scarcity and associated political danger. This can only be achieved by technology improvement and innovation.
The objective of the specialisation in "Energy Technologies" is to develop a thorough understanding of energy conversion and utilization technologies. The students learn about state-of-the-art analysis tools and apply them to study highly efficient, environmentally friendly and integrated processes for the production and utilization of heat, power and secondary fuels like hydrogen. Recommended courses cover relevant topics like, advanced power generation, combined cycles, decentralized heat and power production including

fuel cells, heat pumps and energy utilization in buildings. Other topics which are taught in specialized courses include fuel conversion, gas turbines and nuclear power engineering.

The research activities of the section focus on both systems and components. The system studies aim at optimizing the complete chain of energy production and utilization, the thermodynamic design of a process and its integration into a larger system and the on-line optimization by modern diagnostic tools. Examples are advanced biomass utilization concepts like biomass gasification in combination with fuel cells, gas or ORC turbines and hydrogen production. Component level research is related to combustion, co-combustion and gasification in fluidized bed and/or pulverized fuel systems and combustion of LCV gases in gas turbines.

Description of Specialisation Process Equipment And Separation Technology (PS)

(Process Equipment):
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(Separation Technology):
Prof. dr. ir. P.J. Jansens, +31 (0)15 27 88253, P.J.Jansens@3me.TUDelft.nl
Secretary mw. H. Duijndam, +31 (0)15 27 86678, W.L.E.Duijndam@3me.TUDelft.nl

Separation processes are economically and technologically the key steps for success in the majority of industrial plants in the oil and gas sector as well as in the chemical, waste water, pharmaceutical and food industries. The Process Equipment and Separation Technology (PE/ST) section is positioned between science and industry: its research activities aim at the development of innovative separation technologies and at the optimization of existing separation processes.

In analogy with the materials which we experience in our private life, the majority of the streams in an industrial plant are mixtures of several components. One of the major tasks of the PE/ST section is to develop technologies for the separation of components out of a mixture: the section is internationally recognized for the design and operation of novel equipment and for the development of novel separation processes on industrial scale. The role of Separation Technology and Process Equipment can well be appreciated upon looking at the current energy-consumption of the (petro-)chemical industries in The Netherlands: 352 PJ out of the 2500 PJ total annual consumption of primary energy were used for separation processes in year 2000. This enormous number corresponds to a significant investment-effort devoted to separation equipment, which on average consumes well over 50% of all investments in these industries. The development of efficient separation processes is therefore of the outmost relevance, both with respect to the SPET-curriculum as well as in the research effort of the PE/ST section.

Both in teaching engineers of the future and in doing its own research, the PE/ST section can successfully contribute towards more efficient and environmentally benign technologies, if the fundamentals of heat & mass transfer and thermodynamics are correctly applied. The chair of the section holds in the highest importance that an integrated view is adopted and that close ties to the other adjacent fields are maintained,

namely with the ET, ETh and FD sections. Typical research projects are concerned with the use of non-toxic or non-volatile ("green") solvents in place of more harmful fluids. Furthermore, other research projects aim at two highly selective separation technologies suited to reduce the involved energy consumption, i.e. industrial crystallization and membrane separation processes.

Students specialized in Process Equipment and Separation Technology receive the necessary knowledge and skills that enable them to systematically define, design and optimize a variety of processes and the appropriate equipment.

Description of Specialisation Engineering Thermodynamics (ETh)

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Secretary mw. J.M.A. Ammerlaan, +31 (0)15 27 86734, J.M.A.Ammerlaan@3me.TUDelft.nl

Thermodynamics is the science of both the conversion of matter (Gibbs) and energy (Carnot). The synergy between the process and energy fields largely results from the common thermodynamics fundamentals. For this reason, the research domain of Engineering Thermodynamics is interdisciplinary in both fields of process and energy.

Sustainability is related to the reversibility of processes. Quantification and understanding of irreversibilities in processes allows for the design of more sustainable processes. Here Non-Reversible Thermodynamics gives the students tools to come to more sustainable design solutions.

Transport phenomena of momentum, energy, mass and charge play a major role in process and energy conversion processes. Part of the research is directed to the understanding and quantification of the interaction of these phenomena in Process and Energy equipment.

Current research activities include investigations on Refrigeration and Heat Pump Technology topics. These thermodynamic cycles allow for an upgrading of energy and in this way can significantly improve the sustainability of processes. The research is directed to the development of challenging concepts based on advanced sorption processes in combination with energy storage with phase change materials. Most final projects are developed in cooperation with public and private agencies and organizations.

Description of Specialisation Fluid Dynamics (FD)

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Secretary mrs. R. van der Brugge, +31 (0)15 27 82904, R.vanderBrugge@3me.TUDelft.nl

Almost all equipment and systems in process engineering and energy technology involve flowing liquids and gases, e.g. turbines, mixing reactors, piping systems, and heat exchangers. These flows are generally very complex and non-ideal (i.e., turbulent) and often consist of a mixture of different phases (e.g., liquid/gas, liquid/solid, gas/solid or

liquid/liquid, where the gas, liquid or solid occurs in the form of small bubbles, particles or droplets). For a thorough understanding of the transport processes for heat and mass in various systems, detailed knowledge of the turbulent flows is required, and also of the turbulent flow in relation to other processes, e.g. turbulent mixing and chemical reactions, turbulent multi-phase flows, and turbulence in relation to sound production.

The specialisation of fluid mechanics is directed towards giving training in the fundamental aspects and applications of incompressible fluid flow. In particular the areas to which most attention is given, are turbulence and multi-phase flow, which are the flow types that occur in the process and energy industry. In view of modern technology, much emphasis is put on numerical fluid dynamics (CFD) and its use to solve various practical problems. In addition much attention is given to experiments in the fluid mechanics field, usually in combination with the numerical solutions of flow problems, either for validation or for solving flow problems that cannot be investigated by means of experimental methods.

At the end of the specialisation program the student is trained in all aspects of modern fluid mechanics both by means of courses and by means of specialized research work. Current research activities include investigation on dispersed multiphase flows (i.e., turbulent flows containing small particles), turbulence in relation to mixing, chemical reactions and combustion, transition to turbulence and turbulence control in pipe flow, multiphase flow (liquid/liquid mixtures and gas/liquid/solid mixtures), turbulence and sound production, and microfluidic flows.

In addition of the SPET programme students can obtain the annotation Sustainable Development (SD). See 1.5.7

1.5.4 Variant Production, Mechatronics And Microsystems (PMM)

Coordinator ir. J.J.L. Neve, +31 (0)15 27 86581, j.j.l.neve@3mE.tudelft.nl

The variant Production, Mechatronics and Microsystems (PMM) offers a strong and unique combination of disciplines, which allows students to specialize within the MSc Mechanical Engineering in various advanced, though strongly related, technical fields. The field of work is defined by a number of basic knowledge fields that are applied to a variety of applications. These application domains represent technical challenges on all length-scales. This varies from precision machines (e.g. wafer steppers, manufacturing machines), to subsystems (e.g. smart suspension systems for cars) and even to highly miniaturized systems or micro-systems (e.g. Micro Electro Mechanical Systems (MEMS) for micro-positioning purposes).
The variant PMM is supported by the groups that belong to the department Precision and Microsystems Engineering (PME). The name of the department reflects the major focus in the research of the groups: precision and micro. This focus is in line with major technical challenges in modern industry. One could think of precision machinery like wafer steppers and wafer scanners, which have to operate with nanometer positioning accuracy. Another example is the ultra-precise production of workpieces, for instance, for the automotive

industry. Microsystems, often referred to as MEMS (Micro Electro Mechanical System), are systems based on micro components with dimensions in the sub-mm range, and feature dimensions in the micrometer range.
The application spectrum of this MSc variant includes fields such as automotive, sport equipment, aerospace or biomechanics where advanced simulation, mechatronics, smart microsystems and production techniques are essential innovation factors.
Educational Programs

The educational program of the variant PMM includes 3 specialisations. These are:

- **Specialisation Production Technology (PT)**
  - Precision Manufacturing and Assembly (PMA): (dr.ir. M. Tichem)
- **Specialisation Mechatronics (M)**
  - Mechatronics Design (MD) : vacancy
  - Advanced Mechatronics (AM): Prof. dr.ir. J. van Eijk. This specialisation also covers the fields of Vehicle Mechatronics (dr. ir. E.J. de Vries) and Tribology (dr. ir. A. van Beek).
- **Specialisation Engineering Mechanics (EM)**
  - Structural Optimization and Computational Mechanics (SOCM): prof. dr.ir. A. van Keulen
  - Engineering Dynamics (ED): prof. dr.ir. D.J. Rixen
  - Mechanics of Materials (MM): prof. dr.ir. L.J. Ernst
  - Microsystems Reliability: Prof. dr.ir. K. Zhang

The study program is designed to offer maximum flexibility and added value for the student:

- The courses that are obligatory for the three specialisations within the variant are developed to give introductions to the basic fields of employment of the PMM engineer. These include mechatronic design, production principles, problem solving and design using computational modeling, control and basic laboratory training skills.
- All of the specialisations demand (though in different ways) that at least one of the individual assignments is done within industry (training period).
- Although the students choose a certain specialisation, the program is open individual assignments within all or multiple specialisations. For some students this may be attractive. For instance, a student who designs a mechatronic system may wish to dig deeper into the mechanics of the system, and therefore does an assignment together with or completely under supervision of the expert professor in the field. A production engineering student may find out that optimization of a production process requires the development of an advanced production system, including sensor and control systems. This may lead to co-operation with the mechatronics group.

A detailed overview of the educational program is provided on the next pages. (Always check the website of 3mE on the latest changes of this program.)
Besides a common part for all specialisations, the educational programs for the different specialisations include obligatory courses and exercises and a number of optional courses (electives) in the first year. The second year is devoted to the application and integration of knowledge and skills in individual assignments. The last assignment is thesis work done in one or more of the research themes of PME. The assignment can be carried

out within industry or within the research environment of the department PME. Every student of PME is expected to give oral presentations about his/her literature or research assignment, and about the results of the final assignment. An industrial traineeship in the Netherlands or abroad is a mandatory component of the curriculum.

The total MSc study program consists of 60 EC (European Credits) in courses and 60 EC in individual assignments and projects

Summary specialisation curriculum in European Credits (EC)	PT	M	EM
Obligatory core courses	23	23	23
Obligatory subjects in Specialisation	20	22	14
Elective subjects	17	15	23
Small Design/research assignment, literature thesis or combination of both	10	10	10
Industrial training	15	15	15
Master thesis	35	35	35
Total in EC (European Credits)	**120**	**120**	**120**

Description of Specialisation Production Technology (PT)

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information	ir. J.J.L. Neve,	+31 (0)15 27 86581,	j.j.l.neve@3mE.tudelft.nl
Secretary	mrs.drs. M.E.M. Guffens,	+31 (0)15 27 86578,	M.E.M.Guffens@3me.TUDelft.nl

Production Technology focuses on the technical knowledge and organisation of the entire production chain including processes, machines, and tools. The student acquires knowledge and skills to develop the most suitable production and assembly processes for advanced discrete products. The environment for gaining these skills and knowledge are the challenges originating in the research of the group PMA as well as the challenges put forward by the national and even sometimes international network of companies with which PMA maintains close contacts. The group's research has an emphasis on the development of technology for the production of precise and small products.

The specialisation aims to prepare engineers for a career in companies that develop and produce advanced products. Knowledge on advanced production technologies is essential for the competitive position of these companies. After graduation, the engineers typically become project leaders in production companies, and play a role in innovation of the production engineering knowledge within these companies. The young engineer is for instance responsible for introducing new technological developments, or for the optimisation of the performance of a production process, or supports the industrialisation of prototype products and production processes, or leads a project on further optimisation and rationalisation of entire production systems.

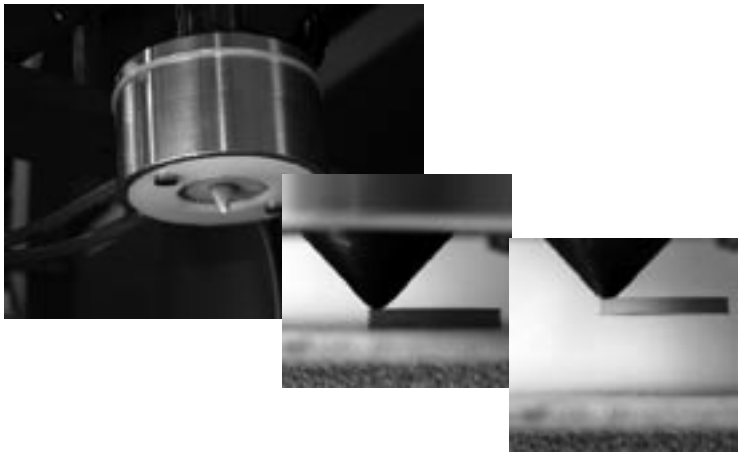
The courses aim to teach the students the essential knowledge for the professional career of the production engineer. The field of work of the production engineer demands a broad set of knowledge domains, including manufacturing and assembly processes, machines and tooling, production automation, production organisation etc. The individual assignments are done within the context of PMA's research or in co-operation with our industrial relations, and offer a wide variety of opportunities to gain a broad spectrum of skills, like design and realisation of mechatronic tooling for micro-assembly, modelling of manufacturing processes, experimental research on processes using our laboratory infrastructure, and production system optimisation.

Examples of recent assignments include:

- The design, optimisation and experimental evaluation of a gripper for handling micro-parts that works on basis of freezing and melting a small amount of intermediate liquid between the gripping head and the part to be gripped (MSc assignment).
- Force measurement in high pressure water jet machining (experimental small research assignment).
- Optimisation of laser machining for the purpose of the manufacture of small ultra-precise moulds (MSc assignment, in co-operation with a Dutch company).
- The development of a self-adjusting mechanism for the alignment of optical fibres (MSc assignment in co-operation with DIMES (Delft Institute for Microelectronics and Submicron Technology).
- Development of new concept for assembly systems that can deal with variation in production volumes asked for over time (MSc assignment, in co-operation with a Dutch company).
- Research on a feeding concept for feeding small parts in the context of micro-assembly (MSc assignment, in co-operation with the EPFL, Lausanne, Switzerland)
- Research into the optimal production of blanks (sheet metal) at Fokker Papendrecht.
- Modal analysis and proposals for design improvement of a vertical milling machine of Unisign, NL.

The obligatory industrial training period, which is an important step in the professionalisation of the engineer-to-become, have brought our students to all continents of the world. (i.e., China, UK, Australia, South-Africa, Brazil, Germany, Dubai, Japan, USA, Spain)

The research in Production Technology addresses two main fields: precision part manufacturing and micro-assembly. New techniques are developed, or combinations of current techniques, with which advanced engineering materials can be better machined. The research is dealing with processes to generate high accuracy in parts and part features. The focus is on the processing of advanced engineering materials and the realisation of complex functional part properties. Research projects deal with loose and bonded abrasive processes, high speed machining and combined processes. State-of-the-art CNC machine tools are at disposal in the laboratory of PMA. Besides the process development itself the improvement of the necessary machine tools and tools is part of the research activities. The experimental work is supported by simulation approaches to predict the process and system behaviour.



Characteristics of the micro-assembly application area are part sizes down to the sub-millimetre range and high accuracy in part joining between 0.1 and 10.0 µm. Parts come from different technological domains, the semi-conductor domain with components processed by silicon wafer oriented techniques and the precision / micro mechanical engineering domain with a wide range of parts (mechanical, optical etc.) The current focus is on micro-part feeding, micro-part gripping, self-adjustment of optical interconnects (alignment of optical fibres to e.g. diodes), and massive, wafer level assembly of small components.

Description of Specialisation Mechatronics (M)

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Secretary mrs. Debby van Vondelen, +31 15 2785572, D.M.C.vanVondelen@3mE.TUDelft.nl

The chairs Mechatronics Design and Advanced Mechatronics are both focussing on the design and its modelling aspects of advanced machinery (wafersteppers, fast and precise production machines, microfactories, etc). While Mechatronics Design is more pinpointing on innovating construction principles into new designs, Advanced Mechatronics is more oriented towards the integration of control so to say. Next to objectives as miniaturization and nanometer precision both groups are challenging micro and nanometer scale applications as Micro Electromechanical Systems (MEMS), inkjet printheads, etc. Furthermore, activities related to Tribology and Vehicle Mechatronics are integrated or carried out in collaboration with others.

Both groups are strongly multidisciplinary where integration of mechanics, control, electronics and (embedded system) software development plays an important role. On the work floor the Mechatronics student will experience this multidisciplinarity of project teams in the second year. These project teams (Postdocs, PhD.-students and Msc.degree students) work on the same machinery but study different aspects. Based on his or her interest the Mechatronics student will have the opportunity in the specialisation phase to broaden his or her curriculum and skills towards the design and modelling, control, embedded system development, sensor and actuator electronics and MEMS applications.

The research projects within the groups are often carried out in collaboration with industries (Philips, ASML, Océ, SKF, Assembleon, etc.) or international research institutions (Univ. of Tokyo, Univ. of Hokkaido, Osaka Univ. and Keio University in Japan and the EPFL, Lausanne in Switzerland).

The integration of expertise on tribology in the groups gives opportunities to study and to do research on (air) lubrication and friction as applied in advanced bearing concepts for instance. Mechatronic bearings developed in the lab are based on electromagnetic levitation or active air lubrication.
In collaboration with DCSC (partly supervised) advanced control algorithms can be designed to optimize speed and precision of precision machinery.

Another important field that can be studied in collaboration with specialists within DCSC and PME is vehicle mechatronics. The topics are mainly focussed on dynamics and control, but design aspects (e.g. designing and applying semi-active suspension elements) may be included as well.
Ongoing Projects:
– Anti-roll actuators in vehicle based on wheel force sensors. (SmartCars with DCSC)
– Reliable Brake-by-Wire
and many Master projects in the Automotive industry

Advanced Mechatronics focusses specifically on the development of high performance servo systems, such as CD- players, harddisk drives, wafersteppers. Magnetic bearing systems are developed for the application in the newest generation high performance tools.

Ongoing projects:
– High precision magnetic bearing concepts for optical disc mastering
– High precision planar drives
– Rapid pick and place machinery for micro components
– High precision desktop machinery for combined high speed milling and electrodischarge machining
– Desktop machinery for haptic micro assembly
– Hybrid bearings for high speed spindles (>300'000 rpm)
– MEMS technology for dual stage disk drives
– MEMS technology for inkjet printing

Student–exchanges (from TUD to(opposite way)):
EPFL: 2003/2004: 3 (2)
Univ. of Tokyo: 2004/2005: 2

Job opportunities:

Most likely the majority of the Msc.-graduates are warmly welcomed as mechatronics designer to work in multidisciplinary teams at Philips, ASML, Océ, SKF, Assembleon, etc. to develop new products. Other opportunities are continuing research within universities, institutes or companies. Another part may want to work for engineering consultancies, and a still smaller part of you may even want to startup a company.

Description of Specialisation Engineering Mechanics (EM)

The Specialisation Engineering Mechanics is supported by the following four disciplines:

Engineering Dynamics (EM-ED):
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Secretary Ms. C.P. du Burck, tel. +31 15 27 85733, c.p.duburck@3mE.tudelft.nl

Mechanics of Materials (EM-MM):
prof.dr.ir. L.J. Ernst, tel. +31 15 27 86519, l.j.ernst@3mE.tudelft.nl
Secretary Ms. C.P. du Burck, tel. +31 15 27 85733, c.p.duburck@3mE.tudelft.nl

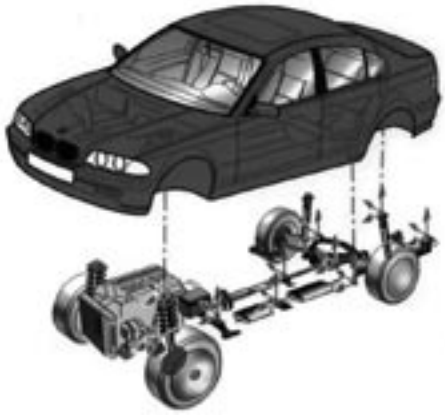
Microsystems Reliability (EM-MR):
prof.dr.ir. K. Zhang, tel: To be announced, email: to be announced
Secretary Ms. C.P. du Burck, tel. +31 15 27 85733, c.p.duburck@3mE.tudelft.nl

Structural Optimization and Computational Mechanics (EM-SOCM) 1)
prof.dr.ir. A. van Keulen, tel. +31 15 278 6515, F.vanKeulen@3mE.tudelft.nl
Secretary Ms. M.C. Stolker, tel. +31 15 278 6513, m.c.stolker@3mE.tudelft.nl

Engineering Mechanics is the field of study covering the foundations of mechanical engineering. Broadly speaking: theoretical and experimental analysis of the statics and dynamics of structures and mechanical systems (loads and performance), material properties of system components, and automation of design and optimization of mechanical system components.
The Specialisation Engineering Mechanics therefore focusses on the understanding of the characteristics of mechanical systems, rather than operational aspects. Engineering Mechanics is a core field for mechanical engineers. As a result, graduates from this Specialisation are often sought by industry as members and as future leaders of teams that work energetically on mechanical innovations.
The Specialisation aims to cover the field of engineering mechanics in general, while it focusses on three disciplines within that field: Engineering Dynamics, Mechanics of Materials, and Structural Optimization and Computational Mechanics. The latter are brought together in Fundamentals of Microsytems.

The selection of obligatory courses for the Specialisation aims to give the M.Sc. students a somewhat broad view of the fundamentals in engineering mechanics.
Then, the student may elect to develop an in-depth focus in the field covered by one of the three disciplines mentioned above. Or, the student may elect to work in more than one of those disciplines, and thereby be open to synergy from working in multiple fields. Or, the student may elect to focus on a theme which combines one or more of the above-mentioned disciplines in combination with a discipline covered by another Specialisation. In order words, the student will encounter considerable flexibility in setting up his preferred study programme.
The possibility to be flexible in setting up the study programme is important because is caters to the individual interests of the student, and because it prepares for modern careers in engineering in which one must always be flexible in terms of projects to be handled and jobs to be pursued.

