ME - Guide

Master 2003 - 2004

ME - Guide

Study guide Master programme Mechanical Engineering

Colophon

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Preface

The ME-guide is the primary information source for all existing and future MSc-students Mechanical Engineering.
The guide has the same lay out as the previous course year. Some changes have been made:

- The study load for each course is no longer given in Dutch study points but in European Credits (EC). These credits are in line with the European Credit Transfer System (ECTS), which is used within the European Union in all higher education. One EC equals 28 hours of study, whereas the previous Dutch study point equalled 40 hours. The study load of one course year has been unchanged: 1680 hours. Consequently one course year equals 60 EC. The learning goals and contents of the different courses were not affected by ECTS. However because the study load is given as an integer number of EC, the nominal number of study hours may have changed marginally.

- The admission to the study programme has been enlarged. It is now possible for Bachelors of Science with a degree in Mechanical Engineering, Applied Physics, Aerospace Engineering, Civil Engineering, Industrial Design Engineering or Marine Technology to get entrance to the study programme. Also bachelors of a polytechnic high school with a relevant diploma can get entrance through a pre master programme.

- Course schedules have been included, so that all information for study planning can be found in the guide. It is no longer necessary to consult other documents to find the location, semester period and lecturing hours of a course.

Much care has been given to publish correct information in this guide. Nevertheless sometimes it may be necessary to adapt course information or scheduling. In such a case the most up to date information can be found on the website http://www.wbmt.tudelft.nl

The editors of this guide wish all students a pleasant and successful study year.

prof. J. 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 educational programme Mechanical Engineering is to educate Mechanical Engineers (MSc), who have the following qualities:

- Broad and deep knowledge of the basic engineering sciences
- Broad basic technical and scientific knowledge of the Mechanical Engineering disciplines: production, transport, process technology, energy conversion, and mechatronics
- Specialized in at least one Mechanical Engineering discipline
- Ability to innovate, model and design systems and equipment
- Ability to contribute to solving multidisciplinary problems by means of a systematic approach, analysis and synthesis and to work both in multidisciplinary teams and independently in an international industrial context
- Ability to communicate effectively with team members and environment
- Ethical conduct, taking responsibility with regard to sustainability, economy and social welfare
- Ability to maintain professional competence trough life-long-learning

1.2 Educational Concept and Assessment

The study programme involves two years of study, each with a study load of 60 EC (European credits). The total programme involves 120 EC.
Based on the choice of variant and specialization the master programme involves two major parts:

Lecture courses (50-70 EC)
These courses are divided in three parts:
- Compulsory part per variant (approximately 20 EC)
- Compulsory part for the chosen specialization (approximately 15 EC)
- Elective part (at least 15 EC)

For each variant and specialization these parts are described in paragraph 1.5.
The general rules for the courses within these parts are as follows:
- At least 6 EC society oriented courses
- At least 9 EC mathematics, physics or other fundamental mechanical engineering courses.
- The student can select at least 15 EC of courses at his own interest, in consultation with the lecturer responsible for the chosen specialization. For each variant an overview of recommended courses may be given.
  Most courses are assessed by means of an oral or written examination.

Assignments (50-70 EC)
The assignments take place mainly in the second study year of the MSc-programme. In general the assignments are carried out individually.

The assignments may involve:
- Internship in industry or a project task defined in consultation with an external party (industry, research institute, etc.) of 15 EC.
  In case the MSc-thesis is performed in cooperation with and at the office of an external party this part of the programme may be combined with the MSc-thesis.
- Literature study
- Laboratory exercise
- MSc-Thesis (35-60 EC)

The assignments are assessed, based on a written report.
The MSc-Thesis is the final assignment in the MSc-programme. The student prepares a written report about his research or design task, performed in the assignment.
After the report has been submitted the final examination will be held. In advance of this so-called 'Ingenieurs-Examination' the student presents his work in a colloquium. The examination is held with at least three scientific staff members including the thesis supervisor. The committee may also include external examiners from industry or a research institute.
In paragraph 1.5 the requirements for assignments are specified for each variant and specialization.

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. This is a result of the European Credit Transfer System (ECTS), which encourages acknowledgement of study results between higher education institutions within the European Union. The study load for one study year is 60 EC. These EC give an indication of the weight of a certain part of the course. One EC involves approximately 28 hours of study. These 28 hours include all time spent on the course: lectures, self study, internship, assignments, examinations, etc.

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, however the master's programme can also be entered after completing a BSc-programme of a polytechnic high school or the Royal Netherlands Naval College (KIM).
Admission to the MSc-programme is described in the following three subsections.

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 Technical University (Delft, Eindhoven or Twente) or a Technical 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, the student is conditionally admitted to the MSc-programme. It is then possible to compose a final list of courses for approval by the board of examiners. Final admittance is granted after completing the BSc-programme.
In advance to admittance to the MSc-programme, a BSc-student may obtain approval to take part in examinations of a few MSc-courses. The student has to make a request to the board of examiners. The approval will only be given in case the student can pass for less than 12 EC in the BSc-programme in the relevant educational period.

Academic BSc-degree Marine Technolgy, Civil Engineering, Aerospace Engineering, Industrial Design Engineering or Applied Physics (DUT)

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 15 EC or less and will be part of the elective courses of the chosen variant. For Bachelors Industrial Design Engineering and Applied Physics the additional programme involves maximum 30 EC, of which 15 EC will be part of the elective courses. The total programme will become then 120 + max 15 = max 135 EC.

The additional courses are:

Marine Technology:

- wb1216	Dynamics 2	3 EC
- wb2207	Systems and Control Engineering 2	3 EC
- wb1224	Thermodynamics 2	3 EC
	Total MT	**9 EC**

Civil Engineering:

- wb2104	Systems and Control Engineering 1	3 EC
- wb1126wb	Thermodynamics 1	3 EC
- wb1216	Dynamics 2	3 EC
- wb2207	Systems and Control Engineering 2	3 EC
- wb1224	Thermodynamics 2	3 EC
	Total CE	**15 EC**

Aerospace Engineering:

- wb2207	Systems and Control Engineering 2	3 EC
	Total AE	**3 EC**

Industrial Design Engineering and Applied Physics:
- In consult with the student adviser.

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.

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 Marine Technology, Civil Engineering or 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.

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.

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 chosen variant and specialization may require that also a number of third year courses of the BSc-programme, in the field of the specialization is 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.

- De TH- en HZS-student mag tijdens het volgen van het aanvullende pakket al vakken volgen van de gekozen specialisatie van de MSc-variant en daarin tentamen doen.
- De TH- en HZS-student krijgt gezien zijn vooropleiding vrijstelling van de stage (15 EC).
- De HZS-student krijgt vrijstelling voor de MSc-eis van 6 EC Maatschappijvakken.
- In overleg met de specialisatiedocent zal in het keuzedeel een aantal vakken opgenomen worden om het BSc- en MSc-niveau van de specialisatie te behalen.
- De totale studielast voor een TH-student komt hiermee op 34 + 120 - 15 = 139 EC.
- De totale studielast voor een HZS-student komt hiermee op 40 + 120 - 15 - 6 = 139 EC.

Coördinator voor de HBO-instroom is Ir. Jaap van der Zanden.
Secretaris van de Examencommissie is Ewoud van Luik.

Pre-Master programme

Vakcode	Vaknaam	Docent	EC	Contact-uren p/w en tentamens of EC per semester 1A	1B	2A	2B	Herk Aug.	TV	BEO
VOOR TH- EN HZS-STUDENTEN										
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	Nieuwstadt	3			4t	ht		s	dc
		Totaal TH	34	9	11,5	10,5	3			
AANVULLING VOOR HZS-STUDENTEN										
wb1113wb **1)**	Dynamica A	Paraschiv	3				4t	ht	s	ec
wb2104 **2)**	Systeem- en regelt. 1	Dijkstra	3			4t	ht		s	ec
		Totaal HZS	40	9	11,5	13,5	6			

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 >= 4,5 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
- 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 Variants, specializations and annotations ME

In order to enter the MSc-programme the student should compile a list of courses, which should be approved by the lecturer of the chosen specialization. This list should be filled in at 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. Course schedules can be found in appendix 6.6.

Variants and specializations

There are 6 different variants and 25 specializations Mechanical Engineering:

1 Transportation Engineering
1.1 Transport Engineering and Logistics
1.2 Marine Engineering
1.3 Dredging Technology

2 Control Engineering and Mechatronics
2.1 Systems and Control Engineering
2.2 Advanced Mechatronics
2.3 Man-Machine-Systems and Control
2.4 Engineering Dynamics
2.5 Mechanics of Materials
2.6 Tribology
2.7 Vehicle Mechatronics

3 Process and Energy Technology
3.1 Energy Technology
3.2 Process Equipment
3.3 Fluid Mechanics
3.4 Marine Diesel Engines

4 Production Technology and Organisation
4.1 Production Technology
4.2 Design and Life Cycle Engineering
4.3 Industrial Organisation
4.4 Maintenance Engineering

5 Solid and Fluid Mechanics
5.1 Mechanics of Materials
5.2 Engineering Dynamics
5.3 Optimization of Constructions
5.4 Fluid Mechanics

6 Biomedical Engineering
6.1 Medical Instrumentation & Medical Safety
6.2 Bio Mechatronics
6.3 Tissue Biomechanics and Implants

Annotations

There are also 3 annotations, which can be done as a supplement to the variant programme:

a Technical Marketing
b Offshore Technology
c Sustainable Development

1.5.1 Variant Transportation Engineering

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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 and hinterland transport reliable, cost effective, efficient, fast and flexible transport systems are essential.
Offshore exploration of deep-sea reservoirs of oil and gas is essential for the world's supply of energy. In the Netherlands, the marine, dredging and transport sector has a share of more then 10% of the gross national product and many Dutch companies in this sector have leading positions on the world market, in particular the dredging industry. 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. To ensure future accessibility of cities, new transport systems like underground transport systems, play an important role.
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, dredging 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, dredging and transport companies on the world market.
The essence of Transportation Engineering is to develop, design, built and operate marine, dredging and transport systems and their equipment. 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, dredging and transport sector, it can be expected that this trend will continue at increased speed. New generation transport and marine 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, dredging and marine systems, the logistics of the systems and the interaction between the equipment and control systems.