More and substantial insight in the general field of study in the Specialisation Engineering Mechanics can be obtained from the following sketch of typical activities in the disciplines:



Engineering Dynamics

Focus on the dynamic behaviour of structures and mechanisms, to help determine their characteristics and their room for improvement of dynamic performance. The program offers courses and projects, that involve fundamentals of structural vibrations of mechanical systems and of multibody systems. Research involves computer simulations as well as experimental investigations in the dynamics laboratory. In addition to the study of pure mechanical systems, attention is also on so-called multi-physics systems displaying interaction with fluid flow and with electromechanical fields. Research projects cover a broad spectrum, with emphasis on fundamentals of high performance dynamic systems. We mention some specific examples, from various parts of the dynamics spectrum:

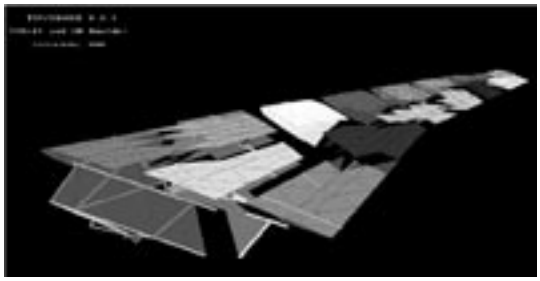
- passive suppression of vibration in key components of a wafer stepper, at ASML;
- shock response of small electronic equipment (e.g. MP3 player), at Philips;
- analysis of vibrations on cold rolling mills, at CORUS;
- mechanical performance of downhole components of oil drill strings, at Shell;
- multibody dynamics analysis of a human knee prothesis, inhouse;
- biodynamic identification of sacro-iliatic joints with ultrasound measurements and modeling, inhouse
- influence of vibrations on performance of a high-performance optical test bench, at TNO-TPD;
- dynamic load analysis of satellites coupled with Ariane launchers, at Estec
- analysis of stability of offshore components, inhouse;
- efficient hybrid modelling of the vibrations of coupled automobile components, at BMW;

Fundamentals of Microsystems

Design of mechanical systems requires a thorough (fundamental) understanding of their behavior and demands modeling tools. The focus in this discipline is primarily put on modeling, experimental characterization and validation, and optimization of mechanical systems. The modeling involves development of adequate material models, including material identification and model validation. On the other hand, the modeling also deals with multidisciplinary models and fast reanalysis, mandatory for design purposes. Once models are available, the route towards automated design (optimization) is opened. The research activities center around several applications: (i) microsystems, (ii) biomechanical systems and (iii) aerospace structures. It should be emphasized, that the microsystems take the most prominent position. Some typical examples of ongoing projects are:

- Reliability of microsystems (Philips)
- Curing of electronic materials (Philips)
- Buckling of thin layers (Philips research)

- Fast reanalysis (Airbus)
- Topology optimization of microsystems (inhouse, SNU Korea, Dimes)
- Modeling of surface effects (Philips, Dimes)
- Model updating using ground vibration tests (NLR, Airbus)
- Design of microgrippers using shape memory alloys
- Design of electrostatic actuators
- Bone ingrowth simulation for shoulder endoprosthesis (EUR, LUMC).



Curriculum

1st MSc year

Course code	Course name	Lecture hours	Specialisations PT	M	EM	EC
Obligatory courses						
sc4021 (=sc4020)	Control Theory for PMM	4/0/0/0	o	o	o	4
wb1442	Introduction to microsytems	2/2/0/0	o	o	o	3
wb1450-05	Mechanical Analysis for Engineering	3/2/0/0	o	o	o	4
wb2414	Mechatronics (design)	2/2/0/0	o	o	o	3
wb5434-05	µ-assembly, packaging and testing	0/0/4/0	o	o	o	3
wb5450-05	Capita Selecta PME	0/0/0/2	o	o	o	1
wb5451-05	Attending student colloquia	1/1/1/1	o	o	o	1
wb5452-05	Intro lab (practicum)	2/4/0/0	o	o	o	4
Total EC obligatory courses Variant			**23**	**23**	**23**	
Obligatory courses Specialisation (e=can be selected as elective course)						
et4245wb	Electromechanical Systems	0/0/0/3	e	o	e	4
wb1406-05	Experimental mechanics	0/0/2/2	e		o	4
wb1418	Engineering Dynamics	2/2/0/0	e	o	o	3
wb1440	Engineering optimisation	2/2/0/0	e	e	o	3
wb1451-05	Engineering mechanics Fundamentals	0/0/2/3	e		o	4
wb2303	Measurement theory and praxis	0/0/2/2	o	o	e	3
wb2427	Predictive modelling	0/0/4/0	o	o	e	3
wb2428-03	mechanical design in mechatronics	2/2/2/0	e	o	e	5
wb3424-04	Production organisation principles	0/2/0/0	o			2

Course code	Course name	Lecture hours	Specialisations			EC
			PT	M	EM	
wb5400	Tribology and precision machinery	0/0/2/2	e	o	e	4
wb5414-03	Design of machines and mechanisms	2/2/0/0	o			3
wb5420-03	(Design of) production systems	4/0/0/0	o			3
wb5421-03	Modelling of manufacturing processes	0/0/0/2	o			3
wb5453-05	State-of-the-art in Material removal process	0/0/4/0	o	e	e	3
Total EC obligatory courses Specialisation			**43**	**45**	**37**	
Elective courses [2)]						
ae4-X01	Modern Topics in materials Science	2/0/0/0	e			3
ae4-X04	Materials Selection in Mechanical design	0/0/2/0	e			3
ae4-153	Adv. Numerical Techn. for Fluid Flow and Struct. Eng.	0/0/2/2			e	3
ae4-485	Manufacturing engineering	0/0/2/2	e	e		3
ae4-684	Fibre reinforced materials	0/0/0/4			e	3
ae4-786	Sheet metal forming in AE industry	0/4/0/0	e			3
ae4-900	Continuum Mechanics	0/0/4/0			e	3
ae4-930	Aeroelasticity	0/0/2/2			e	3
ct5142	Non-linear numerical mechanics	0/4/0/0			e	3
ct5145wb	Random vibrations	0/4/0/0			e	3
et4250	Integrated Circuit Technology	0/0/0/2		e		3
et4257	Silicon Sensors	0/4/0/0		e	e	3
id5171	Literature research and information retrieval	0/0/2/0		e		2
id5211	Computer visualization	2/0/0/2			e	3
in2670	database beheer	0/0/0/2	e			2
in4050tu	Java and Object oriented design	2/2/0/0	e			6
in4073	Embedded RT systems	0/0/4/0+P	e	e		6
ms3021	Metals science	4/4/0/0	e			4
ms3421	Developments in production and processing	2/0/0/0	e			2
ms4011	Mechanical properties	0/0/4/0	e			3
sc4070	Control Systems Lab	0/0/3/0	e			4
sc4110	System Identification	0/0/4/4		e	e	5
sc4150	Fuzzy logic and engineering applications	0/0/3/0	e			3
tn2052	Electricity and Magnetism	0/0/2/2		e		5
wb1310	Multibody Dynamics A	0/0/0/4+P			e	3
wb1405A	Stability of thinwalled constructions	0/0/4/2			e	4
wb1408a	Shell structures - intro	0/0/4/0			e	3
wb1408b	Shell structures - advanced course	0/4/2/0			e	5
wb1409	Elasticity theory	2/2/0/0			e	3
wb1413-04	Multibody dynamics B	0/0/2/2		e	e	4
wb1416	Numerical Methods for Dynamics	0/0/2/2		e	e	3

Course code	Course name	Lecture hours	Specialisations			EC
			PT	M	EM	
wb1417-05	Fluid-structure interaction	0/0/0/3			e	4
wb1433-04	Thermo-mechanical modelling and characterization of polymers	0/0/3/0			e	3
wb1440	Engineering optimisation	2/2/0/0		e	e	3
wb1441	Engineering Optimization 2	0/0/2/2			e	3
wb1443	Matlab in Engineering Mechanics	0/2/2/0		e	e	2
wb2305	Digital control	0/4/0/0		e		3
wb2308	Biomedical Engineering Design	2/0/0/0			e	4
wb2402	Hydraulic Servosystems	2/2/0/0		e	e	3
wb2408	Physiological systems	0/4/0/0			e	3
wb2415	Robust Control	0/0/4/0		e		6
wb2421	Multivariable Control	0/4/0/0		e		6
wb2431	Bone mechanics and implants	0/2/2/0			e	3
wb2432	Bio mechatronics	0/0/2/2			e	4
wb2454-05	Multiphysics modelling using FEMLAB	0/0/2/2		e	e	4
wb3404A	Vehicle dynamics A	0/0/2/2		e	e	3
wb3423-04	Modelling of Industrial Systems	2/0/0/0	e			3
wb5414-03	Design of Machines and Mechanisms	2/2/0/0			e	3
wb5430-05	Engineering informatics	0/4/0/0	e			3
wb5431-05	Life cycle engineering	0/0/0/4	e			3
wi4007tu	Fourier and Laplace transforms	0/0/2/2			e	3
wi4011	Numerical methods for large algebraic systems	0/0/4/0			e	3
wi4014tu	Numerical Analysis C2	2/2/0/0			e	6
wi4145tu	Computational Science and Engineering	0/0/4/0			e	6
wm0516tu	Turning technology into Business	0/4/0/0	E			6
wm0605tu	Business Economics for Engineers	2/2/0/0	e		e	4
wm… tu	Language courses (in consultation with coordinator)		e	e	e	
	Total EC elective courses (choice)		**17**	**15**	**23**	
	Total EC obligatory and elective courses		**60**	**60**	**60**	**60**

2nd MSc year

Course code	Course name	Lecture hours	Specialisations PT	M	EM	EC
MEPMM01	1st student project		10	10	10	10
MEPMM02	Internship/2nd student project	3)	15		15	15
MEPMM03	final student project		35	35	35	35
MEPMM04	Integration project mechatronics	3)		9		
MEPMM05	Litt survey for Mechatronics	3)		6		
	Total EC projects		**60**	**60**	**60**	**60**
	Total EC MSc program		**120**	**120**	**120**	**120**

1) The Mechanics of Materials and Structural Optimization and Computational Mechanics are bundled in one group, named Fundamentals of Microsystems.

2) Students are invited to suggest their own electives in consultation with their study-coordinator

3) Mechatronics students choose other MEPMM02 or MEPMM04+PMPMM05

1.5.5 Variant Biomechanical Design (BMD)

Coordinator Dr. ir. J.L. Herder, tel. + 31 15 2784713, j.l.herder@3me.tudelft.nl

Introduction

The variant BioMechanical Design (BMD) is one of five variants within the MSc programme of Mechanical Engineering. The core of this variant is carried out at the Department of BioMechanical Engineering. Students will receive advanced education in the design and engineering of robotic devices, mechatronic design, control engineering and biological principles.

BioMechanical Systems are technical systems designed for interaction with biological systems, or designed following the principles of biological systems. Examples are telemanipulation systems, such as the ones used in surgical robots, in space or in the off-shore industry; in which a human controls a master robot whilst a slave robot mimics these actions. Other examples of biologically inspired design are endoscopes with the flexibility and steerability of an octopus tentacle, humanoid robots walking as humans do, and intelligently collaborating robots using, mainly, local interactive information exchange, similar to humans.

Specialisations:

- BR = BioRobotics
- BCD= BioCompatible Design
- IMS= Intelligent Mechanical Systems

Description of specialisation BioRobotics (BR)

The specialisation 'Bio-Robotics' places emphasis upon the analysis and design of robots which are meant to physically interact with humans. Topics include haptic interfaces and bi-pedal robotics. A haptic interface is a controlling device e.g. for a slave robot or for a virtual environment, which provides force feedback to the human operator. The force feedback provides additional information to the human about the (real or virtual) environment, so as to improve task performance. Another example topic is bi-pedal humanoid robots, which use the same strategy as human beings for walking, i.e. making optimal use of the passive dynamic properties of the legs. These robots are intended for assistance in a human environment ('service robots'), to study human walking or for the entertainment industry. Students in this specialisation are encouraged to take robotics-related courses from other departments (such as robot vision or artificial intelligence).

Description of specialisation BioCompatible Design (BCD)

Probably the greatest diversity of mechanical designs can be found in nature. For each challenge posed by the (often hostile) environment, a wealth of solutions to cope with the threats has evolved. In the specialisation 'BioCompatible Design' an extensive excursion into biology will provide the students with inspiration to search for uncommon and innovative solutions, often for uncommon challenges. Numerous applications exist in such fields as medical interventions (minimally invasive surgery, endoscopy), rehabilitation technology, aerospace, assembly of microsystems, etc.

Description of specialisation Intelligent Mechanical Systems (IMS)

Contemporary machines are required to have superior performance in function, cost, and quality in every life cycle stage, not only in operations but also in maintenance and even at the end-of-life stage. They must be easy to use, intelligent to interact with humans, robust and fault-tolerant, easy to maintain even if a fault happens, be ready for reconfiguration to cope with increasingly changeable situations, and sustainable from the environmental point of view. This requires machines to be designed and built based on innovative machine design principles, in particular by learning from biological systems and by embedding intelligence. Applications of these principles include industrial machines, transportation machines, office equipment, home appliances, or any mechatronics products. For example, we can think about a new generation of production robots, which have some basic intelligence to communicate to other robots, and to decide for themselves what will be the best strategy to cope with demands in the production line. Students will learn to structure the data processing between multiple robots in order to optimize the 'team performance', thereby inspired by biological examples like an ant colony. Information acquisition, decision making based on reasoning, and active control of intelligent mechanical systems are key features in this specialisation.

Relation to the MSc Biomedical Engineering

Students at the Department of Biomechanical Engineering have the choice between two MSc programs: MSc Biomedical Engineering (specialisations 'Medical Instruments and Medical Safety' and 'Biomechatronics') and MSc Mechanical Engineering (Variant 'Bio-Mechanical Design', specialisations 'Bio-Robotics', 'Biocompatible Design' and 'Intelligent Mechanical Systems'). MSc students BioMedical Engineering (BME) have 50% of their course in the biomedical field, and are being educated for design and/or research in the medical industry or hospitals, whereas MSc students Mechanical Engineering, BioMechanical Design (BMD), have more courses in the mechatronics field: mechanics, control engineering, design of mechanisms. In addition, the BME students will typically take some courses in the biomedical domain, in order to obtain knowledge about the biological systems that the technical systems will interact with, and to get inspiration from nature.
BME students will receive a certificate MSc BioMedical Engineering on which the specialisation (Medical Instruments and Medical Safety, or Biomechatronics) is marked. BMD students will receive a certificate MSc Mechanical Engineering, on which the variant BioMechanical Design and the specialisation ('Bio-Robotics', 'Biocompatible Design' or 'Intelligent Mechanical Systems') is marked.

CURRICULUM

Course code	Course name	Lecture hours	Specialisations			EC
			BR	BcD	ImS	
sc4020	Control theory	4/0/0/0	6	o	o	o
wb2306	The Human Controller (voorheen cyb.erg.)	0/0/0/4	3	o	o	o
wb2309	Introduction Man-Machine Systems Engineering	2/0/0/0	1	o	o	o
wb2404	Man-Machine Systems	0/4/0/0	4	o	o	o
wb2433-03	Humanoid robots	4/0/0/0	3	o	o	o
wb5435-05	Machine Intelligence	0/0/4/0	3	o	o	o
sc4070	Control systems lab	0/0/4/0	4	o		o
wb1413-04	Multibody dynamics B	0/0/2/2	4	o	r	
wb2303	Measurement theory and praxis	0/0/2/2	3	o	r	
wb2407	Human movement control	0/4/0/0	4	o	r	
wbp202	Haptic System Design	no lectures	4	o	o	r
wb1310	Multibody dynamics A	0/0/0/2	3		o	r
wb2308	Biomechanical Engineering Design	0/2/0/0	4	r	o	
wb2408	Physiological Systems	0/4/0/0	3		o	
wb2436-05	Bio-Inspired Design	0/0/4/0	3	r	o	o
wb5414-03	Design of Machines and Mechanisms	2/2/0/0	3			o
wb5430-05	Engineering Informatics	0/4/0/0	3	r		o
wb5431-05	Life Cycle Engineering	0/0/0/4	3	r		o
et4085	Image processing	3/0/0/0	3	r		

Course code	Course name	Lecture hours	Specialisations			EC
			BR	BcD	ImS	
et4245wb	Electromechanical systems	0/0/0/4	4	e	e	e
id4125	Product Life Cycle Engineering & Design A	0/0/3/0	3			r
in4010TU	Artificial Intelligence		6	r		
in4073	embedded real time systems	0/0/3/3	6	r		r
sc4060	Predicitive Control Systems	0/0/3/0	4	e	e	e
sc4080	Knowledge Based Control	0/0/2/0	3	r		r
sc4090	Optimization in Systems and Control	4/0/0/0	3	e	e	e
sc4100	Mechatronic Design	2/2/0/0	3	r		r
sc4110	System Identification	0/0/2/2	5	e	e	e
sc4120	Special topics in signals, system and contol	0/0/0/2	3	e	e	e
sc4150	Fuzzy Logic & Engineering applications	3/0/0/0	3	r		r
tn3534	Pattern Recognition	0/0/4/0	3	e	e	e
tn3541	Data Analysis	4/0/0/0	3	e	e	e
wb1406-05	Experimental mechanics	0/0/2/2	4	e	e	e
wb1416	Numerical methods in Engineering Dynamics	0/0/2/2	3	e	e	e
wb1418	Engineering dynamics	2/2/0/0	3	e	e	e
wb1419	Engineering Dynamics and Mechanisms	2/2/0/0	4	e	e	e
wb1440	Engineering Optimization	2/2/0/0	3	e	e	e
wb1442	Introduction to microsystems	2/2/0/0	3	e	e	e
wb2301	System Identification & Parameter Estimation	0/0/2/2	7	r	r	r
wb2305	Digital control systems	0/4/0/0	3	e	e	e
wb2400	Process control	0/0/2/2	3			r
wb2402	Hydraulic Systems	2/2/0/0	3	e	e	e
wb2413-04	Instrumentation in the Process Industry	0/0/0/4	2			r
wb2414	Mechatronics	2/2/0/0	3	e	e	e
wb2415	Robuust regelen	0/0/4/0	6	e	e	e
wb2416	Lineaire matrixongelijkheden regeltheorie	0/0/0/4	6	e	e	e
wb2422	Modelling 2	0/0/4/0	6	e	e	e
wb2427	Predictive Modelling	0/0/4/0	3	e	e	e
wb2428-03	Mechanical design in mechatronics	2/2/2/0	5	r	r	r
wb2432	Biomechatronics	0/0/2/2	4	r	r	
wb2435-03	Surgical Instruments & Medical Safety	2/0/0/0	2		r	
wb3417-04	Discrete Systems	2/2/0/0	5	r		
		obligatory courses	**39**	**37**	**36**	
		elective courses to select	**21**	**23**	**24**	
		Total courses	**60**	**60**	**60**	
		Total projects (assignments/thesis)	**60**	**60**	**60**	
		TOTAL	**120**	**120**	**120**	

1.5.6 Variant Solid And Fluid Mechanics (SFM)

Coordinator dr.ir. B.J. Boersma, +31 (0)15 27 87979, B.J.Boersma@3me.tudelft.nl

Design, modeling and control of most practical structures and systems relies on solid or fluid mechanics. In cases of fluid-structure interaction both solid and fluid mechanics are needed. Prompted by rapid developments in computer and information technology, attention has been shifted from analytical approaches towards numerical models and techniques during the last decades. For these reasons, (computational) mechanics and (computational) fluid dynamics are among the keystones of many engineering disciplines, for example aeronautics, civil and mechanical engineering, and bioengineering.
Obviously, new theories and models require rigorous experimental validation. The master programme Solid and Fluid Mechanics is organized as a two-year study devoted to the fundamentals of contemporary mechanics. This implies that a variety of courses are embedded, addressing the formulation and fundamentals of governing (continuum) theories, numerical solution procedures and discretization techniques, among others.
The Solid and Fluid Mechanics programme gives an excellent basis for those aiming at a research carreer in industry or academia. However, also for those planning a carreer in advanced engineering the programme yields a solid basis for further specialisation.
The program is organized on the basis of a joint curriculum and four specialisations. These are:

- FM = Fluid Mechanics
- ED = Engineering Dynamics
- MM = Mechanics of Materials
- SO = Structural Optimization & Computational Mechanics

For each of these specialisations the joint curriculum is compulsory and differentiation takes place on the basis of an individual selection of courses.

Description of specialisation Fluid Mechanics (FM)

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Secretary Mrs. H.J. van der Brugge +31 15 2782904 h.j.vanderbrugge@3me.tudelft.nl

The specialisation of fluid mechanics is offering training in the fundamentals of incompressible fluid flow. The areas to which most attention is directed are turbulence and multi-phase flow and these are in particular the areas which occur in many industrial and environmental applications. In view of modern developments in technology, much attention is given to numerical fluid dynamics (CFD) and its uses to various practical problems. Furthermore, the fluid mechanics group carries out extensive research on new developmentes in the application of numerical tools to fluid mechanics, in particular with respect to the simulation of turbulence. Fluid mechanics is a strongly nonlinear physical phenomenon and therefore we cannot do without experiments in this field. Most of the numerical work is, therefore, combined with experimental research in which emphasis is put on the use of new measuring techyniques. As a result, the student will be trained in all aspects of modern fluid mechanics both by means of courses and by means of research work.