Specialisations:
- Transport Engineering & Logistics
- Marine Engineering
- Dredging Engineering

Obligatory courses MSc variant			
Course code	Course name	Lecture hours	EC
et3026wb	Electrical power drives	0/3/0/0	3
mt216	Internal combustion engines	0/0/0/2	3
wb3408	Dredging design	0/0/2/2	4
wb3419-03	Characterization & handling bulk solid materials	2/2/0/0	6
wb3420-03	Introduction transport and logistic engineering	2/2/0/0	5
		Total	**21**

1.5.1.1 Specialisation Transport Engineering and Logistics

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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 there where it is required significant 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 needs 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 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.

Courses Transport Engineering and Logistics (TL)

Obligatory courses variant	21 EC
Obligatory courses specialisation	21 EC
Elective courses	18 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Transport Engineering & Logistics			
Course code	Course name	Lecture hours	EC
ct3750	OR Transport systems and traffic networks		4
ct4330	OR Harbours and shipping ways		
wb3410-03	Large scale transport systems	0/0/2/0	3
wb3417-03	Discrete systems: modeling, prototyping, simulation & control	2/2/0/0	4
wb3421-03	Automation and control of Transport Systems	0/0/2/2	5
wb3422-03	Design of transport equipment	0/0/2/2	5
		Total	**21**

1.5.1.2 Specialisation Marine Engineering

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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. Only a limited number of courses, according to the variant rules, is mandatory. Next to that, the students are expected to follow a number of specialisation courses up to 18.5 EC. 21 EC 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's thesis) abroad.

MSc-thesis

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. Examples of recent master thesis projects are:

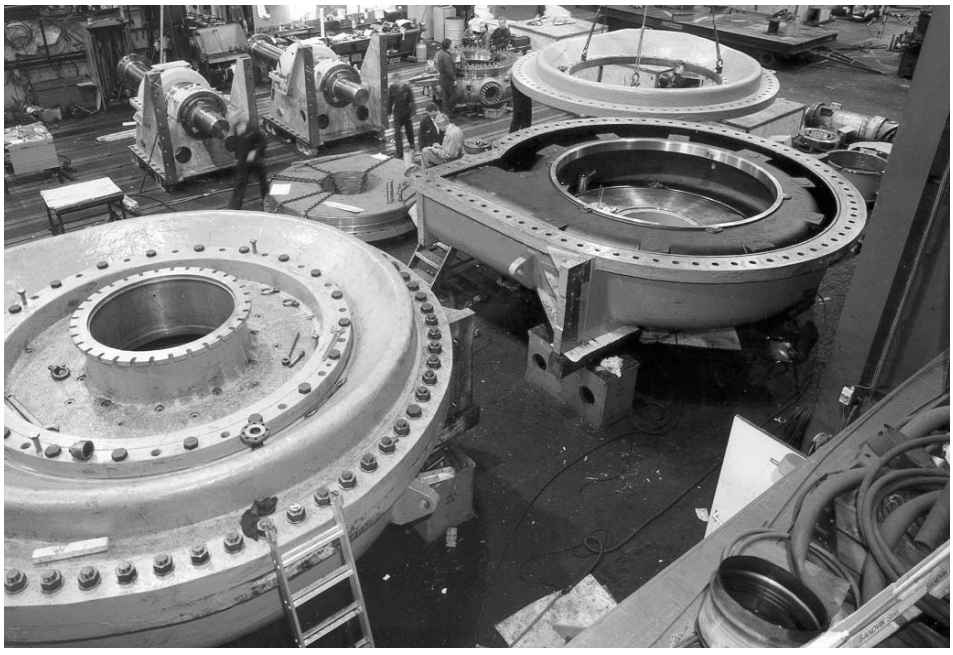
- Development of a simulation model of a dredging pump.
- Technical and economical investigation into an all-electric ship (AES) concept for a chemical tanker.
- Model development and simulation of the dynamic behaviour of a complete propulsion system (engine, propeller and ship) in a heavy seaway.
-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

Courses Marine Engineering (ME)

Obligatory courses variant	21 EC
Obligatory courses specialisation	18,5 EC
Elective courses	20,5 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Marine Engineering:

Course code	Course name	Lecture hours	EC
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
mt518	Resistance and propulsion 1	0/0/4/0	2
mt518p	Tests resistance and propulsion 1	0/0/x/0	1
mtp205	Project 2-4 design propulsion plant	0/0/0/x	5,5
mtp301	Project 3-1 design auxiliary systems	x/0/0/0	3
		Totaal	**18,5**



1.5.1.3 Specialisation Dredging 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.

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Courses Dredging Engineering (DE)

Obligatory courses variant	21 EC
Obligatory courses specialisation	19 EC
Elective courses	20 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Dredging Engineering			
Course code	Course name	Lecture hours	EC
ct2090 ta3800	OR Soil mechanics first part OR Soil mechanics 1		3
wb1427-03	Advanced fluid dynamics A	2/2/0/0	5
wb2402	Hydraulic servo systems	2/2/0/0	3
wb3413	Dredging processes 1	2/2/0/0	4
wb3414	Dredging processes 2	0/0/2/2	4
		Total	**19**

Recommended elective courses						
Course code	Course name	Lecture hours	EC	TL	ME	DE
ctbd3980	Realization civil projects		4			X
ctip3070	Three-dimensional lay-out		3	X		
ctvk4810	Exploitation and control of transport		4	X	X	
ctwa3030	Foundation engineering		3			X
ctwa3320	Groundwater mechanics and -flow		4			X
ctwa4300	Introduction coastal water engineering		4			X
ctwa5305	Waterbouwkundige kunstwerken B.O.		2			X
ide5131	Business marketing for engineers		3	X	X	
in2024tu	Introduction databases		4	X	X	
in2038p	Exercise introduction databases		2	X	X	
in3010tu	Introduction virtual reality		4	X	X	
in4005tu	Industrial automation		4	X	X	
in4013tu	Expert systems		4		X	
in4028tu	Business systems engineering		5	X	X	
in4050tu	Object oriented programming with Java		6	X	X	
mk3431	Welding techniques		3	X		
mp1700	Ingenieursgeologie		2			X
mp3790	Soil mechanics II		3			X
sc4020	Control theory	4/0/0/0	6	X	X	X
tn3713	Advanced thermodynamics		3		X	
wb1310	Multibody dynamics A	0/0/0/4	3	X	X	X
wb1330	Design in fibre reinforced plastics	0/0/2/0	2	X		
wb1406	Experimental mechanics	0/0/2/2	3	X		
wb1412	Non-linear vibrations	0/0/2/2	3	X	X	
wb1413	Multbody dynamics B	0/0/2/2	3	X	X	
wb1416	Numerical methods for dynamics	0/0/2/2	3	X		
wb1427-03	Advanced fluid dynamics A	2/2/0/0	5			X
wb2303	Measurement techniques	0/0/2/2	3	X	X	X
wb2306	Cybernetical ergonomics	0/0/0/4	3	X	X	
wb2311	Introduction modelling	4/0/0/0	3		X	
wb2400	Process control	0/0/2/2	3		X	
wb2402	Hydraulic servo systems	2/2/0/0	3	X	X	
wb2404	Man-machine systems	2/2/0/0	4	X	X	
wb2414	Mechatronics	2/2/0/0	3	X		
wb3303	Mechanisms	0/0/2/2	3	X		
wb3404A	Vehicle dynamics A	0/0/2/2	3	X	X	
wb3404B	Vehicle dynamics B	0/0/2/2	3	X	X	
wb3410-03	Large scale transport systems	0/0/2/0	3		X	
wb3413	Dredging processes 1	2/2/0/0	4		X	
wb3414	Dredging processes 2	0/0/2/2	4		X	
wb3415-03	Simulation of transport systems with ADAMS	0/0/2/0	3	X	X	
wb3416-03	Design with Finite Element Method	0/0/0/2	3	X	X	
wb3417-03	Discrete systems	2/2/0/0	4		X	
wb3418	Pro Engineer	-/-/-/x	2	X		
wb3422-03	Design of transport equipment	0/0/2/2	5		X	X