Description of specialisation Engineering Dynamics (ED)

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The dynamical behaviour of structures and mechanisms is at the center of the research and teaching tasks of the Engineering Dynamics group. Our students learn the fundamentals of structural vibrations, multibody dynamics and the basic tools to handle such problems. Structural dynamics and its coupling with fluid or electromagnetic fields are applied to a large variety of domains such as machine design, biomechanics, mechatronics and aerospace. Education and research in Engineering Dynamics involves computer simulations as well as experimental testing and measuring dynamic properties in the lab. MSC-theses are related either to research topics currently handled in the group or subjects students have a personal interest in. Also many opportunities to carry out the Master thesis in collaboration with industries exist (e.g. Philips, Shell, Corus, ASML, BMW).

Description of specialisation Mechanics of Materials (MM)

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The continuous improvement of mechanical products and processes requires a flexible design method. For this in the design phase a profound insight in the mechanical properties during and after production is required. Engineering Mechanics offers a variety in analytical, numerical and experimental methods to gain / improve insight in the mechanical properties.
A recent development in flexible designing is the so-called "virtual prototyping". Here, in the design phase the various steps in the production process and the resulting (mechanical) product properties (of the "virtual prototype) are established by means of simulations. Subsequently the design can be adopted / improved. Each adaptation results into an alternative "virtual prototype". The procedure, combined with adequate optimisation, can result in efficient and fast product development; where with reasonable probability the resulting (mechanical) properties (of the "real prototype") will meet the preset qualifications. Therefore, in the past few years virtual (=simulation-based) prototyping is beginning to draw attention from both industries and the academic world. Virtual prototyping involves a variety of aspects such as mechanical modelling of the material behaviour, numerical simulation, design of appropriate optimisation tools and adequate experimental verification techniques. Education and research in Mechanics of Materials is directed to these aspects, with special focus on experimental characterization and modelling of (process dependent) material behaviour, simulation of production steps and related mechanical properties of products and experimental verification of simulation results.

Reliability of Microelectronics and Microsystems

Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of micro-systems. Because of the continuing

miniaturization in this area new concepts in mechanics as well as in experimental methods are being developed and applied. Master theses will often be related to these challenges and will offer opportunities to co-operate with the industrial research partners, such as Philips, Fraunhofer IZM, IMEC, TNO, Thales, Siemens, Kitron, Motorola, ICI, DSM. Key subjects of MSc research work are:

- Typical failure modes in microelectronics and Microsystems, related to design and production.
- Experimental mechanics directed to materials characterization and modelling and to verification of product properties.
- Simulation of microelectronics and micro-system behaviour during and after production.

Description of specialisation Structural Optimization & Computational Mechanics (SO)

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Recent developments in computer technology have opened possibilities for automated design and optimization. This requires a solid understanding and knowledge of both (computational) mechanics and optimization. However, nearly always other disciplines are involved as well, for example, production, electrical, material sciences, etc. The educational programme on Structural Optimization and Computational Mechanics includes lectures on the fundamentals of mechanics, numerical modelling and optimization.
The present fields of application embedded in the research programme are composite structures, micro-electrical-mechanical-systems (MEMS) and biomedical applications.
MSc-theses will typically be related to these fields of application and can be carried out in collaboration with other research institutes or industry

Curriculum

Course code	Course name	Lecture hours	EC
Obligatory courses variant Solid & Fluid Mechanics			
ae4-900	Continuum Mechanics	0/0/4/0	4
ct5142	Computational Methods in Nonlinear Mechanics		3
wb1409	Theory of Elasticity	2/2/0/0	3
wb1419	Engineering dynamics and mechanisms	2/3/0/0	4
wb1427-03	Advanced Fluid Mechanics A	2/2/0/0	5
wb1428	Computational Fluid Dynamics	0/0/2/2	3
		Total	**22**

Course code	Course name	Lecture hours	EC
Recommended elective courses specialisations (≥ 28 EC)			
ae4-30	Aero-Elasticity	0/0/2/2	3
ae4-140	Gasdynamics I	2/2/0/0	3
ae4-141	Gasdynamics II	0/0/2/2	3
ap3181D	Multiphase Flow	0/0/2/2	6
ctme5145	Random vibrations	4/0/0/0	3
ide521	Computer Visualisation	2/0/0/2	3
in006tu	3D Computer Graphics	0/3/0/0	4
tm2721	Physical and Mechanical Properties part B	0/0/4/4	3/3
tn3713	Advanced thermodynamics	0/0/3/0	6
tn3733	Turbulent reacting flows	2/2/0/0	6
tn3753	Transport phenomena II	0/0/3/0	6
wb1310	Multibody Dynamics A	0/0/0/4	3
wb1402a-04	Plates and Shells	0/4/2/0	5
wb1405a	Buckling Analysis	0/0/4/2	4
wb1406-05	Experimental Mechanics	0/0/2/2	4
wb1408A	Shell Structures - introductory course	0/0/4/0	3
wb1408B	Shell Structures - advanced course	0/4/2/0	5
wb1412	Linear and nonlinear vibrations in mechanical systems	0/0/2/2	3
wb1413-04	Multibody Dynamics B	0/0/2/2	4
wb1416	Computational Engineering Mechanics	0/0/2/2	3
wb1417-05	Fluid-structure interaction	0/0/0/2	4
wb1424atu	Turbulence A	0/0/2/2	6
wb1424b	Advanced turbulence	0/0/2/2	3
wb1429-03	Microfluidics	0/0/2/2	3
wb1433-04	Thermomech. modelling & char. of polymers	0/0/3/0	3
wb1440	Engineering Optimization	2/2/0/0	3
wb1441	Optimization II	0/0/2/2	3
wb2303	Measurement Theory and Praxis	2/2/0/0	3
wb2414	Mechatronics	2/2/0/0	3
wb5414-03	Design of Machines and Mechanisms	2/2/0/0	3
wi3001	Num.Meth.for Partial Differential Equations	2/2/0/0	6
wi4006	Special functions	2/2/0/0	6
wi4008	Complex analysis	2/2/2/2	4
wi4010	Advanced Course on Numerical Linear Algebra	4/0/0/0	6
wi4011	Numerical fluid Dynamics	2/2/2/2	6
wi4014tu	Numerical Analysis C2		6
wm0605tu	Business Economics for Engineers		4
wm0621tu	Innovation Management		3

Obligatory courses	22 EC
Elective courses	28 EC
Assignments and projects	70 EC
Total	**120 EC**

Hydraulic rack and pinion elevating system, IHC Gusto Engineering

1.5.7 Annotations

As an addition to the variant programme there are two annotations, to broaden the knowledge on a certain subject. After completing such an annotation, the student gets a supplement to the MSc-degree, which declares a more than average knowledge about that subject. These annotations are:

a Technical Marketing
b Sustainable Development

The study programme, including an annotation, has to comply with the requirements of paragraph 1.2 (120 EC).

Annotation Technical Marketing

The responsible lecturer for Technical Marketing is prof. mr. dr. Sicco C.Santema (tel. +31 15 27 83076).
The Technical Marketing annotation offers students the possibility to gain knowledge and skills in a more commercial direction. The study programme is meant for students, who want to prepare themselves for a technical commercial function (sales, marketing), in the area of their variant and specialisation.
The study programme will be determined in consultation with student, lecturer responsible for the chosen variant and specialisation and the responsible lecturer for Technical Marketing (prof. mr. dr. ir. Sicco S. Santema). The marketing component in the study programme consists of at least 16 EC marketing courses and 16 EC of the MSc-thesis should be devoted to marketing aspects. This means that a significant part of the elective courses has to be used for technical marketing. The marketing content of the MSc- thesis should be complementary to the chosen variant and specialisation. The thesis should provide a synthesis between technology and marketing. Normally this part involves a marketing research study, for products, which still have to be developed, or a market introduction study, for developed products, but not yet introduced into the market. At the

end of the MSc- thesis integration between marketing and technology will take place. This will result in a synthesis report.
Both the lecturer of the chosen variant and specialisation and a technical marketing lecturer will guide the student.

Course code	Course name	Lecture hours	EC
Obligatory courses Annotation Technical Marketing			
ID4141	Consumer research	0/0/3/3	4
ID5131	Business marketing for engineers	0/0/2/0	3
IDE511	Integral aspect of business marketing/ E-Business Design	0/0/0/4	3

Other courses in contemplation with coordinator Technical Marketing and the lecturer of the chosen variant.

Annotation "Sustainable Development" (SD)

SD Coordinator prof.dr. A.H.M. Verkooijen, +31 (0)15 27 86687, A.H.M.Verkooijen@3me.TUDelft.nl
Secretary mw. J.M.A. Ammerlaan, +31 (0)15 27 86734, J.M.A.Ammerlaan@3me.TUDelft.nl

This certificate can be obtained as an addition to the SPET specialisations. In order to obtain the certificate, the students must satisfy 3 study requirements:

1. **Colloquium**: A two weeks seminar during which students work in interdisciplinary groups and face topical sustainability issues and approaches (4 EC). Socio-technological scenario's and actual development around societal aspects and the role of technology are central issues during this course. The interdisciplinary colloquium, consisting of two weeks work, is planned twice a year; in April and in October. There is room for maximum 20 students therefore students must sign up in time. For registration please turn to the secretariat of Education in Sustainable Development (ODO), +31 (0)15 27 83791, A.T.M.Dokkuma-tenDam@tbm.TUDelft.nl or K.H.J.vanDuyn-Derwort@tbm.TUDelft.nl

2. **Elective courses package**: Students must choose a balanced package of at least two 'Sustainable Development' related courses (a total of 5 EC) in two clusters (minimum 2 EC per cluster). These clusters are: Design, Analysis and Tools (Cluster A) and Management, Policy and Society (Cluster B). The Coordinator (SD-referent) advises students so to choose a balanced package of elective courses.

3. **Sustainability issues in the Final Project**: students are asked to incorporate sustainability issues specific to their disciplines in their graduation project. The SD Coordinator evaluates the graduation project by assessing how aspects of Sustainable Development are treated. The Coordinator evaluates the project before the beginning and after completion as for the way SD has included in the problem definition, in the actual project development and in the conclusion. The SD Coordinator advises the graduation committee. The Professor who supervises the Final Project remains primarily responsible for the general evaluation of the work.

The EC points necessary to obtain the SD certificate (Forms for the additional certificate) are summarized as follows:

Colloquium (wm0922tu)	4 EC
Compulsory sustainability courses	6 EC
Elective courses	5 EC
Final project	30 EC
Total	**45 EC**

1.5.8 Technical University Teacher Course (TULO)

Graduated Masters of Science Mechanical Engineering and Marine Technology have the opportunity to participate in a special course to become a high school teacher in science or mathematics.
There is a standard course, which includes 60 EC. A maximum of 30 of these points can be integrated in the MSc study programme, the other, at least, 30 points have to be earned in a post MSc course.
For more information on admission to the programme and the study programme please contact the office of TULO.

Office of TULO
faculty TBM
Jaffalaan 5, 2628 BX Delft.
Phone: 015 27 82786 / 015 27 83768
E-mail: j.geerlings@tbm.tudelft.nl

1.6 Enrolling for courses and tests

There are different procedures to enroll. Usually it is necessary to enroll for courses and tests.

Courses Students can enroll for specific courses at Blackboard. Most of the communication between lecturer and students goes by blackboard announcements. Also exchange of information, assignments and reports often takes place via at Blackboard.

Tests Enrolling for tests is compulsory and can be done at the TAS-site ('Tentamen Aanmeld Systeem' http://www.tas.tudelft.nl). This should be done two weeks before the test takes place, at the latest, otherwise the test will not be accounted for by the lecturer. If a student has enrolled, but decided not to do the test, the student must cancel this, at least one week before the test takes place.

Using TAS When first using TAS the student must choose a personal password. This can be done by

using the campus card in a card reader. At the faculty there are two card readers: one is located near the Pallas / Parthemus computerroom (4, 1st) and one is located at Education support staff (8B, 2th).

1.7 Pass rules and criteria for 'honours-degree'

Pass rules To pass a course or assignment, a grade of at least 6,0 is necessary. It is possible to pass the MSc- examination with one grade of 5. The grades are rounded off to the nearest integer.

Examination On completing the programme, the student should apply for the Master's examination by means of a form, available from the Education Support Staff or the website.

'honours- degree' The 'honours-degree' is granted to graduates with the following study results:

- Grade average, excluding the MSc-thesis, is at least 7,5.
- No grades lower than 6.
- Grade for MSc-thesis is at least 9.
- Not more than 3 years to complete the MSc-programme.

This is a summary from part of the "Regulations and guidelines for the board of examiners", appendix 6.1 of this studyguide.

1.8 Honours Track

During the course year 2002-2006 it is possible to follow an honours track for excellent students. An honours track is a special individual programme, in addition to the regular Master programme, of 30 EC (840 hours) and is related to Marine Technology and / or to the role of technology within society. The extra programme has to be finished during the Master programme of the student. Students who have successfully completed their honours track receive a special certificate of the university. Students, who have finished the Bachelor programme with a weighted averaged mark of 7.5 or higher and students who have shown an excellent performance during the first semester (no fails and weighted averaged mark 7.5 or higher), are eligible for following the honours track in their Master programme. The Director of Education is responsible for the programme of each individual honours track.

1.9 Study and internship abroad

Study abroad offers a lot of attractive prospects. You become acquainted with a different (organisational) culture, a different university life and a different educational

system. Besides you enlarge your personal network, you learn to live within a foreign environment, and you improve your knowledge of languages. To put it briefly: a period of study abroad will make a valuable contribution to your personal education and you will draw much benefit from it at your search for a proper job.

You can make use of one of many exchange agreements with European and non-European universities for your study at a foreign university. Within such an agreement you do not pay the foreign university any tuition fee. In addition to this, grants are available for financing the additional expenses for staying abroad. For your first information on studying abroad it is recommended to visit the Back Office International Programmes of the Student Facility Centre. Much documentation about study abroad is available at this Centre, like information on all universities with which an exchange agreement exists, possibilities of financing, and travel reports from students.
If you got a clear idea about where you want to go to, you can ask the Coordinator for International Exchange Marine Technology for advise about your programme at the foreign university and about the recognition of your results at the host university. Your graduation professor will judge your work afterwards according to the rules you agreed upon, prior to departure.

The foreign programme should at least contribute 12 EC to your MSc programme.
To arrange everything you have to do a lot yourself. Therefore you have to take a preparation period into account of preferably a year, but at least half a year.

Internship

Usually a internship is arranged via one of the staff members of the section to which your specialisation belongs. In addition to this you can visit the Information Centre of the Student Facility Centre (see above). They offer a lot of information, not only on a large number of companies abroad, but also on financially related affairs, working permits, visa, etc.

Additional information on both study and internship abroad is available at the TUDelft website (http://www.tudelft.nl); via Campus Portal choose under the heading STUDENT AFFAIRS: 'Internship, study, jobs'.

International Coordinator 3mE
Mw. M.P.I. Toppenberg
Room 8C, ground floor
Mekelweg 2
2628 CD Delft
Tel.: +31 15 278 6959
Fax.: +31 15 278 8340
E-mail: m.p.i.toppenberg@3me.tudelft.nl

1.10 Cheating, Citation and plagiarism

When doing an assignment, project or other educational activity, the student uses sources and knowledge of other people. This is allowed if the following points are taken in mind:

Citation

Citation, literaly copying text is allowed, if:

- The text is limited in length and
- the citation is made between quotation marks and
- the source, even when this is an internet source, is mentioned in a correct and complete manner.

Parafrasing

Parafrasing means describing a text of a third party in your own words. This is allowed, if:

- It is mentioned what is being copied and of whom and
- the source, even when this is an internet source, is mentioned in a correct and complete manner and
- there is a clear seperation between the ideas of the third party and own ideas.

Plagiarism

Plagiarism means copying of pieces of text, ideas, design and theories of others, without mentioning the source. Plagiarism is a form of cheating and is illegal.

Cheating
Passengers

Cheating is wider than plagiarism and also includes taking a look at other's work during exams or refusing to make an proportional amount of effort in a group assignment, which is assessed based on the effort of the group as a whole. People, who do this are called passengers.

Students suspected of copying, cheating, or being passengers, run the risk of being barred by the examination board from all tests and examinations held by TU Delft for up to one year. This can also have wide-ranging consequences for both the duration and the financial aspects of your course of study.

(With information from the TBM flyer 'Copying is a copout')

Organisation

2 Organisation

2.1 Faculty

The faculty 3mE offers the study programmes Biomedical Engineering (BME), Materials Science and Engineering (MSE), Mechanical Engineering (ME), Marine Technology (MT), Systems and Control (SC) and Offshore Engineering (OE). The faculty also participates in the interfaculty MSc programmes Transport, Infrastructure and Logistics (TIL).
3mE is an abreviattion of Machanical, Maritime and Materials Engineering.
The organisation of the faculty and the structure of the educational and board of examiners of the faculty are described in the faculty regulations. The dean has the final responsibility for the faculty. He is assisted by the Director of Education. Together with the department heads they form the management team. The dean is supported by the Faculty Staff and is advised by a number of advisory boards.

Dean Prof. drs. M. Waas, room: 8F-1-14, phone: 015 27 85401, email: m.waas@3me.tudelft.nl

2.2 Education support staff

The education support staff is executing the education support of the study Mechanical Engineering. For all issues related to the Mechanical Engineering study the students can get information. The Education Support Staff consists of the following persons:

prof.ir. Hans Klein Woud	Director of Education	j.kleinwoud@3me.tudelft.nl	Tel. 015 27 81556
ir. Nic-Jan van Bemmel	Manager Educational Programmes	n.j.vanbemmel@3me.tudelft.nl	Tel. 015 27 88791
Fatma Çinar	Education Administration office	f.s.cinar@3me.tudelft.nl	Tel. 015 27 86753
Teuni Eden	Student adviser	t.eden@3me.tudelft.nl	Tel.015 278 2176
Lies Gesink	Education Administration office	e.g.gesink@3me.tudelft.nl	Tel. 015 27 86591
Louise Karreman	Study Administration office	l.m.karreman@3me.tudelft.nl	Tel. 015 27 83457
Ewoud van Luik	Coordinator Education	e.p.vanluik@3me.tudelft.nl	Tel. 015 27 85734
dr. ir. Dick Nijveldt	Educational Adviser	d.nijveldt@3me.tudelft.nl	Tel. 015 27 85921
Carel Piguillet	Software Support	c.f.f.piguillet@3me.tudelft.nl	Tel. 015 27 86820
Mascha Toppenberg	International coordinator	m.p.i.toppenberg@3me.tudelft.nl	Tel. 015 27 86959
ir. Jaap v.d. Zanden	Student adviser	j.vanderzanden@3me.tudelft.nl	Tel. 015 27 82996

Education Support Staff
Mekelweg 2, 2628 CD Delft
Location 8C, ground floor
Phone: 015 27 86959
Fax: 015 27 88340

2.3 Education committee

The education committee advises the dean and the education director on the contents and the structure of de study programme and the examinations.
The education committee exists of four lecturers and four students. Also the education director, the education adviser and a student adviser take part in the meetings.

Chairman dr. S. Dijkstra
Mekelweg 2
2628 CD Delft
phone: 015 27 85606
e-mail: s.dijkstra@3me.tudelft.nl

Secretary mrs. L.M. Karreman
room 8C, ground floor
Mekelweg 2
2628 CD Delft
phone: 015 27 83457
e-mail: l.m.karreman@3me.tudelft.nl

2.4 Board of examiners

The board of examiners consists of all lecturers, involved in the study programme, as mentioned in paragraph 1.5.
The board of examiners is responsible for the rules and regulations of the examinations and the assessment of the examination results. Requests can be addressed to the board of examiners for participating in a deviating study programme.

Chairman prof. ir. J. Klein Woud
room 7-1-121
Mekelweg 2
2628 CD Delft
phone: 015 27 81556
e-mail: j.kleinwoud@3me.tudelft.nl

Secretary E.P. van Luik
room 8C, ground floor
Mekelweg 2
2628 CD Delft
phone: 015 27 85734
e-mail: e.p.vanluik@3me.tudelft.nl

2.5 Students association "Leeghwater"

'Gezelschap Leeghwater' is the students association of Mechanical Engineering at the TU Delft. The goal is to give its members support to their study and to look after the interests of the students of Mechanical Engineering.

Gezelschap Leeghwater
Mekelweg 2
2628 CD Delft
Phone: 015 278 65 01
Fax: 015 278 14 43
E-mail: info@leeghwater.nl
http://www.leeghwater.nl

The first aim, support to the study, is taken care of by organising excursions, case studies and by taking a seat in the organisation of the "Delftse Bedrijvendagen". Gezelschap Leeghwater also publishes a year book, an agenda and five times a year the magazine 'de Slurf'.

The second aim, to look after the interests of the students, is taken care by organizing "lecture response groups" in order to give feedback to teachers. Every year one member of the board of Gezelschap Leeghwater is responsible to represent the students in discissions with the faculty and education staff about education. He or she is the person, who canalizes complaints and wishes about the education programme, organization and lecturers. This person can be contacted by onderwijs@leeghwater.nl

Books

Every weekday between 10.00 a.m. and 16.00 p.m. Gezelschap Leeghwater sells books at its office. Here you can buy books at cost price, last-years examinations and various office articles. On blackboard last years examinations are available for members of Gezelschap Leeghwater to download and print.

2.6 Student guidance

For assistance and advise to students the faculty has two student advisers. The student adviser is the person for questions or problems related to the study or about issues, which may influence the ability to study. The student adviser functions as oracle (vraagbaak) and as confidential consultant to students.

Individual help and advice
The student adviser has no educational responsibilities and can, therefore, devote himself totally to individual students and to help solving their problems which may be an obstacle to their study progress. He also takes seat in a lot of boards and has contact with the lecturers, so that he has up to date information about what is going on in the study Mechanical Engineering. He also has contact with other student advisers and personal advisers at the TU Delft and outside the University; so he knows what is going on elsewhere.