Course code	Course name	Lecture hours	EC	TL	ME	DE
wb4300B	Introduction to pumps and compressors	0/0/2/0	2		X	X
wb4303	Energy in society	0/4/0/0	3		X	
wb4401	Deeltjestechnologie-W	2/2/0/0	3			X
wb4408A	Diesel engines A	0/0/2/2	4		X	
wb4408B	Diesel engines B	2/2/0/0	4		X	
wb4410A	Refrigeration A1	0/0/2/2	3		X	
wb4420	Gas turbines	2/2/0/0	3		X	
wb4421	Gas turbines, simulation and application	0/0/2/2	3		X	
wb5302	Design theory: information transducers	0/0/2/0	2	X		
wb5414-03	Design of machines and mechanisms	2/2/0/0	3	X		
wb5420-03	Design of production systems	4/0/0/0	3	X		
wi2061	Continuüm mechanica I		4			X
wi3006	Continuüm mechanica II		4			X
wi3+31 15tu	Introduction stochastic operations research	0/0/2/2	4	X		
wi3021tu	Applied statistics B		4	X	X	X
wi4014tu	Numerical analysis C2 (exercise 30 h.)	2/2/0/0	4	X	X	X
wi4019	Non-linear differential equations		3	X	X	
wi4051tu	Introduction operations research	2/2/0/0	4	X	X	
wi4052	Risk analysis		6		X	
wm0301tu	Introduction philosophy of technology		3		X	
wm0304tu	Philosophy of science	0/2/0/0	4	X	X	
wm0324lr	Ethics and technology		3		X	
wm0401tu	History of engineering	0/0/4/0	3	X		
wm0504tu	Industrial organisation A	4/0/0/0	3	X		
wm0505tu	Industrial organisation B	0/0/4/0	3	X		
wm0604tu	Commercial economics	0/0/2/2	3	X		
wm0605tu	Business economics for engineers		4	X	X	
wm0621tu	Innovation management		3	X	X	
wm0771	Technisch milieurecht		3		X	X
wm0781	Octrooirecht en octrooibeleid		3		X	X
wm0801tu	Introduction safety engineering	0/4/0/0	3	X	X	
wm0903tu	Technology and global development		4		X	
wm1101tu	Upper-intermediate English (refresher)		3		X	
wm1102tu	Written English for technologists		3		X	

1.5.2 Variant Control Engineering and Mechatronics

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In the Control Engineering and Mechatronics variant seven specialisations are working together. The general aim is the improvement and optimization of the performance of dynamic systems by design or control, including the role of a human operator. The dynamics of the systems are of great importance for the performance of the system. Therefore a good design is a first step to improve the behaviour. In the participating groups different research fields and a wide range of applications are tackled. In the Systems and Control group the control concepts are studied and techniques to model the bevaviour in mathematical terms. The Man-machine Systems group is focussing on the role of the human operator handling tools, machines or vehicles, as well as the optimal design of these mechanical systems. The Engineering Dynamics group specialises in the research of the dynamic behaviour of mechanical systems. The Mechanics of Material group works on analytical and numerical methods to gain insight in the mechanical properties of materials.
The Tribology group studies the control of friction between moving parts. This is one of the important factors limiting the performance of mechanical systems as studied in the Advanced Mechatronics group. Also the electronics, informatics and control are integrated in this group. An other field of application is found in the Vehicle Mechatronics group where applications for the automobile industry are investigated.

The educational program of the variant Control Engineering and Mechatronics is composed of contributions of the following 7 sections:

- Systems and Control Engineering
- Advanced Mechatronics
- Man-Machine-Systems and Control
- Engineering Dynamics
- Mechanics of Materials
- Tribology
- Vehicle Mechatronics

The program consists of two parts:
– Obligatory courses for all students of the MSc variant.
– A combination of some obligatory courses and elective courses depending on the chosen specialisation. The internship and MSc assignment will be defined in consultation with the coordinator.

Courses Control Engineering and Mechatronics

Obligatory courses MSc variant				
Course code	Course name	Lecturer	Lecture hours	EC
sc4020	Control Theory	Bosgra	4/0/0/0	6
wb1406	Experimental mechanics	Booij, v Woerkom	0/0/2/2	3
wb1418	Engineering dynamics	Rixen	2/2/0/0	3
wb1442	Introduction to Microsystems	van Keulen, a.o.	2/2/0/0	3
wb2305	Digital control systems	Dijkstra	0/4/0/0	3
wb2414	Mechatronics	Teerhuis	2/2/0/0	3
wb2428-03	Mechanical construction principles	Langen, Pistecky	4/0/0/0	4
			Total	**25**

1.5.2.1 Specialisation Systems and Control Engineering

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The area of activities of the group is the joint activity of developing theoretical tools for system modelling and control, conducting applications and implementation of control designs. Research is carried out in two subject areas, the system identification and the robust multivariable control design. The applications are focussed on two relevant field for the industry, the advanced process control and the electro-mechanical and servo-hydraulic moion control systems. The M.Sc.students get a fix basis of modelling techniques, analysis and synthesis for the wide range of applications such as industrial crystallizers, power systems, flight simulators and mechatronic devices.During the thesis work the theoretic knowledge is applied in one of the research projects. The control engineer is not a narrow minded specialist, but is able to join quite a wide field of positions in the society.The young control engineers leaving the group easily find their way to the various industries.

The purpose of Measurement and Control Engineering is the controlling of systems in the best way possible. For this, a thorough knowledge of systems is needed, for which purpose basic theories are being developed within the section. The theories developed are applied to a wide range of systems, such as complex processes (crystallizers, power stations and control rooms), mechanical systems (flight simulator, robots), but also biological systems (heart, shoulder and arm) and hand prosthesisses and orthesisses. In order to gain sufficient insight into the systems to be controlled, a close cooperation with many other disciplines is indispensable. This field of study aims to provide all students with a thorough knowledge that can be used for the modelling, analysis and synthesis of a wide range of applications. During the completion of one's studies, this basic knowledge is deepened further and made operational in one of the research projects. The graduated control engineer is not narrowed down to one field of specialization, but is employable in a wide-ranging field. Therefore, there is a high demand for engineers with a control engineering background from a wide variety of disciplines in industry, health care and research centres.

Courses Systems and Control Engineering

Obligatory courses variant	25 EC
Obligatory courses specialisation	20 EC
Elective courses	15 EC
Assignments and projects	60 EC

Obligatory courses specialisation Systems and Control Engineering				
Course code	Course name	Lecturer	Lecture hours	EC
sc4110	System Identification	Van den Hof	0/0/2/2	5
wb2422	Modeling 2	Bosgra	0/4/0/0	6
wb2423	Introduction Project	vd Weiden, Teerhuis	x/0/x/0	3
wb2425	Integration Project	Huesman	x/x/x/x	6
			Total	**20**

Recommended elective courses specialisation Systems and Control Engineering				
Course code	Course name	Teacher	Lecture hours	EC
et4245wb	Electromechanical systems	Compter, Polinder	0/0/0/3	4
wb2303	Measurement techniques	Teerhuis	0/0/2/2	3
wb2400	Process Control	Dijkstra	0/0/2/2	3
wb2402	Hydraulic servo systems	Teerhuis	2/2/0/0	3
wb2413	Instrumentation	vd Weiden	0/0/2/2	3
wb2415	Robust Control	Scherer	0/0/0/4	6
wb2416	LMI's	Scherer	4/0/0/0	6
wb2421	Multivariable Control	vd Weiden	0/0/4/0	6
wb2424	Mathemethics for SR	Scherer	2/2/2/2	6
wb2426	Chemistry and chemical plant	Huesman	0/0/2/2	3
			Total minimal to select	**15**

1.5.2.2 Specialisation Advanced Mechatronics

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Advanced Mechantronics focusses specifically on the development of high performance servo systems, such as CD- players, harddisk drives, wafersteppers. The field of Mechatronics is strongly multidisciplinary in which mechanics, control, electronics, information technology all play an important role and are integrated. The research project of the group are often carried out in close cooperation with industries or international research institutions. The development of fast and high precision measurement instruments at low cost are studeid as well as fast and accurate actuators for micro and nanometer scale applications. Magnetic bearing systems are developed for the application in the newest generation high performance tools.

Courses Advanced Mechatronics

Obligatory courses variant	25 EC
Obligatory courses specialisation	19 EC
Elective courses	16 EC
Assignments and projects	60 EC

Obligatory courses specialisation Advanced Mechatronics

Course code	Course name	Lecturer	Lecture hours	EC
et4245wb	Electromechanical Systems	Compter, Polinder		4
wb2423	Introduction Project	vd Weiden, Teerhuis	x/0/x/0	3
wb2427	Predictive Modeling	Van Eijk	0/0/4/0	3
wb2430	Mechatronic Project	Spronck	x/x/x/x	9
			Total	**19**

Recommended elective courses specialisation Advanced Mechatronics

Course code	Course name	Lecturer	Lecture hours	EC
et3021wb	Electrical motion systems	Woudstra, Bauer	0/0/3/0	4
et4045	Electronic Instrumentation 1	Wolffenbuttel		4
et4119	Electric power conversion	De Haan, Bauer		4
tn4010	Electricity/ magnetism	Meijers, Bruijn		3
in4024	Intro real time programming	Toeteler		6
wb2303	Measurement techniques	Teerhuis	0/0/2/2	3
wb2402	Hydraulic servo systems	Teerhuis	2/2/0/0	3
wb2421	Multivariable Control	vd Weiden	0/0/4/0	6
wb5302	Ontwerpleer 3B	Pistecky	0/0/2/0	2
			Total minimal to select	**16**

1.5.2.3 Specialisation Man-Machine-Systems and Control

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The field of Human-Machine Systems (MMS) concerns research and design of systems where humans control their environment through a technical system. Clearly, human-machine systems are found in many areas of mechanical engineering, ranging from manual control of tools, machines or vehicles, to supervisory control of complex industrial, medical or transportation systems. In all these cases, the human operators base their

actions on information exchange with the technical system. This dynamic interaction has a central position in MMS. In our research program, system and control theory is used and developed to study the dynamics of the human as a controller, i.e. as part of the control loop. The cognitive and neuromuscular nature of the human as a controller have interesting implications for issues such as identification, perceptibility, responsiveness, open and closed loop behavior. In our design efforts, we apply a human-centered approach, taking into account the capabilities and preferences of the human in order to design technical systems that match these dynamic characteristics optimally. In many cases we find ourselves developing unconventional technology that is useful in our field of application as well as in general mechanical engineering. Graduation projects may incorporate research, design, or both. Projects in supervisory control typically concern operational aspects of automation in industrial installations, including decision making, alarm management, predictive displays etc. Projects in direct control can be subdivided in design of assistive technology for physically challenged people (prosthetics and orthotics for the upper extremity), (walking) robotic systems (control of system parameters, study of human gait, application as leg orthosis), and haptic interfaces (dynamic interaction with virtual environment or telemanipulator, force feedback, application in surgery).

Courses Man-Machine-Systems and Control

Obligatory courses variant	25 EC
Obligatory courses specialisation	30 EC
Elective courses	5 EC
Assignments and projects	60 EC

Obligatory courses specialisation Man-Machine Systems & Control (o = obligatory, e = elective)

Course code	Course name	DC	SC	lecture hours	EC
wb1310	Multibody dynamics A	o	e	0/0/0/2	3
wb1413	Multibody dynamics B	o	e	0/0/2/2	3
wb2301	System identification and parameter estim.	o	o	0/0/2/2	7
wb2308	Biomedical Engineering Design	o	e	2/0/0/0	4
wb2309	Introduction to MMS and Biomedical Eng.	o	o	2/0/0/0	1
wb2400	Process control	e	o	0/0/2/2	3
wb2404	Man-Machine Systems	o	o	2/2/0/0	4
wb2407	Human movement control	o	o	2/2/0/0	4
wb2432	Biomechatronics	o	o	0/0/2/2	4
wb2408	Fysiological systems	e	o	0/4/0/0	3
wbp202	Haptic system design	o	o	x/x/x/x	4
	Total	**30**	**30**		

DC - Direct Control, SC = Supervisory Control

A number of courses are obligatory, see table above. A package of elective courses is tailored to the individual needs and preferences of students, to be approved by the MMS MSc educational advisor. Suggestions are given in the table below. The package should meet the requirements of any MSc package.

Recommended elective courses specialisation Man-Machine Systems & Control					
Course code	Course name	DC	SC	lecture hours	EC
et4245wb	Electromechanical systems	e	e	0/0/0/3	4
tn3111wb	System Identification		e	0/0/2/2	6
wb1419	Engineering Dynamics and Mechanisms	e		2/3/0/0	4
wb1440	Engineering Optimization	e	e	2/2/0/0	3
wb2303	Measurement Techniques	e	e	0/0/2/2	3
wb2306	Cybernetical Ergonomics	e	e	0/0/0/4	3
wb2400	Process control		e	0/0/2/2	3
wb2402	Hydraulic Systems	e	e	2/2/0/0	3
wb2413	Instrumentation	e	e	0/0/2/2	3
wb2422	Modelling 2		e	0/4/0/0	6
wb2427	Predictive Modelling		e	0/0/4/0	3
wb2433	Humanoid robots	e		0/0/2/0	2
wb3303	Mechanisms	e		0/0/2/2	3
wb5302	Design methodology 3B	e		0/0/2/0	2
wb5400	Tribology in machine design	e		0/2/2/2	4

DC - Direct Control, SC = Supervisory Control

The final year consists of a practical assignment or internship, preferably carried out at another university or a company, sometimes abroad. Subsequently, a literature study is performed in preparation of the final project. A total of three formal presentations are to be given (colloquia). The study is concluded with a report or scientific article with appendices (see also the MMS Study Guide at our website).

Obligatory subjects 5th year		
Course code	Course name	EC
wbo104-1B	Progress meeting (every last Wednesday of the month)	3
wbo104-2B	Practical assignment	11
wbo104-3B	Literature study	11
wbo104-4B	Literature study colloquium	3
wbo104-5B	Introductory colloquium	9
wbo104-6B	Graduation colloquium	6
wbo104-7B	Final project report	17
	Total	**60**

1.5.2.4 Specialisation Engineering Dynamics

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Secretariat	mrs. Corinne du Burck	+31 15 27 85733	c.p.duburck@wbmt.tudelft.nl

On the position of Engineering Dynamics within the university, the faculty, and the M.Sc. variant: The specialisation Engineering Dynamics constitutes, historically speaking, part of the cradle of mechanical engineering in general, and (in the context of the M.Sc. variant Control Engineering and Mechatronics), one of the parents of control engineering and mechatronics. Indeed! Indeed, most structures are subjected to dynamics loads and their performance and lifetime depends in part of those loads (Tacoma Narrows bridge, Erasmus bridge and other large structures, vibrations in electric machinery, in the human body, in transportation systems, in tools and processing equipment; the list of unwanted but nonneglible dynamics is truly endless). In addition, an enormous class of machinery and equipment is specifically designed for desired dynamic operations: automobiles, steel processing "streets", chip-manufacturing equipment, transportation systems, robotic manipulators, micro sensors and actuators, electrical machinery, vibration-inducing systems for physiotherapeutic purposes, and so on. In many cases the performance of the "natural" system does not fully satify the design criteria. In those cases, control engineers with a sound understanding of the characteristics of the "underperforming" mechanical system are to be engaged to "beef up" system performance with the aid of sensors, actuators, and suitable estimation and control loops. The "marriage" of the specialisation Engineering Dynamics with other specialisations within the M.Sc. variant "Control Engineering and Mechatronics" is therefore a sensible one.
On the field of activity of Wb-Engineering Dynamics:
The field of activity is best illustrated by examples of recent M.Sc. thesis topics: dynamics of extremely slender oil drillstrings (Shell), passive vibration suppression in a new type wafer scanner (ASML), dynamic loads on a passenger car by a new type combustion engine (BMW); vibration damping of a maneuvering robotic manipulator (University of Pisa); environment-induced dynamic misalignments in a new astronomical spacecraft (TNO-TPD); interaction between inkjet system structural vibrations and inkjet motion (Océ-vdGrinten). Engineering Dynamics covers these fields but other fields as well, such as finite element modelling of mechanical systems and biomechanical systems, finite element modeling of micro mechanical systems, multi-body modelling; simulation of dynamic biomechanical systems, experimental analysis of dynamic systems, prediction and analysis of nonlinear vibrations, numerical computation of system dynamics, parallel computing of the dynamics of very-large scale systems, model order reduction for controller design, robotic manipulators. Dynamic students will thrive when engaging in Engineering Dynamics projects.
On obligatory and recommended courses:
Beyond the courses that are obligatory for all Ms.Sc students within the variant "Control Engineering and Mechatronics" there are no obligatory courses for the specialisation Engineering Dynamics. Instead there is a list of recommended courses, from which the interested student is to make a balanced selection. Students are requested to discuss their specific interests with the study coordinator (dr.ir. P.Th.L.M. van Woerkom) and jointly set up a list of courses most suitable for him/her.

Courses Engineering Dynamics

Obligatory courses variant	25 EC
Elective courses	45 EC
Assignments and projects	50 EC

Recommended elective courses common Mechanics

Course code	Course name	Lecturer	Lecture hours	EC
ae4-900	Continuum mechanics	Turteltaub	0/0/4/0	4
ct5142	Non-linear numerical mechanics		0/0/4/0	3
wb1402A	Plates and shells A	Ernst	2/4/0/0	4
wb1405A	Stability of thinwalled constructions	van Keulen	0/0/4/2	4
wb1408	Mechanics of pressure vessels	Ernst	2/2/0/0	3
wb1409	Elasticitytheory	van Keulen	2/2/0/0	3
wb1432	Mechanics of fibre reinforced plastics	Marissen	2/2/0/0	4
wb5303	Tribology	van Beek	0/4/0/0	3

Recommended elective courses Dynamics

Course code	Course name	Lecturer	Lecture hours	EC
ae4-399	Dynamics & control aerospace syst.		0/0/4/0	3
ct5145wb	Stochastic vibrations		6/0/0/0	3
wb1310	Multi-body dynamics A	Schwab	0/0/0/4	3
wb1412	Non-linear vibrations	Woerkom	0/0/2/2	3
wb1413	Multi-body dynamics B	Schwab	0/0/2/2	3
wb1416	Numerical methods for dynamics	Rixen	0/0/2/2	3
wb1417	Fluid-structures interaction	Rixen	0/0/0/2	2
wb1419	Eng. dynamics and mechanisms	Rixen	2/3/0/0	4

1.5.2.5 Specialisation Mechanics of Materials

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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.
Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of (micro-) composite materials. Because of the continuing miniaturization in this area some new concepts in mechanics as well as in experimental methods should be 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, Kriton, Motorola, ICI, DSM.
The 1st year of the educational program is directed to deepening the knowledge in specialised subjects and can be partly directed towards the special interests of an individual student towards the above fields of application. The 2nd year of the educational program is directed to the actual thesis work. Here the student will perform applied research, which normally starts out from a literature study concerning the state of the art of the research subject. Depending on the interests of the individual student, the research subject will be selected such that the major part of activities lies in the field of experimental mechanics and characterisation and modelling of materials properties (with challenges towards micro- and nano-scale phenomena), or in the field of advanced simulation, with applications to the thermo- and/or mechanical behaviour of Microelectronics, Microsystems and/or Composites. A combination of both types of activities is also possible.