Personal circumstances
During a talk with a student adviser, often intimate information comes up. The student can be sure that this information will be dealt with confidentially. This kind of information will only be used after consultation with the student, to plead to apply TU- or faculty regulations.

Advice to Examination Committee, Professor, ...
A student adviser can decide, as result of certain conditions, to advise e.g. the board of examiners, in favour of a specific student. When necessary the student adviser becomes an intermediary between TU Delft personal advisers: student, deans, psychologists and physicians. The amount, in which the student adviser pays attention to a student, is up to the student. The student adviser keeps an eye on the study progress of most of the students and calls up one when necessary, but it is strongly recommended to contact the student adviser yourself when a question or problem comes up. Waiting often results in an increase of the problem. The two student advisers at the faculty are available for all questions. They also have their own specialisms.

Foreign Student Financial Support (FSFS)
The Delft University of Technology provides financial assistance to foreign students in cases where their study suffers delay due to special circumstances like physical illness, physical or sensory disorder, mental problems, insufficient organisation of the educational programme by the faculty.

Mrs. Teunie Eden, student adviser for all students BSc-MSc 3mE, as well as counsellor in case of harassment (see down this page)
Specialisms: Exchange students, International MSc-students, social programme international students.
Mekelweg 2, 8C, ground floor
Email: t.eden@3me.tudelft.nl
Phone: 015 27 82176

Ir. Jaap v.d. Zanden, student adviser for all students BSc-MSc 3me.
Specialisms: Graduate students, polytechnic high school students, quality control, student mentors.
Mekelweg 2, 8C, ground floor
Email: j.vanderzanden@3me.tudelft.nl
Phone: 015 27 82996

Dyslexia
Students having dyslexia usually have problems with reading and understanding of long texts. This can be an obstacle to 'normal' study progress. Therefore these students are advised to contact one of the student advisers and to set up a remedial plan. Important issues are:

- A planned study delay often helps
- When necessary, longer time for tests is possible
- Studying with a fellow student often results in more study progress
- IBG has extra student grants

2.7 Working conditions, RSI and harassment

RSI (Repetitive Strain Injury) is a well known problem by now. Within the TU Delft the number of complaints caused by RSI is increasing. Still too many employees and students neglect the first symptoms of RSI, without knowing where to go with their questions and complaints. On the internet there is a lot of information to be found on this matter. An example is http://www.rsi.pagina.nl.
Free software, can be downloaded on the 3mE website, that helps you to prevent RSI: http://www.3me.tudelft.nl, button: "facilities".

Causes There are two mechanisms that cause RSI:

- Dynamic loading: repetitive dynamic loading of muscles in fingers and hands, without taking breaks, can cause an overload in these muscles. Friction between muscles, tendons and bones can eventually cause damage.
- Static loading: constant stressing of muscles in the neck, shoulders and arms prevents blood circulation and squeezes off nerves. This results in cold and tingling fingers. Mental stress and unfavourable positioning of the body increases this effect.

Symptoms There are various symptoms, which indicate RSI: pain, stiffnes, tingling and a loss of strength can occur in neck shoulders, arms, wrists, hands and sometimes even in legs. Wtihout resting these symptoms will only get worse.

Prevention How to prevent RSI:

- Vary repetitive tasks, like typing and using a mouse, with non repetitive tasks, like walking to the printer or reading documents.
- Take regular breaks. It is recommended for every two hours work to take a 10-minute break and for every 10 minutes work to take a 20-second break, to improve blood circulation. It is even better to do exercises, within these breaks. For this purpose anti-RSI-software can help.
- It is strongly disrecommended to do more than six hours of computer work a day.
- Make sure that the working position of the body is correct. A good installed workplace is important for a correct working position. Sit straight in front of your monitor and keyboard. The height and distance of the monitor and desk should be sufficient. A chair with a convex back at waist height is favourable.
- Try not to work under stress caused by deadlines or private problems.

Don't neglect the symptoms of RSI. For questions you can contact the following people:

- Student adviser
- Labour and environmental adviser Leen Paauw, l.paauw@3me.tudelft.nl
- Student Health Care (SGZ), tel: 015 2121507, studentenartsen@sgz.nl
- Student Facility Centre (SFC), http://www.sfc.tudelft.nl
- VSSD support, tel: 015 27 82057, http://www.vssd.nl

Harassment

Harassment is inappropriate, unwanted behaviour which disturbs someone. Teasing, mocking, gossiping, bullying, sexual or racial intimidation, violence and discrimination are all forms of harassment.

Counsellor If you have problems you can turn to the Counsellor as appointed by each department within the university. Counsellors operate under strictly confidential and trustworthy conditions and can offer advice, information, support and assistance to victims of harassment. When necessary they may enlist the assistance of mediators. They can also assist and guide you, should you wish to submit your complaint to the DUT Complaints Committee. All actions are subject to your permission and approval.

If you experience any problems do not hesitate! Everyone at TU Delft has a right to feel respected and safe!

The Counsellor for our department is:
Mrs. T.Eden
Mekelweg 2, 8C, ground floor, email: vertrouwenspersoon@3me.tudelft.nl
Phone: 015 27 82176

2.8 Quality Control

The quality of the education is continuously monitored and evaluated. This is done by the faculty itself and by external organisations. The results of the evaluations are public. A summary of these results can be found on the internet.
Based on these results the education committee and the education director advises the dean.

Internal Quality Control:

Course Evaluation

- To evaluate the opinion of the students a "**course-evaluation-system**" exists. This system gives all students the opportunity to give their opinion on the education. The study programme and courses are evaluated each year by means of a questionaire.
- **Evaluation meetings** with students and lecturers.

Complaints

- Submitting and dealing with **complaints**. These complaints can be lodged at the students association or at the education director.
- The faculty evaluates itself regurlarly in a self-assessment.

External quality control:

- The study is being accredited every five years, by the NVAO (Nederlands Vlaamse Accreditatie Organisatie). In preparation of the accreditation, the study is evaluated by a visitation committee formed by QANU (Quality assurance Netherlands Universities)

2.9 Information services

Study guide

This study guide is the main information source of the study programme and is available to all students at the education support desk (8B, 2th).
The website, however always contains the most recent information. Announcements, which are of importance for the study, like changes in the schedules, are made timely on

Blackboard

the homepage of the faculty and at Black Board.
Schedules about the lectures, assignments and examinations are available at the desk of the study administration. At the homepage of the faculty and Black Board the changes in

Grades

these schedules are given. Grades can also be found on blackboard.
Information that is not related directly to the study e.g. information by students association 'Leeghwater, will be published on publication boards. Members of 'Leeghwater' will be kept informed by e-mail.

2.10 Rules and Regulations

Student Statute (Studentenstatuut)
The Education Specific Part of the Student Statute (OSDS) applies to the education and the examinations of the study Marine Technology.
The OSDS defines which educational services are given by the faculty and what is demanded from the students. The OSDS intends to offer the students an easy way to accomplish improvements in the educational situation, with help of the education director.

The OSDS consists of:
- This Study Guide.
- The Course and Examination Regulations for the study Marine Technology (CER, see appendix 6.1).
- Implementation Procedures (appendix 6.2).
- Regulations and guidelines for the board of examiners (appendix 6.3).

Faculty regulations
- It is not allowed to smoke within the faculty building.
- Students have to follow the instructions given by staff members. Staff members are those who support or give lectures and those who are responsible for buildings and the surrounding areas.
- On the first demand of a staff member the student should identify him- or herself by showing the campus card.
- The student should be present in time, before the start of a lecture, assignment, instruction or meeting. The lecturer or assistant may reject students who are late.
- Regular times for lectures to start are:

Lecture	Start	End
1st hour:	8.45	9.30
2nd hour:	9.45	10.30
3rd hour:	10.45	11.30
4th hour:	11.45	12.30
5th hour:	13.45	14.30
6th hour:	14.45	15.30
7th hour:	15.45	16.30
8th hour:	16.45	17.30

- Bikes should be placed in the bike stands provided.
- There is an opportunity to store personal belongings in lockers which are provided in the main hall. In the corridor situated next to lecture rooms A till F, bigger lockers can be used to store helmets. At the end of the study year, before the 15th of July, the lockers should be empty and the keys should be returned. Lockers, still in use after the 15th of July, will be provided with a new lock on cost of the student.
- Eating and drinking is only allowed in the canteen, the coffee corner and in the immediate surroundings of a soda, candy, coffee or soup dispensers.

- Writing on, drawing on, sticking things on or scratching in furniture, walls, doors or windows is prohibited.
- Garbage and paper should be disposed in bins.
- For the use of computers, network connections, printers and plotters there are rules and regulations, which should be taken in consideration.
- Disobeying of rules and regulations can result in a suspension or a denial of certain facilities. Theft or destruction on purpose of properties of DUT and also serious misbehaviour will be mentioned to the proper authorities.

Internet facilities

The utilisation of internet facilities at the faculty is bound to some regulations:

It is allowed to:
- Send e-mail to persons (or applications) from which can be expected that they will not consider the e-mail as annoying. Also you can receive e-mails which can be temporary stored in the inbox.
- Read online magazines and to place articles in it.
- Use the network information services like WWW-servers and FTP-servers, which are in use at this moment and also which will become available in the future. All use of services is bounded by regulations.
- Use the "Intranet DUNeT" on telephones provided through the faculty.

It is not allowed to:
- Damage or disable facilities.
- Use available facilities in any other way as they were supposed to be used:
  - Downloading, uploading and filesharing of copyright protected items, such as texts, audio and video files, in any format.
  - Downloading and installing any applications on the faculty computers.
  - Playing computer games using network facilities.
- Make excessive use of the facilities.
- Let a third party use available facilities (including fellow students).
- Do damage or obstruct other users or equipment linked to the world wide web.
- Disrespect other peoples privacy, for example by sending information under a false name.
- Become member of a mailing list outside the faculty without permission of the "dutwmail director". This rule only applies to the students.
- Distribute or show material that can be regarded as offending, for example insulting phrases or pornographic images or movies.

Sanctions:
- Account deactivation immediately after a violation has occurred.
- In case of serious violation and in case of repeated violation: prohibition of the use of ICT facilities, up to a year.
- In case of law violation: notification to the police.
- All claims, as a result of violations, are passed to the violator.

Facilities

3 Facilities

In this study guide is being referred to locations, within the faculty building, by means of a number and a letter between brackets, which corresponds to the faculty map in appendix 6.7. The floor is also indicated (BG= ground floor, 1st = first floor, etc.). Locations outside the faculty can be found at the campus map, appendix 6.5.

3.1 Lecture Rooms / Meeting Rooms

Lecture rooms are used for lectures, presentations and instructions. The next table summarises all lecture rooms, mentioning capacity and location.
Meeting rooms are available for meetings, discussions etc. of small groups of students. Reservations can be made as the desk of the education support staff.

Room	Capacity	Location
A	300	6, BG
B	200	6, BG
C	150	6, BG
D	150	6, BG
E	70	6, BG
F	70	6, BG
J	50	8D, 1st
K	30	8G, 1st
L	30	8G, 1st
P	40	4

3.2 Individual study facilities

At several locations in the faculty individual study places are available. Some of these study places are equipped with computers. These places are free to use, without reservation. Places should be left clean and tidy.
Besides the study places as mentioned above, there are also places to study in the faculty library and the central library (see 3.5). In the library students have to be silent. The same rules apply as for the study places.

3.3 Computer rooms

Besides computers at the study places, computers are available in the computer rooms. All computers give access to the internet. The computer rooms are free to use by all students, if they are no in use for instructions or assignments. When they are, the computer rooms are not accessible for everybody. A schedule, on the door of each computer room tells when these instructions or assignments take place. The next table shows all the computer rooms and their location.

Room	Location
Athena room	4, 1st
Parthemus room	4, 1st
Pallas room	4, 1st
Design studios	8G, BG

3.4 Research facilities

The faculty has a number of research laboratories. Students may perform a part of their study in these laboratories, like the MSc-Thesis or a laboratory exercise . The laboratories are used for research activities of Ph.D.- Students and staff.

Fluid Mechanics laboratory

Contact Laboratory manager: B v.d. Velden
Phone: 015 27 82892
Location: Leeghwaterstraat 21

Delft Bio-robotics Laboratory

Facilities Several bi-pedale robots
Contact Laboratory manager: dr.ir. M. Wisse
Phone: 015 27 86585
Location: 5, 1st , room 03-L

Engineering Dynamics Laboratory

Facilities Dynamic test equipment and analyzing systems
Contact Phone laboratory: 015 27 89394
Phone manager: 015 27 86739
Location: 5, BG, room 07

Laboratory for Precision Manufacturing and Assembly

Contact ir. J.J.L. Neve
Phone: 015 27 86581
Location Leeghwaterstraat 37b

Laboratory for process equipment & Thermal Power Engineering

Facilities Pilot scale research equipment and utilities, Analytical equipment, Computational Tools
Contact Laboratory manager: J. v. Os
Phone: 015 27 86921
Location: API building, Leeghwaterstraat 44

Laboratory of Systems and Control

Contact Laboratory manager: ing. R. van Puffelen
Location: 5, BG

Mechanics of Materials Laboratory

Facilities Test machines and analyzing equipment
Contact Phone: 015 27 89394 / 89424
Location: 5, BG, room 07

Tribology Laboratory

Facilities Tribological Test Equipment
Contact Laboratory manager: B. Hoevenaar
Phone: 015 27 86805
Location: 5, BG, room 16

3.5 Library

Central library

Prometheusplein 1
Postbus 98
2600 MG Delft
tel: 015 27 85678
fax: 015 27 85706
www.library.tudelft.nl

The library of the TU Delft consists of a main building and smaller faculty libraries . The main building has a large collection of books and magazines. The main part of the collection can be lent from the library and has to be requested. 30 minutes after requesting the item will be available. The remaining part of the collection (open shelves) is only available within the library.
The main building has more than 1000 study places (at the ground floor, on the different floors of 'the cone' and in a couple of group rooms), a computer room and coffee and candy dispensers.
To lend a book, a student needs a library card, which pass can be acquired at the desk in the main building or at the faculty libraries.

		Lecture period	Exam period	Summer holiday
Opening hours	Mo - Thu	9:00 - 22:00	9:00 - 24:00	9:00 - 17:00
	Fri	9:00 - 18:00	9:00 - 22:00	9:00 - 17:00
	Sa and Su	10:00 - 18:00	10:00 - 22:00	Closed
Book desk	Mo - Thu	9:00 - 19:00	9:00 - 19:00	9:00 - 19:00
	Fri	9:00 - 17:00	9:00 - 17:00	9:00 - 17:00
	Sa	10:00 - 13:00	10:00 - 13:00	10:00 - 13:00

Books can be borrowed for a period of 28 days. This term can be extended as long as no other person makes a reservation for the book. As a maximum, 20 items can be loaned. If a book is requested but not available, the requester will receive a notification by email or post if the book is available.
The central library is behind the auditorium (aula) at the Prometheusplein,
see appendix 6.5.

Opening hours Monday to Friday 9:00 - 17:00

Request Searching and requesting books is possible by the online catalogue at http://www.library.tudelft.nl. This catalogue includes all collections of all libraries of the TU Delft. Besides the catalogue, requesting of books is possible at the desk of the central library and the faculty library.

Library card In order to use the library facilities a student is supposed to have a library card. This card can be requested at the desk of the central library or faculty library. To make the request the student must bring an Personal Identification (passport, driver's licence, etc.) and an Adress Identification (recent bank statement, insurance policy, etc.). The library card is free from charge and for personal use only.

3.6 Lecture notes and books

Most lecture notes, which are used for lectures at the faculty, can be bought at the 'repro', as well as some books and office articles are available. Books are also available at student association 'Leeghwater' (www.leeghwater.nl) and VSSD (www.vssd.nl).
Opening hours repro: Monday to Friday 9:00 - 16:00
http://www.io.tudelft.nl/repro/, 015 2783062
Location: 10, BG.

For courses at other faculties, lecture notes can be bought at the concerning faculties:
- Aerospace Engineering: 1st floor, 015 27 81250
- Applied Physics: room no. C 057, 015 27 87992
- Civil Engineering: 015 27 81727
- Management of Technology: ground floor, next to entrance, 015 27 86373
- Electrical Eng, Mathematics, Computer sc. (EWI): room 350, 015 27 87855

3.7 Mailbox and access to the internet

Each student has the possibility to acces and communicate on the Internet. Therefore each student receives a faculty login account and an e-mail account. The email account is accessible everywhere, via a webmail server. At the faculty students can use printers, plotters, scanners, etc.

Printing Printing is paid for by a print account. Each student gets a welcome account of €11.50 to start with. At the reception desk the account can be upgraded, from 8:30 till 16:30. It is possible to check the print account at all time, by pointing with the mouse on the 'dollar sign'-symbol in the taskbar at any computer at the faculty.

The services mentioned above are taken care of by:

I&A Service information and automation (Dienst Informatisering en Automatisering) (I&A):
Managing of computers, servers and the network.
Phone: 015 27 82001
E-mail: helpdesk@3me.tudelft.nl

System administrator and postmaster J.M.Kalkman, phone: 015 27 86858, e-mail: j.m.kalkman@ocp.tudelft.nl, room 8A-1-06

DTO Service Technical Support (Dienst Technische Ondersteuning) (DTO):
Supporting when problems with accounts occur.
Phone: 015 27 82000
E-mail: info@dto.tudelft.nl

3.8 Catering

The faculty offers a variety of catering facilities.

Canteen The faculty canteen serves a comprehensive lunch. The canteen can be found at location 10, BG.

Coffee corner The coffee corner is specialised in a quick snack. The coffee corner is situated near the main entrance (8F). Chairs, tables and couches are available. Opposite of the coffee corner there are dispensers for coffee, candy bars, sodas, soup, etc. Paying at these dispensers is only possible with the electronic chipcard 'chipknip'.

Faculty room The faculty room is a place for giving symposia, meetings or graduation parties ("afstudeerborrels"). A reservation can be made at the desk of the education support staff.

Lagerhuysch The Lagerhuysch is situated below ground level in section 8B, with access from the square in front of the faculty. The Lagerhuysch offers the possibility for celebrating graduation parties (afstudeerborrels), but also for organising symposia and meetings. The students associations Gezelschap Leeghwater and William Froude regularly organise activities.
On the site http://www.lagerhuysch.tudelft.nl a route description and a reservation form for the Lagerhuysch can be found.

Auditorium Within the TU Delft auditorium a variety of catering facilities is available. Lunch time is from 11.30 till 13.30, diner time from 16.30 till 19.30. See appendic 6.5 for the location.

Service for Students

4 DUT - Services for students

Delft University of Technology (DUT) provides several service centres for students:
- Student Facility Centre
- Sports Centre
- Cultural Centre 'Mekelweg 10'
- Library

For all other services: refer to the DUT website, http://www.tudelft.nl.

SFC

The Student Facilities Centre (SFC) consists of several departments, which provide a diversity of services to students, staff members and faculties.

Some examples of these services are provision of information concerning:
- Studying abroad
- All possible forms of education at DUT
- Study support and advise
- Housing
- Financial support and sponsoring for students and student associations

Student Facilities Centre Front Office
Julianalaan 134
2628 BL Delft
Postbus 5
2600 AA Delft
Phone: 015 27 88012
http://www.sfc.tudelft.nl

Sports Centre

The Sports Centre provides all kinds of sports activities:
- Indoors, in several halls and gyms, in which almost any kind of sport can be done.
- Courses and trainings organized by professional instructors.
- Outdoors there are 12 tennis courts and (natural) grass fields for playing soccer, hockey, cricket, rugby, baseball and softball. Most of these fields are illuminated during evenings.

It is possible to use the facilities on an individual basis.

Sports Centre
Mekelweg 8
2628 CD Delft
Phone: 015 27 82443
Fax: 015 27 87087
http://www.sc.tudelft.nl

Cultural Centre 'Mekelweg 10'

Anyone who likes to express oneself in an artistic manner can do this is at the Cultural Centre. The activities and courses are aimed at cultural education and at stimulating forms of expression such as: (audio-)visual, communicative, musical and dancing. 'Mekelweg 10' also supports cultural activities of student organisations and members of DUT staff.

The facilities are:
- Design studios
- Several studios for midi and Deejay's
- Darkroom for photography
- Video editing room
- Rehearsal room for musicians

Cultural Centre 'Mekelweg 10'
Mekelweg 10
2628 CM Delft
Phone: 015 27 83988
Fax: 015 27 83946
http://www.cc.tudelft.nl

ICT Infrastructure

Infrastructure services, concerning telephony and ICT facilities are provided by DTO (Technical Support Service). Services concerning students, as described at http://www.dto.tudelft.nl are:

- Internet facilities for student accommodation:
  A number of internet acces facilities for student accommation are offered by the TU Delft.