Courses Mechanics of Materials

Obligatory courses variant	25 EC
Obligatory courses specialisation	23 EC
Elective courses	17 EC
Assignments and projects	55 EC

Obligatory courses specialisation Mechanics of Materials			
Course code	Course name	Lecture hours	EC
ae4-900	Continuum Mechanics	0/0/3/0	4
mk5751	Rheology of polymeric liquids		3
mk6261TU	Fracture Mechanics		3
wb1408	Mechanics of Pressure Vessels	2/2/0/0	3
wb1409	Theory of Elasticity	2/2/0/0	4
wb1432	Mechanics of Fibre Reinforced Plastics	2/2/0/0	3
wi4007tu	Fourier and Laplace transforms	0/0/2/2	3
		Total	**23**

Recommended elective courses specialisation Mechanics of Materials			
Course code	Course name	Lecture hours	EC
ct5142	Non-linear Computational Mechanics	0/0/4/0	3
ct4150	Plasticiteitsleer		4
wb1310	Multibody Dynamics	0/0/0/2	3
wb1402a	Plates and Shells	2/4/0/0	4
wb1405a	Stability of thin-walled structures	0/0/4/2	4
wb1412	Non linear Vibrations	0/0/2/2	3
wb1413	Multibody Dynamics B	0/0/2/2	3
wb1416	Numerical methods for dynamics	0/0/2/2	3
wb1417	Fluid-Structure interaction	0/0/0/2	2
wb1419	Engineering Dynamics and Mechanisms	2/3/0/0	4
wb1430a	Composite Materials for Durable Structures	2/2/0/0	3
wb1430b	Fibre Reinforced Plastics - extended course	0/0/4/4	6
wb1440	Engineering optimisation	2/2/0/0	3
wb2303	Measurement Theory and Praxis	0/0/2/2	3
wb5303	Tribology	0/4/0/0	3
wi4014tu	Numerical Analysis C2	2/2/0/0	4
		Total to select	**17**

1.5.2.6 Specialisation Tribology

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Tribology is the science aimed to control and predict friction and wear between moving parts. Knowledge of those aspects is fundamental in order to optimize reliability and performance of mechanical systems, instruments, engines etc. This field of research is related to most aspects of mechanical engineering, physics, science of materials, chemistry and mathematics. An integral approach is essential to realize innovative solutions to answer the continue increasing demands with respect to lifetime, reliability, performance, fuel economy, bio compatibility of lubricants, reduction in maintenance costs etc.

In the variant "Control Engineering and Mechatronics" our specialisation is focussed at the design of the mechanical system. Teamwork with the control engineers is essential to achieve the optimal performance of the complete mechatronic system.

Because detailed knowledge of tribology is important in a wide range of specialisations, from manufacturing processes to machine or product design, our students can be found at Philips, OCE, ASML, Corus, TNO, IHC, RWS, SKF etc.

MSc-thesis Examples of current research topics are: the optimization of manufacturing processes such as sheet metal forming and high speed cutting, water lubrication in marine applications, high precision positioning systems etc.

Courses Tribology

Obligatory courses variant	25 EC
Obligatory courses specialisation	15 EC
Elective courses	20 EC
Assignments and projects	70 EC

Obligatory Courses Tribology

Course code	Course name	Lecture hours	EC
wb1432	Mechanics of fibre reinforced plastics	2/2/0/0	4
wb5303	Tribology	0/4/0/0	3
wb5400	Tribology in machine design	0/2/2/2	4
wi4014tu	Numerieke analyse C2	2/2/0/0	4
		Total	**15**

Recommended elective courses specialisation Tribology			
Course code	Course name	Lecture hours	EC
et3026wb	Electrical motion systems	0/3/0/0	3
mt216	Internal combustion engines	0/0/0/2	3
wb1310	Multibody dynamics	0/0/0/2	3
wb1432	Mechanics of fibre reinforced plastics	2/2/0/0	4
wb2414	Mechatronics	2/2/0/0	3
wb2427	Predictive Modeling	0/0/4/0	3
wb5303	Tribology	4/0/0/0	3
wb5400	Tribology in machine design	0/2/2/2	4
wb5414-03	Design of Machines and Mechanisms	2/2/2/0	3
wb2451-03			4
wb2452-03			4
wb2453-03			4
wb2454-03			4
		Minimal to select	**10**

Assignments, projects, internship Tribology:

Code	Name	EC
wb0102-2	Literature survey + colloquium	12
wb0102-3	Numerical methods applied to tribology / Design case	12
wb0102-4	MSc assignment	56
	Total	**70**

1.5.2.7 Specialisation Vehicle Mechatronics

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In the current automotive industry we see an increasing demand for advanced mechatronics and control applications in vehicles. Fuel economy, increased safety, driver assistance and driver comfort are the goals that are pursued in modern vehicle design. Vehicle Mechatronics is directed towards improving the traditional mechanical systems with additional functionality leading to an integrated system approach to reach these objectives efficiently. In this integrated system approach elementary vehicle dynamics knowledge constitutes an essential basis. Typical master thesis subjects cover X by wire systems (drive, brake, steer, shift), vehicle dynamics control (ABS ASR ESP VDC), and active and semi- active suspension and roll control systems.

Courses Vehicle Mechatronics

Obligatory courses variant	25 EC
Obligatory courses specialisation	17 EC
Elective courses	18 EC
Assignments and projects	60 EC

Obligatory courses specialisation Vehicle Mechatronics			
Course code	Course name	Lecture hours	EC
mt216	Internal combustion engines	0/0/0/2	3
sc4110	System Identification	0/0/4/0	5
wb2311	Modeling 1	2/0/0/0	3
wb2423	Introduction Project	x/0/x/0	3
wb3404A	Vehicle dynamics A	0/0/2/2	3
		Total	**17**

Recommended elective courses specialisation Vehicle Mechatronics			
Course code	Course name	Lecture hours	EC
et4045	Electronic Instrumentation 1		4
et4096	Model predictive control	2/0/0/0	3
et4099	Knowledge based control systems	0/2/0/0	3
et4101	Optimization in Systems and Control	0/0/2/0	3
in4024	Intro real time programming		6
wb1310	Multi-body dynamics A	0/0/0/2	3
wb1412	Non-linear vibrations	0/0/2/2	3
wb2303	Measurement techniques	0/0/2/2	3
wb2402	Hydraulic servo systems	2/2/0/0	3
wb2415	Robust Control	0/0/0/4	6
wb2416	LMI 's	4/0/0/0	6
wb2421	Multivariable Control	0/0/4/0	6
wb2429	Electromechanical systems	0/0/0/3	4
wb3404B	Vehicle dynamics B	0/0/2/2	3
	Advanced Vehicle Control	2003-2004	3
		Minimal to select	18

1.5.3 Variant Process and Energy Technology

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One of the principal industrial contributors to our economy is presently the petrochemical and process industry and the energy production industry. Although these are well-established industrial area there are nevertheless many new developments, which requires new technology. To mention only a few: there is a need to improve efficiency of processes and the quality of products while at the same time the impact on the environment of these processes and their energy consumption should be kept to a minimum. For these reasons new sustainable technology must be developed and then incorporated in new designs, which eventually must find their way in industry.
The master program `Process and Energy' gives its student the training to participate in this challenging field. This is done by first giving every Master's degree student training in the fundamental topics of the field, which are: thermodynamics, fluid mechanics and system's theory. Secondly, training is offered in three specialized directions in which the Master's degree student will follow courses in which state of the art techniques and solution methods are discussed and in which both numerical and experimental tools will treated. Finally, a specialized research topic allows the Master's degree student to get involved in the solution of a real problem in the area of Process and Energy.
The "Process and Energy" program gives an excellent basis for those aiming at a carrier in process and energy industry but it also allows for students who want to specialize further by doing research in academia or industry.
The program is organized on the basis of a joint curriculum and four specializations. These are:

- Energy Technology
- Process Equipment
- Fluid Mechanics
- Marine Diesel Engines

For the first year there is joint compulsory curriculum of 23 EC for each of the three specializations. The rest of the program has to be selected in consultation with the responsible lecturer.

Joint curriculum Process and Energy			
Course code	Course name	Lecture hours	EC
wb1427	Advanced Fluid Dynamics	2/2/0/0	5
wb2311	Introduction modelling	4/0/0/0	3
wb4300A	Equipment for heat and mass transfer	0/4/0/0	3
wb4300B	Introduction to pumps and compressors	0/0/2/0	2
wb4302	Thermodynamics of energy conversion	4/0/0/0	4
wb4303	Energy, society and sustainability	0/4/0/0	3
wb4429-03	Thermodynamics of mixtures	0/0/4/0	3

Total 23

1.5.3.1 Specialisation Energy Technology

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Sustainability requires the efficient utilization of primary resources i.e. energy and materials with a minimal impact on the environment and at the same time ensuring economic profitability of all activities. The supply of sustainable energy and its efficient use is of major importance for the development of our society and economy.
The objective of the specialization in "Energy Technologies" is to develop a thorough understanding of energy conversion and utilization technologies. The student will learn and apply tools to contribute to the development of highly efficient, environmentally friendly and integrated processes for the production and utilization of heat, power and secondary fuels like hydrogen. The obligatory courses comprise relevant topics like, advanced power generation, combined cycles, decentralized heat and power production including fuel cells, heat pumps and energy utilization in buildings. Within the optional program and in the assignments the student can focus on fuel conversion, advanced power generation, gas turbines, for special applications, nuclear power engineering, heat pumps and energy utilization in buildings.

It is recommended to develop the first assignment in cooperation with industry inside or outside the Netherlands. The final assignment will be linked to the research activities of the section. Current research activities include investigations on systems and components level. 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 on-line diagnostic tools. Examples are advanced biomass utilization concepts like biomass gasification in combination with fuel cells/ gas turbines or the 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, heat pumps, refrigeration and energy utilization in buildings.

Courses Energy Technology

Obligatory courses variant	23 EC
Obligatory courses specialisation	26 EC
Elective courses	11 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Energy Technology			
Course code	Course name	Lecture hours	EC
wb4422	Thermal Power Plants	0/0/4/0	4
wb4423-03	Modelling and Simulation of Energy Convers. Syst.	0/0/0/4	4
wb201-1	Process Design and Calculation	0/0/0/8	6
at least 12 EC from the following courses			
wb4405	Fuel conversion	2/2/0/0	3
wb4410A	Refrigeration fundamentals	2/2/0/0	3
wb4416	Nuclear engineering	0/0/4/0	3
wb4420	Gas turbines	2/2/0/0	3
wb4426	Indoor climate control fundamentals	2/2/0/0	3
wb4428-03	Thermal waste treatment	0/0/2/2	3
		Total	**26**

Recommended elective courses specialisation Energy Technology			
Course code	Course name	Lecture hours	EC
ae4-140	Gas dynamics		3
ct5147	Wind Energy Conversion Systems		3
st314	Process Engineering		3
tn3710	Advanced thermodynamics		6
tn3782	Multiphase flow		6
wb1428	Computational Fluids Dynamics	0/0/2/2	3
wb4402	Project engineering	2/2/0/0	6
wb4421	Gasturbines Application and Simulation	0/0/2/2	3
wb4424	Indoor Climate Control Design	0/0/2/2	4
wb4425	Fuel cell systems	no lectures	2
wb4427	Refrigeration Technology and Applications	0/0/2/2	4

Projects in 2nd year MSc		
Code	Project name	EC
wbo201-2	First assignment	23
wbo201-3	Ms-thesis (within research Energy Technology)	37
	Total	**120**

1.5.3.2 Specialisation Process Equipment

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The section Equipment for the Process Industry is situated in the Laboratory Apparatenbouw voor de Proces Industrie at the Leeghwaterstraat 44. API is the research and education centre for the design and operation of equipment and processes on industrial scale. At API, there is a close cooperation between the Chairs of Equipment for the process industry of OCP and that of Separation Processes from Delft Chemtech (TNW). The research is mainly focused on the development of new and the improvement of existing separation processes as well as the necessary equipment. Systematic design procedures are used and developed addressing equipment design, process design and product quality issues simultaneously. One of the key characteristics of the research program is the integrated application of various disciplines employed in process equipment design, including construction techniques, mechanics, thermodynamics, transport phenomena and process chemistry. The majority of the research projects are carried out in close collaboration with process equipment manufacturers and partners in the process industry

Students with the specialisation Equipment for the Process Industry receive the necessary knowledge and skills that enable them to serve as process and equipment engineers, or to work on plant optimisation and process end equipment development.

The research domain of the Laboratory for Process Equipment is closely related to the petrochemical, the process and the energy production industry. Also many connections are found in the food, metallurgic and pharmaceutical industry. Although these areas are in general well established, the development of new, sustainable separation processes, consuming less energy, produce less waste and produce better products as well as the improvement of existing processes is of vital importance to maintain their technological advance in a global economy.

Student finishing the study at the Laboratory for Process Equipment, find jobs mainly in the process, food or pharmaceutical industry, equipment manufacturers or engineering companies.

Recent research assignments

- Development and application of a design procedure for batch crystallisation processes.
- Supercritical melt micronisation
- Polymorphism and precipitation.
- Heavy metal removal of waste water using metal sulfide precipitation

The education program as has been given below contains courses on the design of separation processes such as distillation, extraction, crystallisation and new hybrid processes. For the so-called G-group a design is made of a real plant in a multidisciplinary team of mechanical and chemical engineering students. To participate in the g-group a number of basic courses much be passed successfully beforehand. The final research assignment finally consists of a mixture of modelling, simulation, equipment design and experimental work.

Courses Process Equipemt

Obligatory courses variant	23 EC
Obligatory courses specialisation	17 EC
Elective courses	20 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Process Equipment

Course code	Course name	Lecture hours	EC
st314	Process Technology	00/2/2	4
wb4402	Project Engineering	2/2/0/0	6
wb4403	Separation processes	0/0/4/0	4
wb4417	Design of Process Equipment	2/0/0/0	3
Total			17

Recommended elective courses Specialisation Process Equipment

Course code	Course name	Lecture hours	EC
tn3713	Advanced thermodynamics	2/0/0/0	3
tn3752	Multiphase flow	0/0/2/2	6
tn3753	Physical Transport Phenomena II		6
wb1408	Mechanics of pressure vessels	2/2/0/0	3
wb4418	Olie en gaswinning buitengaats	0/0/2/2	4
wb4423-03	Modeling and simulation of energy conversion systems	0/0/0/4	4
wi4011	Numerical fluid dynamics	0/0/4/0	4
wm0605tu	Business economics for engineers	0/0/4/0	4
wm0621tu	Innovative mangement	0/0/4/0	3
wm1102tu	Written English for Technologists	0/0/0/6	3

Projects in 2nd year MSc

Code	Project name	EC
	G- group	12
	Traineeship	11
	Final research assignment	37
	Total	**60**

1.5.3.3 Specialisation Fluid Mechanics

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The specialization of fluid mechanics is directed towards giving training in the fundaments and applications of incompressible fluid flow. In particular the areas to which most attention is given, are turbulence and multi-phase flow and these are in particular the areas, which 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 fluid mechanics field usually in combination with the numerical work, either as validation or as an extension of the numerical results. At the end of the program the student will be trained in all aspects of modern fluid mechanics both by means of courses and by means of specialized research work.

Courses Fluid Mechanics

Obligatory courses variant	23 EC
Obligatory courses specialisation	15 EC
Elective courses	22 EC
Assignments and projects	60 EC

Recommended elective courses specialisation Fluid Mechanics			
Society oriented (>= 6 EC)			
Course code	Course name	Lecture hours	EC
wm0605tu	Business Economics for Engineers		4
wm0621tu	Innovation Management		3
wm1102tu	Written English for Technologists		3
Additional Fundamental subjects (>= 9 EC)			
tn3713	Advanced thermodynamics		6
tn3753	Physical Transport Phenomena II		6
tn3782	Multiphase flow		6
wb1428	Computational Fluid Dynamics	0/0/2/2	3
wb4417	Mechanisch-hydraulisch ontwerpen	0/2/0/0	3
General topics			
ae4-140	Gasdynamics I		3
ae4-141	Gasdynamics II		3
ct5147	Wind energy Conversion Systems		3
et4-149	Solar cells		3
mt212	Marine engineering B		3

st314	Proceskunde		3
tn3733	Turbulent reacting flows		6
wb1408	Mechanics of pressure vessels	2/2/0/0	3
wb1424ATU	Turbulence A	0/0/2/2	6
wb1424B	Advanced turbulence		3
wb4402	Project engineering	2/2/0/0	6
wb4403	Fysische scheidingsmethoden	0/0/4/0	3
wb4405	Fuel conversion	2/2/0/0	3
wb4408A	Diesel engines A	0/0/2/2	4
wb4410A	Refrigeration fundamentals	2/2/0/0	3
wb4416	Nuclear Engineering	0/4/0/0	3
wb4418	Olie en gaswinning buitengaats	0/0/4/4	4
wb4419	Modelvorming voor systemen	0/0/4/0	4
wb4420	Gasturbines	2/2/0/0	3
wb4421	Gasturbines application and simulation	0/0/2/2	3
wb4422	Thermal power plants	0/0/4/0	4
wb4424	Indoor Climate Control Design	0/0/2/2	4
wb4425	Fuel cell systems	no lectures	2
wb4426	Indoor climate control fundamentals	2/2/0/0	3
wb4427	Refrigeration Design & Applications	0/0/2/2	4
wi4006	Special functions		6
wi4011	Numerical fluid Dynamics		6
wi4008	Complex analysis		4
wi4017	Non-linear differential equations		6

1.5.3.4 Specialisation Marine Diesel Engines

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Marine Diesel Engines is a specialisation within Process and Energy 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 Program 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

Courses Marine Diesel Engines

Obligatory courses variant	22 EC
Obligatory courses specialisation	16 EC
Elective courses	21 EC
Assignments and projects	60 EC

Obligatory courses specialisation Marine Diesel Engines			
Course code	Course name	Lecture hours	EC
wb4408A	Diesel engines A	2/2/0/0	4
wb4408B	Diesel engines B	0/0/2/2	4

Elective courses specialisation Marine Diesel Engines			
Course code	Course name	Lecture hours	EC
At least 8 EC from the following courses			
wb1428	Computional Fluid Dynamics	0/0/2/2	3
wb4405	Fuel conversion	2/2/0/0	3
wb4416	Nuclear Engineering	2/2/0/0	3
wb4420	Gasturbines	0/4/0/0	3
wb4422	Thermal Power Plants	0/0/4/0	4
wb4423-03	Modeling and Simulation of Energy Conversion Systems	0/0/4/0	4

1.5.4 Variant Production Technology and Organisation

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Research and education in the domain of production play a significant role in modern society. In order to stay competitive, the production of capital goods and consumer goods requires continuous improvement and technological innovation.