- OLI:
  OLI is a foundation that supports students, by offering internet facilities, e.g. to support websites. This is possible for all kind of student organisations, like student associations, study associations, student's houses, etc.
  http://www.oli.tudelft.nl

Course descriptions

In general courses are given in English

sc4020	Control Theory (former wb2420)
Lecturer	prof.ir. O.H. Bosgra
Course Material	Friedland,B. Control System Design: An Introduction to State-Space Methods, 1986
Description	Control engineering: basic theory. State space description of linear dynamic systems. Stability theory, frequency domain analysis. Controllability, observability. Loop shaping for dynamic response. Pole assignment, state feedback. Linear observers, Kalman filter. Design and separation principle. LQ regulator and LQG theory. LQ control system design, dynamic compensation. Tracking control, servomechanism design.
Education	Lecture 4/0/0/0 **EC** 6
Assessment	

sc4070	Control systems lab
Lecturer	prof.dr. R. Babuška, Schutter, dr.ir. B. de
Course Material	Åström K.J. and B. Wittenmark Computer Controlled Systems - Theory and Design. 3rd ed. Prentice Hall, 1997. Download material.
Description	In this course, students have the opportunity to design and implement their own controllers for various laboratory systems (helicopter model, inverted pendulum, inverted wedge, rotational pendulum). In this way, they gain more insight in the use of control theory and gain experience with the practical implementation of computer-controlled systems. MATLAB and SIMULINK are used as the basic platform for the design, analysis, simulation and real-time implementation.
Education	0/0/4/0 **EC** 4
Assesment	Laboratory assignment

sc4110	System Identification
Lecturer	dr.ir. X.J.A. Bombois, prof.dr.ir. P.M.J. Van den Hof
Course Material	Lecture Notes System Identification
Description	Experimental modeling of dynamic systems; methodology. Discrete-time signal- and system-analysis. Identification of transfer-functions. Representations of linear models; black-box models. Identification of prediction-error-methods; least squares-method. Approximation modeling; algorithms. Experiment design and data-analysis; closed-loop identification; model validation; Matlab toolbox
Education	Lecture 0/0/4/4 **EC** 5
Assessment	Oral + project

wb1310	**Multibody Dynamics A**
Lecturer	Schwab, dr.ir. A.L., Wisse, ir. M.
Course Material	Lecture Notes
Description	- Applied Dynamics of Mechanical Systems, Multibody System Dynamics. - Modelling Techniques - General Equations of motion of a three dimensional Rigid Body - Constraints in a Multibody System - Solution Techniques for a mixed Differential and Algebraic - System Overview of the available Computer-Oriented Multibody System Dynamics Methods
Education	Lecture 0/0/0/4 **EC** 3
Assessment	Written + lab. report

wb1402a-04	**Plates and Shells A**
Lecturer	Ernst, prof.dr.ir. L.J.
Course Material	Lecture notes Platen en Schalen (in Dutch).
Description	Tensorial description of geometry of surfaces, general nonlinear thin shell theory, simplified shell theories.
Education	Lecture 0/4/2/0 **EC** 5
Assessment	Oral + assignments

wb1405A	**Stability of Thin-walled structures 1**
Lecturer	Keulen, prof.dr.ir. A. van
Course Material	Every student must prepare his own lecture notes. Some handouts will be provided. In addition, references to literature and textbooks will be given during the lectures.
Description	Functional description, General buckling phenomena, Initial post-buckling behaviour, Linear and nonlinear pre-buckling solution, Buckling of discrete systems, Buckling of finite element models, Geometrical stiffness, Geometrically nonlinear finite element analysis, Eigenvalue analysis Sensitivity analysis.
Education	Lecture 0/0/4/2 **EC** 4
Assessment	Oral + assignments

wb1406-5	**Experimental Mechanics**
Lecturer	Ernst, prof.dr.ir. L.J., M.Sc.,Woerkom, dr.ir. P.Th.L.M. van
Course Material	Course notes for Part A Course notes for Part B
Description	- Measurement of static strains and shape changes in structures using strain gages, photo-elastic method, thermo-elasticity, raster techniques, Moiré, holography, and laser-speckle techniques. - Measurement of structural dynamics: properties of materials, viscous damping and structural damping, visco-elastic materials, modal analysis, frequency response, modal parameter identification, identification of frequency transfer functions.
Education	Laboratory experiments 0/0/2/2 **EC** 4
Assessment	Report + oral exam

wb1408A	**Shell Structures - introductory course**
Lecturer	Ernst, prof. ir. L.J.
Course Material	Lecture notes available via Blackboard
Description	Load bearing principles in shell structures; Axi-symmetrical thin shells; Membrane theory versus general theory; Stress categories and life assessment, background of "design by analysis" in engineering codes; Thermo-mechanical loading; Axi-symmetric thick-walled shells; Finite Element applications to local shell problems; Mechanical design aspects of pressure vessels, flares, tube-plates, nozzles, flanges, etc.
Education	Lecture 0/0/4/0 **EC** 5
Assesment	Oral exam

wb1408B	**Shell Structures - advanced course**
Lecturer	Ernst, prof. ir. L.J.
Course Material	Lecture notes. These will become available during next course on Blackboard.
Description	Plates, shells, elasticity, applied mechanics, tensor analysis. Tensorial description of geometry of surfaces, general nonlinear thin shell theory, simplified shell theories.
Education	Lecture 0/4/2/0 **ER** 5
Assesment	Oral exam

wb1409	Theory of Plasticity
Lecturer	Keulen, prof.dr.ir. A.
Course Material	See website
Description	Stress and strain tensors, elastic constitutive equations, linear theory of elasticity, energy principles, energy theorems, stress functions, composite theory, homogenization
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Oral exam + exercises

wb1412	Linear and nonlinear vibrations in mechanical systems
Lecturer	Woerkom, dr.ir. P.Th.L.M. van
Course Material	See website
Description	- Introduction and review of linear vibration theory. - Occurrence and types of linear and nonlinear mechanical vibrations. - Analysis of linear and nonlinear vibrations in discrete mechanical systems. - Suppression of vibrations. - Introduction of nonlinear vibrations in continuum systems.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Written report

wb1413-04	Multibody Dynamics B
Lecturer	Schwab, dr.ir. A.L.
Course Material	Arend L. Schwab, "Applied Multibody Dynamics", Delft, 2003
Description	In this course we will cover a systematic approach to the generation and solution of equations of motion for mechanical systems consisting of multiple interconnected rigid bodies, the so-called Multibody Systems. This course differs from 'Advanced Dynamics', which mostly covers theoretical results about classes of idealized systems (e.g. Hamiltonian systems), in that the goal here is to find the motions of relatively realistic models of systems (including, for example, motors, dissipation and contact constraints).
Education	Lecture 0/0/2/2 **EC** 4
Assesment	Oral

wb1416	Numerical Methods for Dynamics
Lecturer	Rixen, prof. dr. ir D.
Course Material	Lectures notes
Description	engineering dynamics, computational mechanics, finite elements, time-integration, mode superposition, model reduction, linear solvers, eigensolvers
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Oral exam + ANSYS assignment

wb1417-05	Fluid-structure interaction
Lecturer	Rixen, prof. dr. ir D.
Course Material	Lectures notes
Description	structural mechanics, fluid mechanics, biomechanical flows, vibro-acoustics, coupling, finite elements, aeroelasticity, numerical methods, flutter, buffeting, wind-induced vibrations
Education	Lecture 0/0/0/2 **EC** 4
Assessment	Written report + ANSYS assignment

wb1418	Engineering Dynamics
Lecturer	Rixen, prof. dr. ir D.
Course Material	Lectures notes
Description	dynamical systems, solid mechanics, equations of motion, continuous system, discretization, Finite Elements, harmonic response, mechatronics, vibrations
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Oral exam + assignment

wb1419	Engineering Dynamics and Mechanisms
Lecturer	Rixen, prof. dr. ir D.
Course Material	Lectures notes
Description	This course is an extended version of the course Engineering Dynamics. In addition to the topics treated in the Engineering Dynamics course, more time will be spent on the analysis of mechanisms and on other advanced dynamic engineering subjects
Education	Lecture 3/3/0/0 **EC** 4
Assessment	Oral exam + assignment

wb1424atu	Turbulence A
Lecturer	Westerweel, prof.dr.ir. J.
Course Material	Turbulence by F.T.M. Nieuwstadt, Epsilon Publication No. 24, Utrecht (in Dutch); H. Tennekes and J.L. Lumley, A First Course in Turbulence
Description	Turbulence, Stability theory, Chaos, Turbulence models, Turbelent kinetic Energy, Vorticity, Correlation function, Spectrum, Dispersion
Education	Lecture 0/0/2/2 **EC** 6
Assessment	Written

wb1424btu	Turbulence b
Lecturer	Boersma, dr.ir. B.J.
Course Material	
Description	Course in preparation
Education	**EC** 3
Assessment	

wb1427-03	**Advanced Fluid Dynamics A**
Lecturer	Westerweel, prof.dr.ir. J.
Course Material	Lecture notes
Description	Fluid mechanics, Kinematics, Dynamics, Equations of motion, Continuity equation, Stress-Deformation rate relationship, Navier-Stokes equations, Potential theory, Boundary-layer theory, Stokes flow
Education	Lecture 2/2/0/0 + instructions **EC** 5
Assessment	Written

wb1428	**Computational Fluid Dynamics**
Lecturer	Boersma, dr.ir. B.J., Pourquie, dr.ir. M.J.B.M.
Course Material	J.H. Ferziger and M. Peric, Computational methods for Fluid Dynamics, Springer Verlag.
Description	finite volume method, convection-diffusion equation, stability of schemes, conservation laws for flow problems,steady flow, time-dependent flow, turbulence models, turbulent flow, boundary conditions.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Thesis + exercises

wb1429	**Microfluidics**
Lecturer	Lindken, R., Westerweel, prof.dr.ir. J.
Course Material	Fundamentals and Applications of Microfluidics, by Nguyen & Wereley (Artech House, 2002)
Description	fluid mechanics, electrokinetics, microchannels, MEMS, experimental flow characterization, flow control, microflow sensors
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Written

wb1433-04	**Engineering Optimisation: Concept and Applications**
Lecturer	Jansen, dr. ir. K.M.B.
Course Material	Hand-outs and sections from various books
Description	Linear viscoelasticity, creep, stress relaxation and dynamic behaviour, glass transition. Boltzman superposition principle. Time-temperature superposition. Free-volume interpretation. Crosslinking effects. Deformation modes, shear, tensile and bulk compression. Interconversion relations, Kramers-Kronig relations. Laplace transformation. Non-linear viscoelastic models. Experimental methods: shear rheometers, dynamic mechanical devices, resonance devices, bulk modulus measurements. Thermal Expansion measurements. Differential Scanning Calorimetry.
Education	Lecture 0/0/3/0 **EC** 3
Assessment	Oral exam

wb1440	**Engineering Optimisation: Concept and Applications**
Lecturer	Keulen, prof.dr.ir. A. van
Course Material	P.Y. Papalambros et al. Principles of Optimal Design: Modelling and Computation
Description	- Formulation of optimization problems - Typical characteristics of optimization problems - Minimization without constraints - Constrained minimization - Simple optimization algorithms - Discrete design variables - Approximation concepts Sensitivity analysis
Education	Lecture 2/2/0/0 **EC** 3
Assessment	MATLAB exercises

wb1441	**Engineering Optimisation 2**
Lecturer	Keulen, prof.dr.ir. A. van
Course Material	R.T. Haftka and Z. Gürdal: Elements of Structural Optimization
Description	The course is intended as a follow-up course to wb1441. However, the focus is more on the use of numerical models. Aspects that will be presented are: - Optimization techniques, - Sensitivity analysis - Coupling with simulation techniques, - Multi-objective optimization, Multi-disciplinary optimization The course will be organized as a special topics course.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	

wb1442	**Introduction to Microsystems**
Lecturer	Goosen, J.F.L. , Guest lecturers
Course Material	Handouts
Description	This lecture gives and introduction to Microsystems with typical sizes up to 1mm and feature sizes of a few micrometers. Overview of applications such as sensors, actuators, structural components and signal conversion. An overview of manufacture techniques, reliability, modeling, etc. relevant to microsystem design. Furthermore the physics involved in such small systems and how this differs from systems of a more traditional scale.
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Written -/t/ht/-/-

wb1450-05	**Mechanical Analysis for Engineering**
Lecturer	Prof. Daniel J. Rixen, Prof. Fred v. Keulen
Course Material	lecture notes specifcally designed for the course and available through blackboard
Description	The course is designed to give a overview of essential mechanical topics relevant for production techniques, mechatronics and system designers. The main topics that will be handled are: - Vibration analysis of structures (modal analysis, theory/experimental, damping, non-linearities) - basics of rotor dynamics - Multi-physical aspects of models (electrostatic coupling of microstructures, thermo-mechanical coupling, vibro-acoustics) - Static stability of structures (buckling), non-linearities (geometrical/material), visco-elasticity of materials and fracture The course is intended to give an overview of the important phenomena and to give guidelines for further modeling and solving of structural analysis problems.
Education	Lecture 3/3/0/0 **EC** 4
Assesment	Oral exam

wb2301	**System Identification and Parameter Estimation**
Lecturer	Helm, prof.dr. F.C.T. van der
Course Material	See blackboard
Description	Non-parametric system identification based on estimators of spectral densities. Application to open-loop and closed-loop systems. Parameter estimation for linear and non-linear systems
Education	Lecture 0/0/2/2 Assignments **EC** 7
Assessment	Written rapport and oral exam

wb2303	Measurement theory and praxis
Lecturer	Teerhuis, ir. P.C.
Course Material	
Description	Statical and dynamical performance of mechanical measurement systems. Motion and dimensional measurement devices. Force, torque, pressure and temperature measurement devices. Conditioning, transmission and manipulation of measurement data.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Oral

wb2305	Digital Control
Lecturer	Dijkstra, dr. Sj.
Course Material	lecture notes are available as hard copy and on Blackboard
Description	Computer control, sampling of continuous signals, discrete-time systems, disturbance models, state-space design, pole-placement, optimal control, minimum variance control, implementational aspects
Education	Lecture 0/4/0/0 **EC** 3
Assessment	Computer exam -/t/ht/-/-

wb2306	The Human Controller (formerly Cybernetical Ergonomics)
Lecturer	Helm, prof.dr. F.C.T. van der
Course Material	Reader: Cybernetical ergonomics.
Description	Cybernetical ergonomics, sensory organs, motoric system, fysical load, mental load, human operator control, supervisory control, ergonomic design.
Education	Lecture 0/0/0/4 **EC** 3
Assessment	Written -/-/-/t/ht

wb2308	**Biomedical Engineering Design**		
Lecturer **Course Material**	Plettenburg, dr. ir. D.H., Herder, dr.ir. J. reader: "Ontwerpen in de medische techniek" edited by Just L. Herder and Dick H. Plettenburg (partly in Dutch).		
Description	Medical systems design, Diagnosis; Treatments, Orthopaedics, Rehabilitation.		
Education	Lecture 0/2/0/0		**EC** 4
Assessment	Conceprual engineering Design project		

wb2309	**Introduction Man and Machine Systems**		
Lecturer **Course Material**	Wieringa, prof.dr.ir. P.A. and others A report describing the above topics and some general guidance will be available.		
Description	Introduction of the research field and section Man-Machine Systems, its mission and challenges, overview of the research projects, introduction of staff, course and study planning advices		
Education	Lecture 2/0/0/0	Presence is obligatory	**EC** 1
Assessment	Report		

wb2400	**Proces Control**		
Lecturer **Course Material**	Dijkstra, dr. S. – Copies of the powerpoint sheets are available. – The examples for the simulations with explanation, available on Blackboard		
Description	Dynamic control, Real process characteristics, Common control loops, Linear controllers, nonlinear control elements,multiple-loop systems, cascade control, feedforward control, interaction and decoupling, applications.		
Education	Lecture 0/0/2/2		**EC** 3
Assessment	Computer test		

wb2402	Hydraulic Servosystems
Lecturer	Teerhuis, ir. P.C.
Course Material	- "Analysis synthesis and design of hydraulic servo systems and pipelines.", T.J.Viersma. - "Fluid power control.", Blackburn, Reethof and Shearer.
Description	Dynamic behaviour of hydraulic servo systems Design of (low function) servo systems Hydraustatic bearings, hydraulic line dynamics
Education	Lecture 2/2/0/0 **EC** 3
Assessment	

wb2404	Man Machine Systems
Lecturer	Wieringa, prof.dr.ir. P.A.
Course Material	Reader: Man-Machine Systems, Peter A. Wieringa (Blackboard)
Description	Human Operator Models, Operator Supervisory Control, Cognitive Modeling, Task Analsysis, Operator Support Systems, Human Error, Alarm Handling
Education	Lecture 0/4/0/0 **EC** 4
Assessment	Oral

wb2407	Human Movement Control
Lecturer	Helm, prof. dr. F.C.T. van der
Course Material	Reader (in preparation): Human movement control. Scientific papers handed out during the course.
Description	Biomechanics, biophysics, biomedical engineering, human movement control, motion recording, robotics, musculoskeletal systems.
Education	Lecture 0/4/0/0 **EC** 4
Assessment	Oral

wb2408	**Physiological Systems**	
Lecturer	Dankelman, prof.dr. J., Grimbergen, prof.dr.ir. C.A.	
Course Material	lecture notes in Dutch.: J. Dankelman, C.A. Grimbergen, J.A.E. Spaan. Fysiologische Systemen (Physiological Systems)	
Description	Functioning of physiological systems described from an engineering point of view. Subjects are heart, circulation, muscles, lungs, kidneys and nerve system. Modelling, measurement techniques, design of artifical organs.	
Education	Lecture 0/4/0/0	**EC** 3
Assessment	Oral	

wb2413-04	**Instrumentation in the process industry**	
Lecturer	Weiden, dr.ir.A.J.J. van der	
Course Material	Lecture notes	
Description	Design process of a real chemical industrial plant. Process Control and Instumentation. Supply systems and secrurity issues. Distributed proces control and information mangement and alarm systems. Excursions to equipment suppliers, engineering offices and to real plants.	
Education	Lecture 0/0/0/2	**EC** 3
Assessment		

wb2414	**Mechatronical Design**	
Lecturer	Teerhuis, ir. P.C.	
Course Material		
Description	In preparation	
Education	Lecture 2/2/0/0	**EC** 3
Assessment		

wb2415	Robust Control	
Lecturer	Scherer, prof.dr. C.W.	
Course Material	Lecture notes	
Description	- Linear systems - Robust stability and performance analysis - Structured singular values - H-infinity controller synthesis - Robust performance synthesis	
Education	Lecture 0/0/4/0	**EC** 6
Assessment	Written exercises and oral exam	

wb2416	Linear Matrix Inequalities in Control	
Lecturer	Scherer, prof.dr. C.W.	
Course Material	Lecture notes	
Description	- Semi-definite programming (linear matrix inequalities) - Time-varying and non-linear uncertainties - Robust stability and nominal/robust performance analysis - Integral quadratic constraints - LMI controller synthesis - Linear parametrically-varying systems	
Education	Lecture 0/0/0/4	**EC** 6
Assessment	Written and computer exercises	

wb2418	Seminar System and Control Theory	
Lecturer	Scherer, prof.dr. C.W.	
Course Material		
Description	Doel is het bestuderen van een onderwerp in de systeem- en regeltheorie in seminarvorm, met nadruk op recente belangrijke ontwikkelingen in het vakgebied. In het verleden zijn de volgende op boeken gebaseerde thema's behandeld: Optimization by Vector Space Methods (Luenberger, Wiley (1969)) een Constructive Nonlinear Control (Selpuchre, Jankovic, Kokotovic, Springer (1997))	
Education	Seminar 0/0/0/x	**EC** 3
Assessment		

wb2421	**Multivariable Control Systems**
Lecturer **Course Material**	Weiden, dr. ir. A.J.J. van der - Multivariable Feedback Control Analysis and Design. S.Skogestad, I.Postlethwaite. - Lecture notes: The poles and zeros of multivariable systems, A.J.J. van der Weiden.
Description	Single loop feedback design using frequency domain methods. Poles, zeros and stability of multivariable feedback systems. Decoupling for linear as well as nonlinear systems. The robust servomechanism problem for multivariable systems. Nyquist-like multivariable design techniques. Performance and robustness of multivariable systems. The use of singular values for assessing performance; generalization of the classical control theory. Model uncertainties. H-infinity norm, robust stability and robust performance. Specify performance for obtaining an H-infinity controller.
Education	Lecture 0/4/0/0 **EC** 6
Assessment	Oral exam and MATLAB exercise

wb2423	**Introduction project SC**
Lecturer **Course Material**	Teerhuis, ir.P.C., Weiden, dr.ir.A.J.J. van der Lecture notes
Description	In this project the concepts and theory of the basic program concerning Control Systems and Signal Analysis will be reviewed. Implementation issues of e.g. PID controllers via continuous-time techniques on real experimental servo-systems are treated. The laboratory sessions use a digital signal processing controller manufactured by dSPACE. These controllers are programmed via the Simulink block diagram language which is part of the Matlab control system design software. Also an overview of the Msc-course is given and its relation with different underlying basic courses.
Education	**EC** 3
Assessment	

wb2426	**Chemistry and Chemical Plant**
Lecturer **Course Material**	Huesman, ir. A.E.M.
Description	Chemie: Wat is chemie? Periodiek systeem, anorganische en organische chemie, het mol-begrip, reactiekinetiek, chemische thermodynamica, katalyse, stofoverdracht. Chemische fabriek: de fabriek als chemisch proces, reactorkunde, scheidingsprocessen, procesontwerp.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	

wb2427	**Predictive modelling**	
Lecturer	Eijk, prof.dr.ir. J. van	
Course Material	Lecture notes, handed out during lecture	
Description	Mechatronisch ontwerpen, gedrag voorspellend ontwerpen, systeem ontwerp, modelleren, simuleren, dynamisch gedrag, modaal analyse, servo systemen, machine dynamica	
Education	Lecture 0/0/4/0	**EC** 3
Assessment	Written	

wb2428	**Principles of Mechanical Constructions**	
Lecturer	Langen, dr.ir. H.H., Pistecky, ir. P.V.	
Course Material	Handed out during lecture	
Description	Mechatronisch ontwerpen, mechanisch, constructies, stijfheid, kinematica, mechanismen, ontwerpen, systeem ontwerp, finite element modelling, dynamisch gedrag,	
Education	Lecture 2/2/0/0	**EC** 4
Assessment	Written	

wb2430	**Mechatronics Project (follow up)**	
Lecturer	Spronck ir. J.W., Teerhuis ir.P.C.	
Course Material	Available at the lab	
Description	mechatronic, dynamics, system design, control, predictive modelling, construction, sensor, actuator	
Education	Lecture x/x/0/0	**EC** 9
Assessment	Written report	

wb2431	**Bone Mechanics and Implants**	
Lecturer	Linden, mw. J. van der, Valstar, dr.ir. E.R.	
Course Material	Slides and lecture notes on blackboard	
Description	See website	
Education	Lecture 0/2/2/0	**EC** 3
Assessment	Oral	

wb2432	**Bio Mechatronics**	
Lecturer	Prof.dr. F.C.T. van der Helm, dr.ir. D.H. Plettenburg, dr.ir. J.L. Herder	
Course Material	A reader is available through Blackboard	
Description	Medical Technology, Biomechanics, Human motion control, Orthosis, Prosthesis, Orthopaedics, Neurology, Rehabilitation engineering, Biomedical Engineering	
Education	Lecture 0/0/2/2	**EC** 4
Assessment	Final assignment	

wb2433	**Humanoid Robots**	
Lecturer	M. Wisse, R.Q. van der Linde, P. Jonker, P. van Lith, M. Verhaegen	
Course Material	Reader	
Description	Humanoid robots are the research topic of the future, and partially already today. This course is organized around the central problem in humanoid robot design; they must operate fully autonomously. This results in design constraints such as energy efficiency and autonomous control.	
Education	Lecture 2/0/0/0	**EC** 3
Assessment	Oral	

wb2435-03	**Surgical Instruments and Medical Safety**
Lecturer	Dankelman, mw. prof.dr. J.
Course Material	Lecture notes
Description	Surgical instruments and their specific requirements. Quality of surgical tools. Advances and disadvantages of minimally invasive surgery (keyhole operations). Possibilities and problems of using robotic systems. Safety issues in the operation room. Task analysis of the surgical process. Training of surgeons.
Education	Lecture 2/0/0/0 **EC** 2
Assessment	Oral exam

wb2436-05	**Bio-inspired Design**
Lecturer	Dr.ir. P Breedveld, Dr.ir. J.L. Herder, Prof.dr. T. Tomiyama
Course Material	Handouts
Description	The course Bio-Inspired Design gives an overview of non-conventional mechanical approaches in nature and shows how this knowledge can lead to more creativity in mechanical design and to better (simpler, smaller, more robust) solutions than with conventional technology. The course discusses a large number of biological organisms with smart constructions, unusual mechanisms or clever processing methods and gives a number of technical examples of bio-inspired instruments and machines.
Education	Lecture 0/0/4/0 **EC 3**
Assesment	Written report

wb3404A	**Vehice Dynamics A**
Lecturer	Vries, ir. E.J.H. de
Course Material	Lecture notes: Voertuigdynamica A
Description	Automobile: truck, trailer, motorcycle, dynamics, vibrations, comfort, (non-)lineair, stability, frequency response, handling, crosswind, tyre.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Oral exam + exercises

wb3404A	Vehice Dynamics A	
Lecturer	Vries, ir. E.J.H. de	
Course Material	Lecture notes: Voertuigdynamica B	
Description	Automobile, truck, motorcycle, airplane landing gear, dynamics, vibrations, handling stability, tyre, modelling, steady-state and dynamic tyre response, complex vehicle modelling.	
Education	Lecture 0/0/2/2	**EC** 3
Assessment	Written assignments	

wb3410-03	Large Scale Transportsystems	
Lecturer	Rijsenbrij, prof.ir. J.C.	
Course Material	Inauguration speech, 2008 and globalisation	
Description	Subject of this course are mondial cargo flows in the non-bulk area, the so called general cargo. This course concentrates on the phenomenon container transport, a spectacular logistical break-through in the sixties of the last century. Initially the container was succesful for sea transportation, but more and more intermodal developments will also control the long distance land transportation. Technological development, social economical consequences and particularly the role of container transport in the process of globalisation of the industrial production will be discussed.	
Education	Lecture 0/0/2/2	**EC** 3
Assessment	Written	

wb3415-03	Course Adams	
Lecturer	Verheul, ir. C.H.	
Course Material	MSC.ADAMS Starters Course Manual (MSC Software)	
Description	Mechanical systems, dynamics, kinematics, statics, Multi body systems, transport systems, crane dynamics, design process, virtual prototyping	
Education	Instruction 16/16/0/0	**EC** 3
Assessment	Computer test	

wb3416-03	**Design with Finite Elements**
Lecturer	Bos, ir. W. van den
Course Material	Lecture "Ontwerpen met eindige elementen" (DUTCH/ English will be available soon)
Description	FEM Finite element method, CAE Computer Aided Engineering, Structural Engineering Transport technology, Cranes, Mechanics, Design Rules, Structural Integrity
Education	Practical 0/0/0/2 **EC** 3
Assessment	Written Report

wb3417-03	**Discrete Systems: Modeling, Prototyping, Simulation and Control**
Lecturer	Dr. Ir. J.A. Ottjes, Ir. H.P.M. Veeke, Ir. F.P.M. Sopers, Ir. M.B. Duinkerken
Course Material	A text book (in preparation), hand outs, recent publications in the subject area and a Web site: www.tomasweb.com
Description	Modeling, discrete simulation, process, logistics, production, transport
Education	Lecture 2/2/0/0 **EC** 4
Assessment	Written test + practical

wb3418	**Introduction to Pro-Engineer**
Lecturer	Knoester, ing. J.
Course Material	Introduction to Pro-Engineer, Training guide for release 2001 / PTC. Fundamentals of drawing, Training guide for release 2001 / PTC.
Description	Computer Aided Design, Solid Modelling, Parametric Design,
Education	Lecture **EC** 2
Assessment	Assignment **??**

wb3419-03	**Characterisation and Handling of Bulk Solid Materials**
Lecturer	Prof.dr.ir. G. Lodewijks
Course Material	A lecture book (in preparation) and book "Introduction to Particle Technology" by Martin Rhodes, John Wiley & Sons, ISBN 0-471-98482-5, 2000.
Description	This course focuses on the characterisation of the mechanical and dynamical behaviour of bulk solid materials. Bulk solid materials include coal, sand, limestone etc. These materials can be free flowing through bunkers and chutes as well as stored in silos, handled by stackers and reclaimers or transported by conveyors. Experimental ways to determine the mechanical properties of bulk solid materials will be discussed. An experimental assignment to determine these properties of a particular bulk solid material is part of the course. With the experimentally determined properties the behaviour of this material in a silo (no flow or mass flow versus funnel flow) is predicted. A small-scale silo in the laboratory is used to verify this prediction. Knowing the properties of a specific bulk solid material, the effect of these properties on the design of handling or transporting equipment can be determined. Conceptually designing a piece of equipment for storing, handling or transporting a bulk solid material, of which the mechanical properties are determined experimentally earlier in this course, concludes the course.
Education	Lecture 2/2/0/0 **EC** 6
Assessment	Report of experimental and design assignment and oral examination.

wb3420-03	**Introduction Transport and Logistic Engineering**
Lecturer	Lodewijks,prof.dr.ir. G., Rijsenbrij, prof.ir.J.C.
Course Material	
Description	Transport sytems. Logistics. Importance for the economy. Basic models. Multimodal transportation. Terminals. Equipment. Belt conveyors. Dynamic characteristics. Containers. Load units. Logistic chains. Production and distribution. Service systems. Inventory models. Decision analysis. Mechanisation and automation.
Education	Lecture 0/0/0/0 **EC** 5
Assessment	

wb3421-03	**Automatisation and control transportsystem**
Lecturer	Lodewijks,prof.dr.ir. G., Rijsenbrij, prof.ir.J.C.
Course Material	
Description	Automation, control, conveyor systems, data acquisition, data mining, data analysis and communication
Education	Lecture 0/0/0/0 **EC** 5
Assessment	

wb3421-03	**Automation and Control of Transport and Production Systems**
Lecturer	Prof.dr.ir. G. Lodewijks, Dr.ir. H.P.M. Veeke
Course Material	Lecture book
Description	This course focuses on the automation and control of modern transport systems. Automation is often necessary to increase the capacity or to reduce operating costs of transport systems on one hand while maintaining a sufficient level of operational accuracy on the other hand. Automation requires full control of a transport system and its equipment and a throughout understanding of the transport process and the dynamics of the transport equipment involved. In this course the automation of a number of typical transport systems will be studied. Basis of this course is a study of the dynamics of the transport process and the transport equipment. In an automated transport system data communication is important to ensure reliable performance. In this respect equipment and process monitoring is important as well. Therefore data acquisition, mining, analysis and transfer will be discussed in detail. The course is concluded by a practical assignment where the control of transport equipment used in an automated transport system will be studied.
Education	Lecture 0/0/2/2 **EC** 5
Assessment	Oral

wb3423-04	**Modelling of Industrial Systems**
Lecturer	Veeke, dr.ir. H.P.M.
Course Material	Book: "Analyse van organisatieproblemen", J. in 't Veld (partly available in English) Lecture notes: "A Systems Approach for Industrial System Design" , Veeke
Description	Modelling of industrial systems includes both function models for static structures and time-dependent behaviour modelling. A fundamental approach leads to the steady state model and the control paradigm. For multi-aspect modelling the PROPER model will be explained and applied to the field of logistics. Modelling of the design process itself with a clear distinction between interdisciplinary function design and monodisciplinary process design.Informal behaviour modelling.Verification and validation of models for situations where no real system exists yet.
Education	Lecture 2/0/0/0 **EC** 2
Assessment	Written exam

wb3424-04	Production Organisation Principles
Lecturer	Veeke, dr.ir. H.P.M.
Course Material	Lecture notes
Description	This course focuses on production organisation structures. Between the extreme structures of flow shop and job shop there is a continuum of other structures. Characteristics and practical selection criteria for each specific structure are explained. The relation between notions like effectiveness, productivity and flexibility are studied. Control principles are highlighted by the distinction between function control (e.g. planning) and process control (e.g. scheduling, feed back, feed forward). The use of simulation in control functions is explained. Finally decision support for project planning is explained by classical approaches like CPM and PERT, but also by new approaches using simulation.
Education	Lecture 0/2/0/0 **EC** 2
Assessment	Written exam

wb4300B	Introduction to pumps and compressors
Lecturer	Infante Ferreirra, dr.ir. C.A.
Course Material	Touber, S., "Pompen en compressoren", collegedictaat, Faculteit 3mE, TUD, 1996. O'Neill, P. A., "Industrial compressors", Butterworth-Heinemann Ltd, Oxford, 1993.
Description	Introduction to pumps and compressors. Pumps. Types. Definitions. Centrifugal and positive displacement pumps. Compressors. Thermodynamic principles. Positive displacement compressors: reciprocating, helical screw, rolling piston, rotary vane and scroll compressors. Roots-blowers and liquid ring compressors. Radial turbocompressors.
Education	Lecture 0/0/2/0 **EC** 2
Assessment	Written

wb4302	Thermodynamics of energy conversion
Lecturer	Woudstra, ir. N.
Course Material	Thermodynamica voor energiesystemen. J.J.C. van Lier, N. Woudstra. Absorption chillers and heat pumps. K.E. Herold, R. Radermacher, S.A. Klein.
Description	thermodynamics, energy conversion, exergy analysis, chemical exergy, exergy efficiency, value diagram, fuel combustion, heat exchange, turbine, compressor, conventional power station, gas turbine processes, combined cycle systems, combined heat and power, fuel cell systems, refrigerators, heat pumps, absorption cycles
Education	Lecture 4/0/0/0 **EC** 4
Assessment	Written

wb4402	**Project Engineering in the Processindustries**
Lecturer	Dhillon, prof.dr. J.S., Paijens, ir. A.F.M.
Course Material	Slide Hand-outs
Description	Process Flow Diagram, piping an instrumentation diagram, equipment location and elevation drawings, isometric piping drawing, lay-out, safety, mechanical engineering, utilities, authority engineering, electrical engineering, processcontrol.
Education	Lecture 2/2/0/0 **EC** 6
Assessment	Design assignment

wb4403	**Design of Separation Equipment**
Lecturer	Olujic, dr. Z.
Course Material	Z. Olujic; Introduction to the Design of Equilibrium Separation Processes (3mE 1994) O.S.L. Bruinsma, J de Graauw; Inleiding in de industriële kristallisatie - (3mE 1992)
Description	Basic principles and design methods for equipment used in equilibrium stage separation processes, such as distillation, absorption, stripping (desorption), extraction and crystallization, and in mechanical separation processes, such as sedimentation, filtration, etc.
Education	Lecture 0/0/4/0 **EC** 3
Assessment	Written + assignments

wb4405	**Fuel Conversion**
Lecturer	Jaap, dr.ing. W. de
Course Material	Handouts
Description	Combustion, gasification, coal, oil, gases, alternative Solid fuels, reserves, combustion calculations, flame-stability, ignition aspects, flame front, large scale boilers, Emission control, advanced gas-solid separation techniques, measurement techniques, modeling aspects of basic thermochemical reactors
Education	Lecture 0/2/2/0 **EC** 3
Assessment	Written

wb4408A	Diesel Engines A
Lecturer	Stapersma, prof. D. MSc. FIMarE
Course Material	D. Stapersma, "Diesel engines I", "Diesel engines annex: thermodynamic & chemical principles" , "Diesel engines II"
Description	Thermodynamic principles, performance, Seiliger process, air swallow capacity, turbocharging, matching of turbocharger, off-design performance
Education	Lecture 0/0/4/0 **EC** 4
Assessment	Exercises + discussion

wb4408B	Diesel Engines B
Lecturer	Stapersma, prof. D. MSc. FIMarE
Course Material	D. Stapersma, "Diesel engines IV", "Diesel engines annex: thermodynamic & chemical principles" , "Diesel engines V"
Description	fuels, fuel treatment, fuel properties, ignition, combustion mechanisms, measurement of combustion heat release, heat transfer, gas velocities in cylinder, emissions, air pollution
Education	Lecture 0/0/0/4 **EC** 4
Assessment	Oral exam

wb4410A	Refrigeration Fundamentals
Lecturer	Infante Ferreira, dr.ir. C.A.
Course Material	Arora, C. P., "Refrigeration and air conditioning", Brodowicz, K. en T. Dyakowski, "Heat pumps", Cerepnalkovski, I. "Modern refrigerating machines"
Description	Refrigeration fundamentals. Historical overview. Ozone and global warming issues, the Total Equivalent Warming Impact. Overview/comparison of refrigeration and heat pump systems. Mechanical vapour compression, gas cycle (expansion) machines, thermo-electric cooling, absorption refrigerating machines, primary and secondary working fluids. Control. Latest developments in refrigerating technology.
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Written

wb4416	**Nuclear Engineering**
Lecturer	Verkooijen, prof.dr.ir. A.H.M.
Course Material	R.A. Knief, Nuclear Engineering
Description	Introduction to nuclear power. Introduction nuclear physics, reactor kinetics and reactor control. Description of the various reactor types and future trends. Reactor safety and safety analysis. Reactor cooling during normal operation and accidents. Reactor materials. Three Miles Island and Chernobyl accidents. Economics of nuclear power.
Education	Lecture 0/0/4/0 **EC 3**
Assesment	Written

wb4417	**Mechanical and Hydraulic Design Proces Equipment**
Lecturer	Paijens, ir. A.F.M.
Course Material	Chemical Engineering volume 6 "Design", Coulson & Richardson. R.K. Sinnot, Second Edition, 1993, Pergamon Press, ISBN 0-08-041866x
Description	Membraan- en buigspanningen in schaalelementen, spanningen en vervormingen van kolommen, warmtewisselaars en pijpleidingen. Doorstroming van pijpleidingen en apparaten. Axiale menging. Design codes.
Education	Lecture 0/2/0/0 **EC** 3
Assessment	Design assigment

wb4418	**Gas- and oil processing offshore**
Lecturer	Olujic, dr. Z.
Course Material	Bound course material consisting of chapters written by persons involved with the course, edited by Z. Olujic
Description	The course consists of a number of modules covering all process design aspects of gas and liquid processing offshore: high pressure thermodynamics of multicomponent mixtures, gas hydrate forming and prevention, multiphase production and transport, gas/liquid separation, pumps and compressors, auxiliary systems, platform layout, safety considerations, most recent offshore technology developments.
Education	Lecture 0/0/2/2 **EC** 4
Assessment	Design assignments

wb4420	Gas Turbines
Lecturer	Buijtenen, prof.ir. J.P. van, various guests
Course Material	C.J. Houtman, W.P.J. Visser - GASTURBINES (1999) Hand-outs
Description	Ideeal Brayton-process, real gas turbine process; stationary gas turbines and aero engines; performance calculation; optimalisation of various cycle variants; gas turbine types and applications; turbo-machinery; gas turbine-components: compressor, combustion chamber, turbine, jet pipe; emissions; characteristics and control.
Education	Lecture 2/2/0/0 Practical **EC** 3
Assessment	Written

wb4421	Gas Turbine Simulation & Application
Lecturer	Visser, ir.W.P.J., Buijtenen, prof.ir. J.P. van
Course Material	C.J.Houtman, Gasturbines B (reader)
Description	Gas turbine, performance calculation, part load performance, simulation, compressor, gaspad analysis, condition monitoring. Aircraft engines, maintenance, high temperature materials, various applications, case-studies.
Education	Lecture 0/0/2/2 **EC** 3
Assessment	Assignment

wb4422	Thermal Power Plants
Lecturer	Prof.dr.ing. H. Spliethoff
Course Material	Copies of the slides on the internet For some chapters a manuscript will be available at the end of 2002
Description	energy sources, thermal power plants, thermodynamics, exergy, energy, cost-effectiveness, process schemes, optimalisation, steam boilers, turbines, pumps, condensors, steam, combustion, circulation, stability, heat transfer, radiation, convection, materials
Education	Lecture 0/0/4/0 **EC** 4
Assessment	Written

wb4423-03	**Dynamic Modeling and Simulation of Energy Conversion Systems**
Lecturer	Colonna, dr.ir. P.
Course Material	Power Point presentations, notes from lectures.
Description	Physical modeling of dynamic systems, Simulation, Laws of conservation, Lumped parameters models, Causality, Energy conversion systems, Thermodynamics, Heat Transfer, Fluid Dynamics, Ordinary Differential Equations, Numerical Analysis, Modularity, Linearization, Process components, Power plant, Cogeneration, Trigeneration, Fluid Properties, Simulation software, Real time Simulation, Model validation, Simulators.
Education	Lecture 0/0/0/4 **EC** 4
Assessment	Oral and written report

wb4424	**Indoor Climate Control Design**
Lecturer	Paassen, prof.dr.ir. A.H.C. van
Course Material	Lecture notes wb4413 "Indoor Climate Control B, Control of Air Conditioning installations".
Description	Finned tube heat exchangers, apparatus for combined heat and water vapour transfer, cooling towers. Dust extraction from gases, air filters, clean rooms, operating theaters. Fans. Noise pollution from fans through air ducts. Ventilation of industrial and recreational rooms. Control of air conditioning installations. Description of control system, climate, building, installation. Energy saving control strategy. Building automation.
Education	Lecture 0/0/2/2 **EC** 4
Assessment	Oral

wb4425	**Fuel Cell Systems**
Lecturer	Woudstra, ir. N.
Course Material	Fuel Cell Systems Explained. James Larminie, Andrew Dicks, John Wiley & Sons, LTD, 1999, ISBN 0-471-49026-1
Description	Electrochemical power production, open circuit voltage and reversible voltage, efficiencies, fuel cell irreversibilities, activation losses, tafel equation, ohmic losses, concentration losses, Proton Exchange Membrane Fuel Cells (PEMFC), Molten Carbonate Fuel Cell (MCFC), Solid Oxide Fuel Cell (SOFC), stack design, system layout, external and internal reforming.
Education	Self study **EC** 2
Assessment	Oral

wb4426	**Indoor Climate Control Fundamentals**
Lecturer	Paassen, prof.dr.ir. A.H.C. van
Course Material	Indoor Climate A (wb4412) Calculation of heating, cooling load and temperature exceeding.
Description	Introduction indoor climate; Mollier diagram of humid air, thermal comfort, outdoor climate as disturbing factor, calculation of heating and cooling load, simulation models of thermal behaviour of buildings. Installations and their capacities, ducts for air transport, air movement in confined spaces (simple calculations and computer fluid dynamics programs).
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Oral

wb4427	**Refrigeration Technology and Applications**
Lecturer	Infante Ferreira, dr.ir. C.A.
Course Material	See website
Description	Refrigeration Technology and Applications. Characteristics of refrigeration systems. Compressors, condensers, expansion devices, evaporators, absorbers, generators, total compression refrigeration / heat pump systems. Managing frozen foods: safety in the cold chain, freezing and storing of frozen foods products.
Education	Lecture 0/0/2/2 **EC** 4
Assessment	Oral

wb4429-03	**Thermodynamics of mixtures**
Lecturer	Jong, dr.ir. W. de
Course Material	J.M.Smith & H.C. Van Ness, Introduction to Chemical Engineering Thermodynamics, 6th ed, McGraw-Hill Book Company
Description	The course deals with calculation of heat capacity and heat- and Gibbs energy of reaction data, and equations of state necessary for the calculation of thermodynamic quantities. Also, an important aspect is the estimation of thermodynamic data, using for example the corresponding states principle and group contribution methods. Non ideal behaviour of pure substances and mixtures whereby properties of the chemical potential, fugacity and activity is described in detail. Chemical reaction equilibrium calculation methods are explained.
Education	lecture 0/0/4/0 **EC** 3
Assesment	Oral

wb5400	Tribology and precision engineering
Lecturer	dr.ir. A. van Beek
Course Material	Beek, A. van, "Machine lifetime performance and reliability", 432 pp., first edition 2004, available at Leeghwater
Description	friction, wear, material selection, lubricants, failure analysis, lifetime performance, reliability.
Education	Lecture 2/2/2/0 (on appointment) **EC** 4
Assesment	Written report