The PTO section encompasses the whole scope of technological and organizational activities in a product life cycle, from product marketing, product design, via manufacturing and assembly, to operation and maintenance, after sales service, remanufacturing and recycling. Within PTO the specialisation Production Technology (PT) is focussing on manufacturing processes to generate precise parts and on micro-assembly of parts into complex systems. The focus of Industrial Organisation (IO) is on value creation i.e. the design of integrated systems in terms of processes and structures for people and technical means, maximizing productivity. The third specialisation Design and Life Cycle Engineering (DL) tackles industrial problems with tools and methods of engineering design and engineering informatics, while keeping sustainability and business in mind.

The research and education of the group has a high industrial relevance. Some of the industrial driving forces in the field of production are:

- Product miniaturisation. The drive towards miniaturised products asks for advanced technologies to manufacture parts with (sub)micron precision and to assemble (sub)millimetre parts with micron accuracy.
- Customer driven design and production. How to design and manufacture individualised products while maintaining short lead-times and competitive cost-price levels.
- "Intelligent" production of "Intelligent" products. High technology products are built with embedded intelligence. This intelligence has an impact on production beyond the assembly of digital components supporting the embedded intelligence. Developing theories, tools and methods to design and manufacture intelligent products is an important challenge.
- Sustainable production: This requires not only technological development but also a holistic approach to life cycle issues. Abstract level thinking to break existing systems boundaries leads to sustainable production.

The research themes of PTO focus on three areas. One area is the advanced production of small parts and products with high accuracy and complex (free form) geometry. These parts are often made of new advanced materials. The technical solutions for making small parts and for assembling them often require the application of new principles, which calls for a mechatronic approach. The design and engineering of industrial processes is the second important area of attention. In particular the integration of production technological innovations with the design of organisations and the product design process itself receives attention. The third area of research focuses on sustainable production.

This program area aims at the creation of more innovative, high-valued products that can reduce reliance on consumption of natural resources and energy. In particular, it focuses on theories, tools, methods, and organization to design, operate, maintain, remanufacture, and recycle those innovative products. Embedded intelligence is regarded as a key technology for this kind of products. Designing not only at product level but also at systems level including life cycles, services, and business is of particular interest.
The educational program of the section PTO includes 4 specialisations. These are:

- Production Technology (PT)
- Industrial Organisation (IO)
- Design and Life Cycle Engineering (DL)
- Maintenance Engineering (ME)

Together the different subjects of the specialisations cover the entire life cycle of products. A detailed overview of the educational program is given on the next pages. 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 of the research themes of PTO or in industry. Every student of PTO is expected to give oral presentations about his/her literature or research assignment, and about the results of the final assignment.

Courses Production Technology and Organisation

Summary specialisation curriculum in (EC)	PT	DL	IO	ME
Obligatory core courses (incl PTO-lab exercises)	24	24	24	24
Obligatory subjects in Specialisation	16	15	15	31
Elective subjects	15	21	22	15
Industrial training or "Practicum in Industry"	15	(15)	15	--
Design/research assignment , literature thesis or combination of both	15	(15)	9	9
Master thesis	35	45	35	41
Total	**120**	**120**	**120**	**120**

Obligatory courses PTO			
Course code	Course name	Lecture hours	EC
wb2414	Mechatronics design	2/2/0/0	3
wb3417-03	Discrete systems	2/2/0/0	4
wb5414-03	Design of machines and mechanisms	2/2/0/0	3
wb5417	Innovation of manufacturing	0/2/2/0	3
wb5420-03	Design of production systems	4/0/0/0	3
wbo402-1-03	PTO lab exercises	2/2/6/6 or 6/6/2/2	8
		Total	**24**

1.5.4.1 Specialisation Production Technology

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Production Technology focuses on the technical knowledge and management of the entire manufacturing system including processes, machines, and tools. The student acquires knowledge and skills to develop the most suitable production and assembly processes for advanced discrete products, with an emphasis on the technology. 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 innovating the production engineering knowledge within these companies. The young engineer is for instance responsible for introducing new technological developments, or implements the integration of the product design and the production department, or leads a project on further optimisation and rationalisation of entire production systems.

The individual assignments are done within the context of PT's technology oriented research or in co-operation with our industrial relations, and offer a wide variety of challenges, like fundamental modelling of manufacturing processes, experimental research on processes using our laboratory infrastructure, design and realisation of mechatronic tooling for micro-assembly, and production system optimisation.

Examples of recent assignments include:
- Force measurement in high pressure water jet machining, experimental research assignment;
- The design and realisation of a micro-vacuum gripper, design 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, internal MSc assignment in co-operation with DIMES (Delft Institute for Microelectronics and Submicron Technology);
- Realising a main leap forward in the performance of an assembly factory, MSc assignment in co-operation with Philips Shavers, NL.
- 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 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 new 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 PTO. 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.

Courses Production Technology

Obligatory courses specialisation Production Technology			
Course code	Course name	Lecture hours	EC
wb5421-03	Modelling of manufacturing processes	0/0/2/0	3
wb5422-03	Industrial assembly	0/0/4/0	3
wb5425	Fundamentals of machine tools	0/0/2/0	2
wb5432-03	Fundamentals of material removal processes	0/0/0/2	2
6 EC to select; the others may be proposed as part of the electives courses			
wb1442	Introduction microsystems	2/2/0/0	3
wb2303	Measurement theory and praxis	2/2/0/0	3
wb2427	Predictive modelling	0/0/4/0	3
wb2428	Mechanical construction principles	4/0/0/0	3
		Total	**16**

Recommended elective courses specialisation Production Technology			
Course code	Course name	Lecture hours	EC
ae4-485	Manufacturing engineering		3
ae4-686	Sheet metal forming		3
et4131	Sensor systems for robots		3
et4137	Fuzzy Logic for Engineering Applications		3
in2410	Databases	0/4/0/0+P	5
in4013tu	Expert systems in a technical environment	0/2/2/0+P	6
in4050tu	Java and Object oriented design	2/2/0/0	6
in4073	Embedded RT systems	0/0/4/0+P	6
mk4442DC	Design of and with materials		3
sc4020	Control theory	4/0/0/0	6
wb1406	Experimental mechanics	0/0/2/2	3
wb1442	Introduction Microsystems	2/2/0/0	3
wb2303	Measurement theory and praxis	2/2/0/0	3
wb2415	Robust control	0/0/0/4	6
wb2427	Predictive modelling	0/0/4/0	3

wb2428	Mechanical construction principles	4/0/0/0	3
wb5303	Tribology	0/0/4/0	3
wb5412	Micro engineering	2/2/0/0	3
wb5430-03	Engineering informatics	0/4/0/0	3
wm0504tu	Industrial organisation A	4/0/0/0	3
wm0610tu	Elementary business economics		2
		Total	**15**

Assignments, internship specialisation Production Technology		
Course code	Course name	EC
wbo4..-03	Small research assignment	15
wbo4..-03	Internship	15
wbo4..-03	MSc assignment	35
	Total	**65**

1.5.4.2 Specialisation Design and Life Cycle Engineering

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Design and Life Cycle Engineering targets educating engineers who can tackle real industrial problems with clear understanding about sustainability issues. They will learn systems engineering approaches in design, and tools and methods of engineering design and engineering informatics. Special attention will be paid to such stages of product life cycle as design, operation, maintenance, recovery, reuse, and remanufacturing. Research topics include design methodologies for innovative machines, advanced design support and management systems, and life cycle management systems.

MSc-thesis Examples of recent and current graduation projects:

- Armed with factual knowledge acquired through courses and integration skills obtained through laboratory exercises you will be able to solve industrial as well as research problems. Master thesis projects in the area of Design and Life Cycle Engineering are mostly design oriented.
- Design and Life Cycle Engineering aims at the development of innovative products, processes and services that contribute to sustainability. A common paradigm is the integration of intelligence into every aspect of the life cycle, primarily the design. An example is the cellular machine project in which we try to invent a new discipline in machine design based on distributed intelligence, self-organization and reconfiguration. This idea is verified with a test-bed with 20

collaborating robots. Students work on the design and simulation of the robots, their local intelligence and their ways of interaction.

- As another example you may develop a creative knowledge intensive design of machines in collaboration with an industrial partner. In this way students have developed an innovative welding machine for automated production of wheel rims for the automotive industries. A modelling approach has been used to predict and control the physical behaviour during the manufacturing process.
- Design methodology is aimed at reflections on design activities as practiced in industry. Abstract level thinking about design helps to achieve breakthroughs in designs as well as in design practices. This research is performed at a theoretical level as well as in collaboration with industry. An example thesis subject is a theoretical work on knowledge structuring followed by a modularization project of an industrial product family (high performance winches for oil industries).
- Life Cycle Engineering requires a holistic and systematic approach to designing, optimizing, managing, and controlling product life cycle systems. To do so we need a tool to simulate product life cycles. Already students developed a life cycle simulator not only for predicting environmental impacts but also envisioning economic performance that allows us to design business models.