wb5414-03	Design of machines and mechanisms
Lecturer	Werff, prof.dr.ir. K. van der, Tomiyama, prof.dr. T., Herder, dr.ir. J.L.
Course Material	lecture notes wb5414, appropriate literature, software programs
Description	Introduction, definitions of mechanization, machines and mechanisms. Examples of mechanisms in machines. Function modeling, generating concepts Design methods Design process of production machines. Determination of the machine task. Diagram of motion, diagram of goal functions. Available mechanism types. Type- and dimension synthesis of mechanisms.
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Written Report

wb5430-05	Engineering Informatics
Lecturer	Prof.dr. T. Tomiyama
Course Material	Benny Raphael, Ian F. C. Smith, Fundamentals of Computer Aided Engineering, ISBN: 0-471-48715-5, (2003), Wiley & Sons.
Description	The aims of this course are twofold. One is to give fundamental knowledge about computer systems including both hardware and software. The other is to give theoretical foundations behind computer-based engineering tools and systems which play an increasingly important role in mechanical engineering. The course comprises of lectures in a classroom and practices in the form of homework. It emphasizes homework (mostly programming) that will be included in the final evaluation. While any preference is given to a particular programming language, basic programming capabilities are needed.
Education	Lecture 0/4/0/0 **EC 3**
Assesment	Oral exam

vervangt wb5431-04

wb5431-05	**Life Cycle Engineering**
Lecturer	Prof.dr. T. Tomiyama
Course Material	Powerpoint presentations. A copy of the presentaiton will be available through the Blackboard. Any other handouts. Recommended Book: T.E. Graedel and B.R. Allenby: Industrial Ecology (2nd Edition), Pearson Education, Inc., New Jearsey (2003), ISBN 0-13-046713-8 (€58 at Amazon)
Description	This course deals with fundamentals and technology of life cycle engineering that require a systematic and holistic approaches to product life cycles, rather than just end-of-pipe technologies.
Education	Lecture 0/0/0/4 **EC** 3
Assesment	Oral exam

wb5434-05	**Micro-assembly, packaging and test**
Lecturer	Tichem, dr.ir. M.
Course Material	Reader, handout (presentations)
Description	Micro-products and (hybrid) MEMS, micro-assembly, packaging, reliability and test.
Education	lecture 0/0/4/0 **EC** 3
Assesment	Written exam

wb5435-05	**Machine Intelligence**
Lecturer	Prof.dr. T. Tomiyama
Course Material	Benny Raphael, Ian F. C. Smith, Fundamentals of Computer Aided Engineering, ISBN: 0-471-48715-5, (2003), Wiley & Sons. Handouts; Other references will be specified during the course or obtainable from the blackboard.
Description	This course firstly gives an introduction to computational aspects of intelligent systems, in particular, artificial intelligence, logic, and knowledge based systems. These techniques form symbolic computing techniques for advanced reasoning and embedded intelligence. Secondly, the course discusses some soft computing techniques that have been hinted or inspired by biological phenomena or other physical phenomena, such as fuzzy logic, genetic algorithm, simulated annealing, and artificial neural networks. Thirdly, the course illustrates some techniques for intelligent systems to deal with real world applications. The course will not only describe theoretical aspects but also depict applications of these technique to intelligent systems and engineering.
Education	Lecture 0/0/4/0 **EC** 3
Assesment	Written exam

wbp202	**Haptic System Design**	
Lecturer	J.L.Herder, R.Q. van der Linde e.a.	
Course Material	Reader; Blackboard, Website: http://mms.tudelft.nl/staff/herder/haptics.htm	
Description	Haptics, master-slave, control, manipulator, mechanical design, parallel mechanisms, psychophysics	
Education	Assignment	**EC** 4
Assessment	Written report	

Appendices

6.1 Course and Examination Regulations

Section 1 GENERAL

Article 1 SCOPE AND APPLICABILITY OF THESE REGULATIONS

1. These regulations are applicable to teaching and examinations of the Master's degree programme Mechanical Engineering at Delft University of Technology, hereafter referred to as the programme.
2. These programmes are conducted under the responsibility of the Faculty of Mechanical Engineering and Marine Technology at Delft University of Technology, hereafter referred to as the Faculty.
3. For this programme, implementation procedures are in effect that supplement, and are integral to, these Course and Examination Regulations.
4. The Course and Examination Regulations and the implementation procedures are laid down by the Dean.

Article 2 DEFINITIONS

Any terms in these regulations also occurring in the Higher Education and Academic Research Act (WHW) will have the same meaning as that intended by that Act.
In these regulations, the following terms shall be understood as follows:

a. the Act: the Higher Education and Academic Research Act (abbreviated in Dutch to WHW), including its subsequent amendments;
b. programme: the Master's degree programme referred to in Article 7.3a, subsection 1 under b of the Act;
c. student: anyone enrolled at Delft University of Technology (as a student or "extraneus") for purposes of education and/or for taking the examinations and interim examinations that are part of the programme;
d. practical training: practical exercise as referred to in Article 7.13, subsection 2 under d of the Act, in one of the following forms:
   - writing a thesis;
   - writing a paper/completing an assignment, project or technological design;
   - completing a design or research assignment;
   - conducting literature study;
   - completing a work placement;
   - taking part in fieldwork or an excursion;
   - conducting tests and experiments;
   - or participating in another educational activity focused on the attainment of a particular skill.
e. interim examination: a test of a student's knowledge, insight and skills with regard to a particular unit of study, and the assessment of this examination by at least one examiner appointed for that task by the board of examiners.
h. examination: test used by the board of examiners to establish whether all interim

		examinations and tests that are part of the study programme have been successfully completed as specified in Article 7.10 of the Act.
i.	board of examiners:	the board of examiners as appointed according to Article 7.12 of the Act.
j.	implementation procedures:	the implementation procedures integral to the Course and Examination Regulations and applicable to a specific Master's programme.
k.	working day:	each day from Monday to Friday, with the exclusion of official national holidays.
l.	course calendar:	the publication containing all the specific information appropriate to a specific Master's course guide named in Article 1.
m.	examiner:	those appointed by the board of examiners for the purpose of taking interim examinations in accordance with Article 7.12 of the Act;
n.	EC:	European Credits as specified in the European Credit Transfer System
o.	The University:	Delft University of Technology

Article 3 OBJECTIVE OF THE MASTER PROGRAMME MECHANICAL ENGINEERING

The goal of the master programme Mechanical Engineering is to educate graduates in Mechanical Engineering to an academic engineering level. The level corresponds to the technological borders of a specific discipline. The graduates are capable:

- To identify, define and analyse problems, for the solution to which mechanical-engineering principles and techniques can contribute
- To develop and to produce a sound solution to the problem
- To present these solutions effectively

Article 4 ADMISSION TO THE MASTER'S PROGRAMME

1. Admission to this programme will be granted to students in possession of a degree issued for the Bachelor's programme in Mechanical Engineering and Aerospace Engineering issued by the Delft University of Technology, Technische Universiteit Eindhoven, University of Twente or one of the universities of the IDEA-league.
2. Students who are not graduates of one of the courses specified in paragraph 1 but who are in possession of a confirmation of admission provided by the Faculty will be eligible for admission.
3. To obtain confirmation of admission, a student must satisfy the criteria specified in paragraph 1.4 of the study guide.
4. If so requested by a student who is not in possession of a Bachelor's degree as specified in paragraph 1, the board of examiners may depart from paragraph 1 by allowing that student to attend parts of the Master's programme.

Article 5 FINAL QUALIFICATIONS OF THE MASTER PROGRAMME MECHANICAL ENGINEERING

The graduated Master of Mechanical Engineering meets, to a sufficient level, the following qualifications:

1. Broad and profound knowledge of engineering sciences (applied physics and mathematics) and the capability to apply this knowledge at an advanced level in the variant-related discipline.
2. Broad and profound scientific and technical knowledge of the variant-related discipline and the skills to use this knowledge effectively. The discipline is mastered at different levels of abstraction, including a reflective understanding of its structure and relations to other fields, and reaching in part the forefront

of scientific or industrial research and development. The knowledge is the basis for innovative contributions to the discipline in the form of new designs or development of new knowledge.

3. Thorough knowledge of paradigms, methods and tools as well as the skills to actively apply this knowledge for analysing, modelling, simulating, designing and performing research with respect to innovative variant-related systems, with an appreciation of different application areas.
4. Capability to independently solve technological problems in a systematic way involving problem analysis, formulating sub-problems and providing innovative technical solutions, also in new and unfamiliar situations. This includes a professional attitude towards identifying and acquiring lacking expertise, monitoring and critically evaluating existing knowledge, planning and executing research, adapting to changing circumstances, and integrating new knowledge with an appreciation of its ambiguity, incompleteness and limitations.
5. Capability to work both independently and in multidisciplinary teams, interacting effectively with specialists and taking initiatives where necessary.
6. Capability to effectively communicate (including presenting and reporting) about one's work such as solutions to problems, conclusions, knowledge and considerations, to both professionals and non-specialised public in the English language.
7. Capability to evaluate and assess the technological, ethical and societal impact of one's work, and to take responsibility with regard to sustainability, economy and social welfare.
8. Attitude to independently maintain professional competence through life-long learning.

Article 6 FULL-TIME AND PART-TIME COURSE FORMAT

The Master's programme will be provided on a full-time basis.

Article 7 LANGUAGE

1. English shall be the language used for all teaching and examinations.
2. In certain cases, the Dean may depart from paragraph 1 by giving permission for teaching to take place in Dutch, if this is necessitated either by the specific nature of the organisation, the quality of the course, or the students' origins and backgrounds.
3. If a student asks to be allowed to take one component, or several components, of an examination in a language other than English, the terms of the regulations and the guidelines of the board of examiners will be applicable accordingly.

Section 2 COMPOSITION OF THE MASTER'S PROGRAMME AND THE FINAL EXAMINATION

Article 8

1. The composition of the educational programme is laid down in the implementation procedures. This educational programme starts once a year, in September.
2. The examination for a Master's Degree is an integral part of the programme. The study load for this examination totals 120 EC.

Section 3 INTERIM EXAMINATIONS

Article 9 THE NUMBER, PERIOD AND FREQUENCY OF INTERIM EXAMINATIONS

1.a. The course shall provide at least two opportunities per year to sit interim examinations:
- the first shall follow immediately after the teaching period in which the relevant component was taught and completed;
- the second shall be given at the end of the second semester, or otherwise in the August resit period.

1.b. The interim examinations referred to under a. shall be held as indicated for the unit of study concerned in the timetable for the current academic year. At the beginning of each academic year, a timetable specifying the dates and times of written interim examinations shall be drawn up and published.

2. In the event that a course component is not taught within the Faculty itself, and therefore there is no indication of the number of times it is possible to sit an interim examination as referred to in paragraph 1, the course and examination regulations of the relevant Faculty or degree programme will be applicable, provided no decision to the contrary has been taken by the board of examiners.

3. Notwithstanding the provisions of the first clause under 1a, at least one opportunity shall be given per year to take an interim examination in a course component that has not been taught in that year.

4. In certain cases the board of examiners may allow departures from the specified number of times that an interim examination can be sat.

Article 10 THE ORDER OF INTERIM EXAMINATIONS

The implementation procedures shall specify the order in which the interim examinations will be taken, or in which students be to participate in practical training.

Article 11 THE PERIOD OF VALIDITY OF INTERIM EXAMINATIONS

1. Students who have interrupted their studies, or who have delayed their studies for other reasons, shall resit any component they passed ten years or more ago if its contents have since been modified.

2. The board of examiners may, in a student's favour, depart from the provisions of paragraph 1.

Article 12 THE FORM OF THE INTERIM EXAMINATIONS, AND THE METHOD OF TESTING

1. Per year, the form in which each interim examination is to be taken shall be specified in the study guide for the actual course year under the unit of study concerned.

2. If no specification is made of the way in which an interim examination can be taken, because that examination applies to a unit of study that is not taught within the Faculty, and because it involves a unit of study that is not specific to students taking part in a programme administered by the Faculty of Mechanical Engineering and Marine Technology, the relevant conditions in the Course and Examination Regulations for that unit of study shall be applicable. Each year, the board of examiners under which the interim examination falls shall determine the way in which the interim examination is to be taken.

3. The appointed examiner may depart from the provisions of paragraphs 1 and 2 in a student's favour.

4. Each student with a physical or sensory disability shall be given the opportunity to take all interim examinations and practical training in a way that, to the greatest possible extent, is adapted to the disability in question. Under this facility, the form or length of the interim examinations shall be adapted to the individual situation, or practical aids shall be made available.
5. The facilities specified in the previous paragraph should be requested from the board of examiners by the student concerned. This request should be accompanied by a medical certificate issued no more than one year previously by a doctor, psychologist or student counsellor. All requests involving dyslexia should be backed by a recognised dyslexia testing body.

Article 13 ORAL INTERIM EXAMINATIONS

1. Unless otherwise determined by the board of examiners, no oral interim examination shall involve more than a single student at the same time.
2. All oral interim examinations be public, unless, in exceptional circumstances, the board of examiners or the individual examiner decide otherwise, or if the student has submitted an objection.

Article 14 THE ESTABLISHMENT AND NOTIFICATION OF RESULTS

1. Immediately after taking an oral interim examination, the examiner shall announce the result, and issue the student with the relevant written notification.
2. As soon as possible after a written interim examination, and always within a maximum of 15 working days, the examiner shall declare the results. The examiner shall provide the Faculty's student administration office with the necessary details. Paying all due attention to the privacy of individual students, the student administration office shall take responsibility for the registration, publication and reporting of the results within 20 working days of the interim examination.
3. If an interim examination is taken neither in writing nor orally, but in another form, the board of examiners shall decide in advance on the way in which students will be notified of the results, and of the period within which this will occur.
4. When students be provided with written notification of the results of an interim examination, it shall at all times be made clear that they have the right to inspect the relevant examination documents (as defined in Article 15), and that they have the right to appeal to the examination appeals board.

Article 15 CANDIDATES' RIGHT TO INSPECT THEIR EXAMINATION DOCUMENTS

1. For at least one month after the results of a written examination have been announced, it shall be possible for students to inspect their examination and its assessment. At the student's request, he/she will be provided with a copy of the relevant work at cost price.
2. During the period specified in paragraph 1, it is possible for all interested parties to inspect the questions and assignments of the relevant interim examination, and also the norms whereby assessment took place. Upon request a copy of this information shall be provided at cost price.
3. The board of examiners may specify that inspection of examination documents will take place at a predetermined place at no fewer than two predetermined times. The place and dates shall be stated on the list of results. If a student can demonstrate that, due to forces beyond his or her control, it was impossible to be present at the predetermined place and time, a new opportunity shall be provided; if possible, this shall fall within the period specified in paragraph 1.

Article 16 OPTIONS FOR DISCUSSING THE RESULTS OF AN INTERIM EXAMINATION

1. As soon as possible after the results of an interim examination have been announced, student or examiner may take an initiative towards discussing the examination, and to explaining its assessment.
2. For a period of one month, starting on the day following the announcement of the results, a student who has taken a written interim examination may apply to the relevant examiner to discuss the work in question. This discussion shall follow at a place and time specified by the examiner, and always within a reasonable period.
3. If, for whatever reason, the board of examiners organises a collective discussion after an interim examination, there be only two cases in which a student may submit a request of the type specified in the previous paragraph: either a. by being present at the collective discussion and by simultaneously providing the motives for the request; or b. when, due to circumstances beyond his or her control, it was impossible to attend the collective discussion.
4. The conditions of the previous paragraph shall also apply if the board of examiners or the examiner provides the student with an opportunity to compare his or her answers with standard answers.
5. The board of examiners may allow deviations from the stipulations of paragraphs 3 and 4.

Section 4 EXEMPTION FROM INTERIM EXAMINATIONS

Article 17 EXEMPTION FROM INTERIM EXAMINATIONS OR PRACTICAL EXERCISE

1. The board of examiners can grant students exemption from one or more interim examinations or practical exercises, if they have satisfied the examiners either with regard to earlier interim examinations, or with regard to Higher Education examinations, or with regard to knowledge and skills acquired outside higher education. However, this is possible only if they satisfy at least one of the following conditions:
   a. the interim examination involved a unit of study that, in terms of content and study load, was equivalent to a comparable university course in the Netherlands or beyond, or at an institute of professional education (i.e. HBO institute / hogeschool) in the Netherlands.
   b. the student can provide proof of knowledge or experience acquired either during a course provided somewhere other than at a Dutch institute of professional education, or otherwise during activities conducted in another context.
2. If the relevant examiner has made a fully motivated proposal to this effect, the board of examiners may grant exemption from an interim examination.

Section 5 THE MASTER'S EXAMINATIONS

Article 18 PERIODS AND FREQUENCY OF EXAMINATIONS

1. An opportunity to take the Master's examination shall be provided no less than twice a year. In a meeting held before the start of the academic year, the board of examiners shall establish the dates on which the examinations be to be held. These shall be published in the study guide for the programme and year in question.

2. All students can apply to take the examinations as soon as they have fulfilled the conditions of their course, and have provided the student administration office with proof of the course components they have passed.

Article 19 REPORTING ON STUDENTS' PROGRESS

1. At least once a year, each student shall be sent a written report on the progress he or she has made over the preceding period.
2. The report referred to in paragraph 1 shall be composed according to the guidelines established by the Executive Board.
3. The Dean shall be responsible for supervising the progress of all students enrolled on the course. Such supervision shall include an assessment of the options for study that be available to students, both inside the programme and beyond it.

Section 6 PROVISIONS FOR IMPLEMENTATION

Article 20 MODIFICATION OF THE REGULATIONS

1. These regulations may be modified in a special decision by the Dean.
2. No decision shall be made in respect of the current academic year, unless, by all reasonable definitions, it is unlikely to damage the interests of students.
3. No change in the regulations may negatively affect a previous decision made by the board of examiners in respect of a student.

Article 21 TRANSITIONAL RULING

1. In the event that the composition of a teaching programme is modified, or that one of the Articles of the Course and Examination Regulations is changed, the Dean shall decide on a transitional ruling, which shall then be published in the implementation procedures.
2. In all cases, this transitional ruling shall incorporate the following:
   a. a ruling on the exemptions that be available on the basis of interim examinations that a student has already passed,
   b. the number of times that it is still possible to sit for interim examinations under the conditions of the old programme,
   c. the period for which the transitional ruling will be valid.

Article 22 PUBLICATION OF THE TRANSITIONAL RULING

1. The Dean shall take responsibility for publicising the following in an appropriate fashion: the transitional ruling defined in Article 21, and the implementation procedures and the changes to it.
2. The Course and Examination Regulations and the implementation procedures for each course shall be incorporated in the study guide.

Article 23 DATE OF COMMENCEMENT

These regulations shall come into force on 1 September 2005.

6.2 Implementation Procedures

for the teaching and examination regulations appropriate to the Master's programme Mechanical Engineering

Article 1 COURSE CALENDAR

The course calendar for the programme can be found in the Study Guide for the Master's degree programme Mechanical Engineering.

Article 2 COMPOSITION OF THE PROGRAMME

The composition of the Master's degree programme Mechanical Engineering, including number of credit points, assessment, entrance requirements per unit of study is described in the Study Guide.

Article 3 COMPOSING FLEXIBLE STUDY PROGRAMMES

1. Students may themselves compose an individual study programme that will lead to an examination. This programme must consist, either in full or for the greater part, of units of study which be taught on the course they be attending, and may be supplemented with units taught on other courses or at other universities.
2. Each student desiring to compose a programme of the sort referred to in paragraph 1 shall submit his or her own proposal, motivating it in full, for the approval of the relevant board of examiners, i.e. at the beginning of the Master's programme.

Article 4 PROCEDURE FOR APPROVING FLEXIBLE STUDY PROGRAMMME

1. No less than two months before they intend to start on a flexible study programme, all students must submit their proposals for their choices of one or more units of study (as referred to in Article 3) for approval by the board of examiners. Each proposal must be accompanied by a clearly argued motivation.
2. Any decision not to approve the proposal shall be motivated by the board of examiners after the student in question has been given the opportunity of a hearing.
3. The board of examiners shall decide within twenty working days of receiving the application, or, if the application is submitted during an academic holiday, no more than ten working days after this holiday has ended.
4. The board of examiners can adjourn its decision for no more than ten working days. The student shall be given written notification of such adjournment within the twenty-working-day period referred to in the first sentence of paragraph 3. The student shall receive written notification of the decision without delay.

Article 5 THE ORDER OF INTERIM EXAMINATIONS AND ASSIGNMENTS

The order in which the interim examinations will be taken, assignments shall be fulfilled or in which students be to participate in practical training, is laid down by means of entrance requirements, specified in the description of the contents of the programme in the Study Guide.

Article 6 MASTER'S THESIS

1. The programme is concluded by fulfilling a final assignment and presenting a Master's thesis.
2. The Master's thesis is assessed by an examining committee, assigned by the board of examiners.
3. The student applying for the Master's examination has to defend his thesis before the examining committee mentioned sub 2.

Article 7 VARIANTS AND ANNOTATIONS

1. The Mechanical Engineering MSc-programme is provided in 6 variants:
   - Transportation Engineering
   - Control Engineering
   - Sustainable Process & Energy Technology
   - Production, Mechatronics & Microsystems
   - Biomechanical Design
   - Solid & Fluid Mechanics

2. As an addition to the variant programme there are three annotations. After completing such an annotation, the student acquires a supplement to the MSc-degree, which declares a more than average knwoledge about that subject. These annotations are:
   - Technology in Sustainable Development.
   - Technical Marketing
3. Further details and requirements be laid down in the study guide.

Article 8 PARTICIPATION IN THE PROJECT "TU DELFT HELPS REDUCE THE SHORTAGE OF TEACHERS"

Within the framework of the project "TU Delft helps reduce the shortage of teachers in Dutch pre-university education", students can take part in the course "TU Delft/Teachers for schools". This course comprises two parts, a preparatory course and a supervision phase. The total course leads to the award of 9 EC, which should be allocated within the elective subjects.

Laid down by the Dean of the Faculty Mechanical, Maritime & Materials Engineering, after the approval of the Faculty's Student Council, and after considering the recommendations provided by the education committee on june 2005.

6.3 Regulations and guidelines for the board of examiners

Article 1 SCOPE OF THE REGULATIONS

These regulations and guidelines are applicable to the teaching of, and examinations for, the Master's degree programme in Mechanical Engineering, hereafter referred to as the programme.

Article 2 DEFINITIONS

1 When used in these regulations and guidelines, the term Course and Examination Regulations (CER), refers to the current course and examination regulations as intended under Article 7.12 of the Higher Education and Academic Research Act (abbreviated in Dutch as WHW):
2 All other terms occurring in these Regulations will have the same meaning as that intended in the CER and the WHW.

Article 3 DAY-TO-DAY ADMINISTRATION

The board of examiners consists of the lecturers who are engaged in the educational programme and mentioned as such in the curricula, described in section 1.5 of the study guide. The board of examiners shall appoint a chair and a secretary from its members. The chair shall be responsible for the day-to-day management of the committee.

Article 4 MASTER'S EXAMINING COMMITTEE

1. The board of examiners appoints a Master's examining committee for the assessment of each Master's thesis.
2. A master's examining committee consists of no less than three members.
3. The professor in charge is chairman of the committee.
4. No less than one member belongs to the scientific staff of the section responsible for the specialisation concerned; no less than one member belongs to the scientific staff of a different section of Delft University of Technology.
5. The committee can be completed by experts from outside the University.

Article 5 ENTRY FOR INTERIM EXAMINATIONS

1 Students shall apply for interim examinations at the Faculty's Department of Educational and Student Affairs by entering data in the examination application system, or, if the system is not in use, by completing and submitting a form made available by the Department of Educational and Student Affairs. Whatever the means of application, all submissions must be received no less than ten working days before the interim examination.
2 In exceptional cases, the board of examiners can depart from the application period defined in paragraphs 1 and 4 of this Article, provided that this departure is in the favour of the student concerned.
3 Admission to the interim examination will be granted solely to those students who are registered on the list of applicants produced by the examination application system (or by any alternative system currently in force).

4 If, in their opinion, students have not been able to apply for an interim examination due to events beyond their control, they shall apply to the board of examiners no less than two full working days before the day for which the examination is planned. By submitting a declaration of demonstrable force majeure written or issued by, or on behalf of, the board of examiners, the student may be allowed to sit the relevant examination.

Article 6 ORDER DURING AN INTERIM EXAMINATION

1 With regard to written interim examinations, the board of examiners and/or the appointed examiner shall be responsible for appointing invigilators who, on behalf of and under the authority of the board of examiners will ensure that the examination runs smoothly.

2 If asked by, or on behalf of, the board of examiners, all candidates shall identify themselves by showing their campus card.

3 Candidates shall observe all instructions that have been published before the start of the examination by the board of examiners, or by the examiner or invigilator. They shall also follow instructions given during the examination and immediately after it has finished.

4 If a candidate fails to fulfil the conditions of the paragraphs 2 and 3 of this Article, the board of examiners or the appointed examiner can exclude him or her from further participation in the interim examination. The consequence of such exclusion is that no result is established for the examination in question. Before taking such a decision, the board of examiners shall offer the student concerned an opportunity to state his or her case.

5 The time allotted for each interim examination shall, by all reasonable standards, be long enough to allow candidates sufficient time to answer its questions.

6 When the interim examination has finished, candidates may keep the assignment papers. The exception to this rule concerns examinations in which questions and answers must be handed in together.

7 Candidates may not enter the examination room until the invigilator gives permission.

8 No candidates are admitted into the examination room no later than half an hour after the official start of the examination.

9 Candidates are not allowed to leave the examination room within the first half hour following the official start of the examination. After this time, permission to leave the room temporarily will be given only in urgent cases. No more than any one candidate may be absent at the same time.

10 Under no circumstances my items such as briefcases, bags and mobile telephones be used or handled in the examination room.

11 Although candidates are responsible for bringing their own calculators and their own writing and drawing materials, the faculty will provide answer sheets and scrap paper.

12 In the event that a certain examination requires students to use calculators, these calculators may at no time be able to exceed the maximum capabilities specified by the examiner for that subject. In general, programmable calculating equipment is not allowed. (Generally examination assignments should be formulated such that they can be carried out with a simple calculator; at no times should candidates with more complex calculators have an advantage.)

13 Candidates may not write their answers in pencil, unless the lecturer has given prior permission for this.

14 During the interim examination, candidates may not consult books, readers, etc., unless the lecturer has given prior permission for this.

15 If an invigilator catches a candidate or candidates cheating, the procedure described in Article 6, paragraph 2 of these regulations will be applicable.

16 Before permanently leaving the examination room (i.e. no less than 30 minutes after the start of the interim examination), candidates must, at minimum, submit the front page of the answer sheet. This must bear their name and student number.

17 Before the interim examination begins, the invigilator shall instruct the candidates on the procedure they must follow if they leave the examination room without completing all the examination assignments.

18 Students who believe they may qualify for examination in a different form, should, as specified in Article 12 paragraphs 4 and 5 of the CER[1], submit a fully motivated request for this to the chair of the board of examiners.

Article 7 CHEATING

1 Cheating is defined as any act committed by a student for the purpose of making it partly or wholly impossible to make a correct assessment of his or her knowledge, insight and skills.

2 If a student is found to be cheating as defined in paragraph 1 of this Article, the board of examiners can decide to exclude him from the interim examination in question.

3 The decision to exclude a student as defined in paragraph 2 of this Article shall be taken on the basis of the invigilator's report of the cheating.

4 In urgent cases, the invigilator is entitled to act on behalf of the board of examiners by immediately excluding the student or students concerned. The board of examiners shall ensure that, immediately after the interim examination, the report defined in paragraph 3 of this Article is made in writing; and that a copy is issued to the student or students concerned.

5 Within 20 days of his or her exclusion, such a student may appeal to the board of examiners to reverse their decision. To this appeal, the student will attach a copy of the report defined in paragraph 4 of this Article; this may also be accompanied by the student's own written testimony.

6 Before deciding on an appeal of the sort defined in paragraph 5 of this Article, the board of examiners shall give both student and examiner the opportunity of a hearing.

7 The board of examiners will decide on any reversal of the original decision within 30 working days of receiving the student's appeal.

8 The consequence of exclusion is that no examination result will be recorded for the interim examination intended under paragraph 2 of this Article.

9 In the event of cheating, the board of examiners can decide, conditionally or unconditionally, to exclude the student from all further interim examinations for a maximum period of one year.

Article 8 CRITERIA

When taking the decisions that are integral to their duties, the board of examiners and, where appropriate, the examiner, shall be guided by the criteria stated below. When these criteria conflict, the board shall carefully weigh the interests of allowing one criterion to prevail over another. At all times, these standards must ensure that the following conditions are met:

a that the criteria regarding quality and selection inherent to an interim examination are maintained;

b that the need for efficiency is met, particularly by limiting to a minimum any time loss that would hinder those students whose preparations for examinations and interim examinations are running to schedule;

[1] Course and Examination Regulations

c that students who wish to assume too great a study load should be protected from themselves;
d that clemency should be shown in all cases in which students' progress is slowed by circumstances beyond their control.

Article 9 QUESTIONS AND ASSIGNMENTS

1 The scope of an interim examination, and the sources upon which it is based, shall be announced no less than a month before that examination takes place. No questions or assignments in the examination may go beyond the scope of these sources. At the beginning of the course it should be clear what study material (books, lecture notes) will be used during the course.
2 To the greatest possible extent, the questions and assignments of each interim examination shall be evenly distributed over the material being examined.
3 Both in content and form, each interim examination shall represent the learning objectives stated.
4 All questions and assignments shall be clear and explicit. It should also be clear how many credits a question or assignment contributes to the total score of the examination.
5 Well in advance of each interim examination, the board of examiners or the examiner shall announce the form of examination and method of testing as meant under Article 12 of the CER.
6 Well in advance of each written interim examination, the board of examiners or the examiner shall provide an opportunity whereby students intending to participate in it can examine a similar test on the same subject, together with sample answers and the norms that would be applied during its assessment.

Article 10 ASSESSMENT

1 The assessment of an interim examination is expressed in whole numbers on a scale from 1 to 10, with 6 signifying a pass. If desired, practical training can also be assessed as a "pass" or a "fail". All exemptions for a subject are treated as a 6, i.e. a pass.
2 Students pass their Master's examinations by satisfying the examiners in each component of the Master's programme. Students awarded a 5 in a single subject excepting the thesis project will also qualify for the award of their Master's degree.
3 Per subject, the highest mark awarded for an interim exam will be recorded on the examination certificate.

Article 11 THE ESTABLISHMENT OF EXAMINATION RESULTS[2]

1 The votes of the board of examiners shall be established by a simple majority of votes.
2 If the votes are equally divided, the chair of the board of examiners shall have the casting vote, unless the vote takes place in writing.
3 If, in a written vote, the votes are equally divided, there shall be a second ballot. If this, too, leads to an equal division of votes, the proposal being balloted shall be rejected.

Article 12 CUM LAUDE

1 At the discretion of the board of examiners, a candidate for the Master's degree can receive the designation "cum laude" if he or she meets the following conditions:

[2] For the period within which students shall be notified of the results of interim examinations, see Article 14 of the Course and Examination Regulations (CER) for the Master's degree programmes.

a the mark awarded to the components specified in the Master's examination implementation procedures, excluding the mark awarded for the Master's thesis project, shall average no less than 7,5 in a list that contains no marks below 6;
b the candidate concerned shall have completed the Master's degree programme in no more than three years;
c the mark awarded for the thesis project shall be no less than 9;
d the examiner of the graduation assignment shall have submitted a proposal for the award of "cum laude".

2 When establishing the elapsed study time referred to in paragraph 1 subsection b of this Article, all due account should be taken of any delays caused by circumstances qualifying the candidate for support under the "Regeling Financiële Ondersteuning Studenten" (RFOS)

3 At all times, the board of examiners has the authority to decide on awarding the designation "cum laude" in cases that fall outside the provisions defined above.

Article 13 MASTER'S DEGREE CERTIFICATES AND STATEMENTS

1 To establish that a candidate has satisfied the examiners in the Master's examinations, the board of examiners shall issue a degree certificate. This shall be signed by the chair and the secretary to the board of examiners.

2 a The degree certificate as intended under paragraph 1 shall list the specific components of the examination, and, where appropriate, the competencies associated with them.
b The degree certificate shall be accompanied by marks lists in both Dutch and English.

3 If a candidate's performance during the examinations testifies to exceptional abilities, the board of examiners can, under the conditions stated in Article 11 of these Regulations, decide to grant the designation "cum laude" on the degree certificate.

4 Any student who has successfully completed more than one interim examination and to whom, upon his or her leaving the university, a degree certificate as intended in paragraph 1 of this Article cannot be awarded, shall, upon his or her request, receive a statement from the board of examiners in question.

Article 14 PROCEDURE FOR APPROVAL

1 Any student wishing to submit a request as intended under Article 7.3 paragraph 4 of the WHW (i.e. with regard to a flexible study programme) should do so on a timely basis, ensuring that, by all reasonable definitions, there is time for approval to be given before he or she takes the first interim examination. In this, he or she should take full account of the period within which the board of examiners is entitled to decide (see Article 14, paragraph 1). The request shall be accompanied by a clearly argued motivation, and, if necessary, by material that supports it.

2 Students shall submit to the board of examiners any requests for exemption from an interim examination or practical exercise as intended under Article 17 of the CER. The board of examiners shall decide on this after taking advice from the student counsellor. The periods within which decisions shall be taken are defined in Article 14, paragraph 2 of these Regulations and Guidelines.

3 If a student wishes to depart from the teaching programme prescribed in the implementation procedures, he or she shall submit a request to this effect, ensuring that, by all reasonable definitions, there is time for approval to be given before the date of the first interim examination that deviates from that programme. In this, full account should be taken of the period within which the board of examiners is entitled to decide (see Article 13, paragraph 1).

4 A decision to withhold approval for a request of the type intended under paragraphs 1, 3 and 4 of this Article must be fully motivated by the Board of Examiners, and may only be made after the student has been given the opportunity of a hearing, where the student may call upon the assistance of the student counsellor.

5 The student will immediately be informed in writing of a decision on any of the matters intended under paragraphs 1, 2, 3 and 4 of this Article. If the board of examiners concerned has not made a decision during the time period prescribed in article 14, paragraph 1, or otherwise during the period of adjournment, approval will be understood to have been granted.

Article 15 TIME PERIODS

1 A decision on a request such as those described in Article 13, paragraph 1 or 4 shall be made within 40 working days of its receipt; or, if the request was submitted either during an academic holiday or within a period of three weeks before the start of an academic holiday, it shall be made within a period of 40 working days after the end of the holiday. The board of examiners may adjourn a decision for no more than 10 working days. The student will be notified in writing of any such adjournment before the end of the 40-day period specified in the first sentence of this paragraph.

2 The provisions of the previous paragraph will also be applicable to requests such as those described in Article 13 paragraph 3, on the understanding that the time period will start from the moment that the recommendations of the student counsellor have been submitted. The student counsellor shall submit these recommendations to the board of examiners no more than 10 working days after receiving the student's request.

Article 16 RIGHT OF APPEAL

Within four weeks of the event in question, students can appeal to the examinations appeals board against the following: a ruling by the board of examiners, a ruling by an examiner, or their treatment during an examination as defined in Article 7.60 WHW.

Article 17 MODIFICATION OF THESE REGULATIONS AND GUIDELINES

No decision shall be made in respect of the current academic year, unless, by all reasonable definitions, it is unlikely to damage the interests of students.

Article 18 DATE OF COMMENCEMENT

These regulations will come into effect on 1 September 2005.

Approved by the board of examiners of the Master's programme in Mechanical Engineering.

6.4 Lecturers

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For other phone numbers the student can call the universal TU number (015 27 89111) or the reception of the faculty (015 27 86666)

[1] Phone numbers in full are 015-27…..or +31-15-27... when calling from abroad

[2] API: Leeghwaterstraat 44, 2628 CA Delft
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ITS-et: Mekelweg 4, 2628CD Delft
LR: Kluyverweg 1, 2629 HS Delft
TBM: Jaffalaan 5, 2628 BX Delft
TNW: Lorentzweg 1, 2628 CJ Delft
3mE: Mekelweg 2, 2628CD Delft

6.5 Campus Map

Legend Campus map

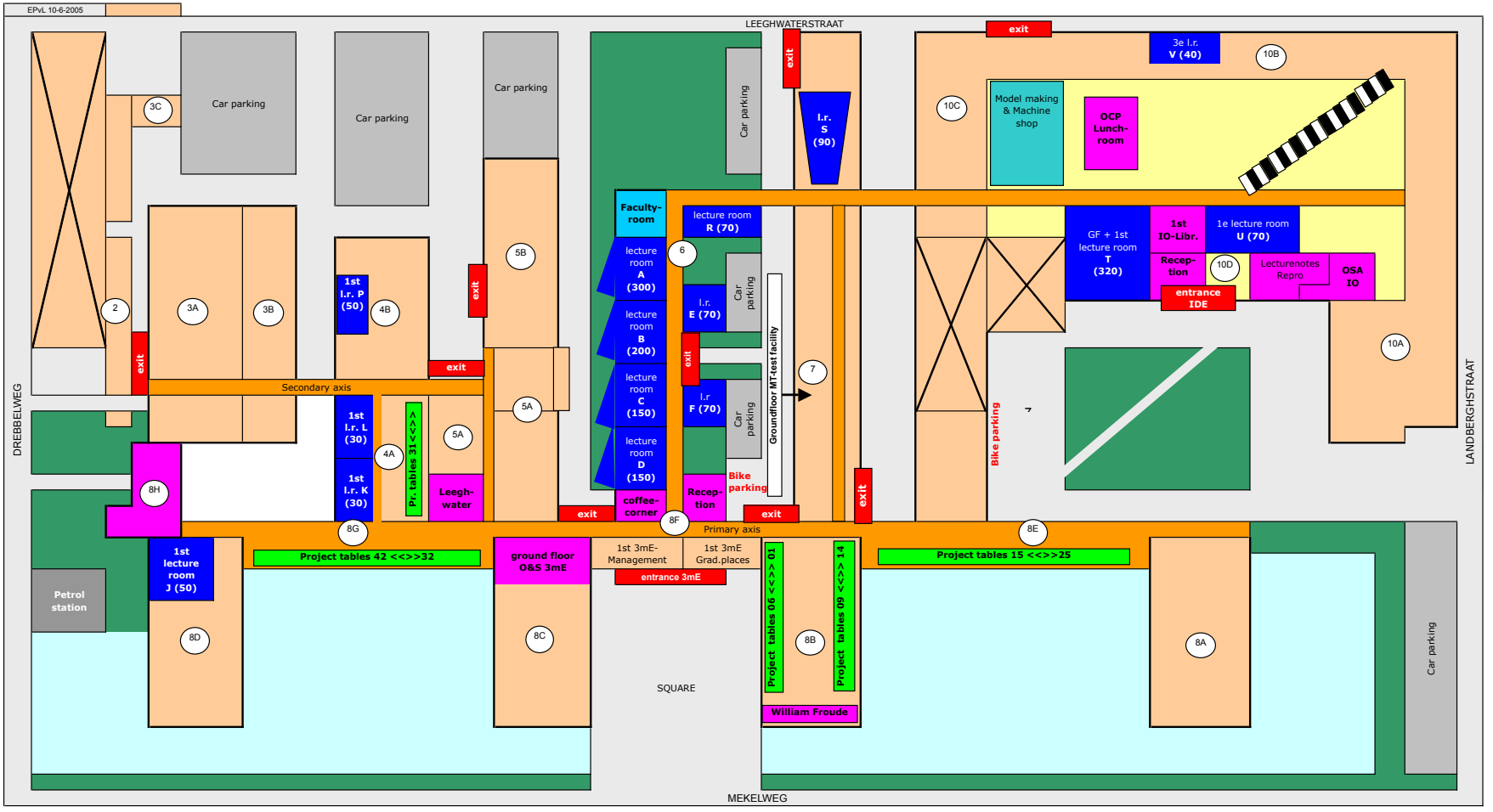
3	Faculty Applied Earth Sciences	36	Faculty Electrical Engineering, Media and Knowledge technology, Technical Computer Science and Technical Mathematics
5	Faculty Life Science and Technology, Botanical Garden	34	Faculty Mechanical Engineering and Maritime Technology, Board of Governors, Staff Board of Governors, TopTech Courses
6	VSSD	37	Sports center
7	Alumni Desk, Facilitating Service	38	Cultural Center 'Mekelweg 10', Studium Generale
10	Master of Science International Programme	40	Faculty Technical Material Sciences
12	Faculty Chemical Technology	41	Service Technical Support
20	Auditorium, Congress center, University foundations Delft, TU Shop	43	Energy and Building Management
21	Library TU Delft, Delft University Press	45	Doc Vision Support Center Delft
22	Faculty Technical Physics	46	Machinery design for the process industry
23	Faculty Civil Technology, Management center for International Cooperation	52	Faculty Geodesy
24	Faculty Architecture	60	Logistics and Milieu Services
31	Faculty Technical Management Science	62	Faculty Aerospace Engineering
32	Faculty Industrial Design		

A description and the exact adresses of all the numbers can be found on the homepage of the TU Delft. In this table are only the numbers published which are of interest for the student of the MSc course Mechanical Engineering or Marine Technology.

All lecture schedules are available

on the campussite of 3mE

http://campus.3me.tudelft.nl



3A	3mE Dep. Materials Science & Engineering (from june 2006)
3B	3mE Dep. Materials Science & Engineering (from june 2006)
3C	3mE Formula Student, NUNA, etc.
4A gf	3mE Mechanical Engineering design studio's and BSc project tables
4A 1st	3mE Labs Mechatronics + PC-rooms
5A	3mE Dep. Precision Micro-systems Engineering
5A	3mE Dep. Delft Center for Systems & Control
5B	3mE Dep. Proces & Energy
6	3mE Lecture rooms A - F + R + Faculty room
7 gf	3mE Marine & Transport Technology (Test Facility)
7 1st	3mE Marine & Transport Technology (Marine Technology)
8B gf	3mE BSc Project tables + William Froude
8B 1st	3mE Marine & Transport Technology
8B 2nd	3mE Dep. Precision Micro-systems Engineering
8B 3rd	3mE Dep. Precision Micro-systems Engineering
8B 4th	3mE Dep. Precision Micro-systems Engineering
8C gf	3mE Offices O&S and M&C
8C 1st	3mE Dep. Biomedical Engineering
8C 2nd	3mE Dep. Delft Center for Systems & Control
8C 3e	3mE Dep. Delft Center for Systems & Control
8C 4e	3mE Dep. Delft Center for Systems & Control
8D gf	3mE Graduation places
8D 1st	3mE Dep. Materials Science & Engineering (from june 2006)
8D 2nd	3mE Dep. Materials Science & Engineering (from june 2006)
8D 3rd	3mE Dep. Materials Science & Engineering (from june 2006)
8D 4th	3mE Dep. Materials Science & Engineering (from june 2006)
8E	3mE BSc project tables
8F bg	Reception WbMT
8F 1st	3mE management + graduation places
8G	3mE BSc project tables
8H	TUD University Board
10A bg	IDE PC-clusters
10A 1e	IDE Design Studio's DE
10A 2e	IDE Design Studio's + lab. DE
10A 3e	IDE DE
10A 4e	IDE DE
10B bg	PMB Welding Shop + ware house
10B 1e	IDE Design Studio's
10B 2e	IDE labs ID
10B 3e	IDE ID
10B 4e	IDE ID + PIM + study advisor + FM
10C bg	IDE Modelmaking & Machine Shop
10C 1e	IDE Photographer + AV-supplies
10D bg	IDE recept. + O&S + Copy Shop
10D 1e	IDE Library