Obligatory courses specialisation Design and Life Cycle Engineering

Course code	Course name	Lecture hours	EC
et4102	Mechatronic Design	0/0/2/0	3
id	Product Life Cycle Engineering and Design A	0/0/4/0	3
wb2427	Predictive Modelling	0/0/4/0	3
wb5430-03	Engineering Informatics	0/4/0/0	3
wb5431-03	Life Cycle Engineering	0/0/0/4	3
		Total	**15**

Assignments and internship specialisation Design and Life Cycle Engineering

Course code	Course name	EC
wbo4..-03	Small research assignment	15
wbo4..-03	Industrial Internship	15
wbo4..-03	MSc assignment	45
	Subtotal individual assignments DL	**60**

Recommended elective courses specialisation Design and Life Cycle Engineering			
Course code	Course name	Lecture hours	EC
ae3-410	System Engineering	0/0/4/0	3
ae4-496	Maintenance Engineering	0/0/2/2	3
ae4-711	Sustainable Development	4/0/0/0	3
et4099	Knowledge based control	0/2/0/0	3
et4137	Fuzzy Logic for Engineering Applications		3
et4148	Modern Robotics	0/0/0/4	3
et4161	Information theory	0/0/0/3	3
et4234	Machine Intelligence	0/2/0/0	5
et4245wb	Electromechanical systems	0/0/0/3	4
id5131	Business Marketing for Engineers		3
id????	Product Service Systems		3
in4010/4011	AI (Intro + Knowledge Based)		6
in4073	Embedded real time systems	0/0/4/0	6
sc4020	Control Theory	4/0/0/0	6
tn3534	Pattern Recognition	0/0/2/0	3
wb1440	Engineering Optimization	2/2/0/0	3
wb1442	Introduction micro systems	2/2/0/0	3
wb2424	Mathematics in Systems and Control	2/2/2/2	6
wb2428	Mechanical Construction Principles	4/0/0/0	3
wb5422-03	Industrial assembly	0/0/4/0	3
wb5425	Fundamentals of machine tools	0/0/2/0	2
wi2064	Decision analysis	0/4/0/0	3
wi4052	Risk Analysis	0/4/0/0	3
wi4059	Reliability Theory	0/4/0/0	3
wi4087TU	Optimization: models and algorithms	?/?/?/?	3
wm0102TU	Organisation Psychology		3
wm0304TU	Introduction Philosophy of Science		4
wm0315TU	Introduction to Logic		3
wm0504tu	Industrial organisation A	4/0/0/0	3
wm0506TU	Management of Innovation		6
		Total	**21**

1.5.4.3 Specialisation Industrial Organisation

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Industrial organisation, prepares for designing industrial processes and for positions in line- and staff management in industry and in engineering consultancy. The student learns to analyse a complex industrial problem in a scientific methodological way and to generate an acceptable solution. Great emphasis is put on modelling as an aid to analyse a certain organisational problem, respectively to engineer improved organisations in particular concerning control. The final assignment is directed to a real problem in a company or organisation in the Netherlands or abroad. Applied studies focus on intelligent management of supply chains and supply networks. A second rapid developing area for projects and assignments comprises predictive modelling, simulation and intelligent adaptation of industrial production and service processes.
Professional knowledge of Industrial Organisation has to play a key role for innovations and operations in industry and technical services in particular in medium-sized and large organizations. Graduates will be able to start and fulfil a prominent role in the design and improvement respectively in project- and line-management of essential parts of the value chain in industries like Shell, Philips, Océ, Stork Fokker, Scania, Electrolux and ASML. Also in organisations directed to technical services like KLM, Railways, Origin, KPN, Ericsson and the Armed Forces, Corresponding positions in consultancy graduates will find in organisations aiming for a professional approach of processes and information systems to serve industry on the local and national level and worldwide, for instance positions with Accenture and Cap Gemini.

MSc-thesis

Examples recent and current graduation projects:

- Analysis of Pre-Series at a car manufacturer in Germany
- Engineering Data Management at an aircraft operator
- The design process of a turbo engine assembly line at a car manufacturer in England
- Lead-time improvement in product-innovation at an advanced instruments manufacturer
- Tool for productivity improvement at a Shell company
- Design of an improved lead-time control system to provide test- and other equipment in aircraft maintenance
- Design for improvement of a dispersed manufacturing network in the Shanghai area.

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Obligatory courses in specialisation Industrial Organisation			
Course code	Course name	Lect.h.	EC
wb5428	Applied systems theory	2/0/0/0	2
wbo403-1	Organisation design & final test case	2/0/0/0	2
wbo403-2	Final preparation & oral exam	2/0/0/0	2
wm0104wb	Psychology of Organisation	2/0/0/0	2
wm0501tu	Introduction to Business Engineering	0/4/0/0	(3)
wm0504tu	Industrial Organisation A	4/0/0/0	4
wm0505tu	Industrial organisation B	0/0/4/0	3
		Total	**15**

Recommended elective courses specialisation Industrial Organisation			
Course code	Course name	Lect.h.	EC
ae4-485	Manufacturing engineering	0/0/2/2	3
ae4-490	Maintenance management	2/2/0/0	3
ae4-711	Durable development	4/0/0/0	3
in2025	Introduction database systems	0/4/0/0	6
in2410	Databases	0/4/0/0+P	5
in4028tu	Business systems engineering	0/0/3/0	5
in4029tu	information systems engineering	2/2/0/0	4
wb1310	Multibody dynamics A	0/0/0/4	3
wb2306	Cybernetical ergonomics	0/0/0/4	3
wb4402	Project Engineering	2/2/0/0	6
wb5303	Tribology	4/0/0/0	3
wb5431-03	Life Cycle Engineering	0/0/0/4	3
wi4051tu	Introduction to operation research	2/2/0/0	4
wm0324lr	Engineering ethics	0/4/0/0	3
wm0404tu	Business sociology	2/2/0/0	3
wm0602	Innovation management		3
wm0610tu	Elementary business economics	2/0/0/0	2
wm0781tu	Patent law and – policy		3
wm1102tu	Written English for technologists	-/-/-/-	3
wm1109tu	Scientific writing and oral presentations	0/2/2/0 or 0/0/2/2	3
		Total	**22**

Assignments and internship specialisation Design and Industrial Organisation		
Course code	Course name	EC
wbo403-3-03	Practicum in Industry	15
wbo403-4-03	Literature thesis or Research Assignment	9
wbo403-5/10-03	MSc assignment	35
	Total	**59**

1.5.4.4 Specialisation Maintenance Engineering

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Maintenance engineering and -management includes control of the failure behaviour of technical systems as well as the organisation and control of maintenance related to the operational or production function in industrial enterprises. Structure, effectiveness and efficiency of maintenance processes like workflow, spare parts stock and purchasing, budgets, cost and personnel have to be controlled. Maintenance technology is directed to realisation of maintenance behaviour, configuration management, diagnostics, failure and root cause analysis, development and adjustment of maintenance programs, application of condition monitoring techniques, and determination of residual life.
Maintenance Engineering in our society is assuring integrity (Safety, Health and Environment) of complex capital intensive technical systems. It also ensures durability, increasing the economic lifetime of technical systems. Graduates will be able to fulfil initial positions in industrial enterprises (e.g. Shell, Heineken, Corus) and major organisations of fleet owners (public transportation like NS), shipping (such as HBG, NedLloyd, Heerema) airlines (KLM) as reliability, maintenance or production engineer.
Also positions could be taken with industrial maintenance service providers (like Stork, GTI and Imtech) in technical-commercial functions like contract or account manager for major customers. Also positions could be fulfilled with engineering contractors (Badger, Fluor Daniel) and original equipment manufacturers (Océ, ASML, Airbus) in design for maintenance and support, as project engineer or product support engineer.
Examples of graduation projects:

- Efficiency improvement of maintenance contractors within Dow Chemicals Terneuzen
- Extension of major maintenance visits of wide body aircraft within KLM Engineering and Maintenance
- Development and implementation of Performance Indicators for Plant Maintenance at Shell Pernis Refinery
- Introduction of Maintenance Performance Contracting within GTI Maintenance
- Developing a Business Agent function for the commercial use of International Space Station within ESA
- Introduction of Equipment Condition and Health Monitoring for large Compressor Units at Air Products.

Obligatory course specialisation Maintenance Engineering			
Course code	Course name	Lect.h.	EC
ae4-490	Maintenance management	2/2/0/0	3
ae4-496	Maintenance technology	0/0/2/2	3
ide343	Development operational safety	0/2/2/0	4
In2041TU	Introduction databases	3/0/0/0	4
wi4051TU	Introduction to operation research	2/2/0/0	4
wi4059	Reliability theory	0/4/0/0	3
wi4070TU	Digital simulation A	4/0/4/0	4
wm0504tu	Industrial Organisation A	4/0/0/0	4
wm0610tu	Elementary business economics	2/0/0/0	2
		Total	**31**

Recommended elective courses specialisation ME			
Course code	Course name	Lect.h.	EC
ae4-485	manufacturing engineering	0/0/2/2	3
ae4-711	Sustainable development	4/0/0/0	3
et3026wb	Electrical power drives	0/0/3/0	4
in2025	Introduction database systems	0/4/0/0	4
mk3421	Corrosion	-/-/-/-	3
mk5171	Welding technology	0/2/2/0	3
mk5291	Non-destructive research	0/0/2/2	3
mk5621	breaking mechanics	-/-/-/-	3
mk5631	Damage analysis	-/-/-/-	3
mk6261tu	Breukleer	4/0/0/0	3
wb4300b	Introduction pumps and compressors	0/0/2/0	2
wb4402	Project engineering	2/2/0/0	6
wb5201	Power drives	0/0/2/2	3
wb5303	Tribology	4/0/0/0	3
wb5400	Tribology in machine design	0/2/2/2	4
wb5431-03	Life Cycle Engineering	0/0/0/4	3
wi4052	Risk analysis	0/4/0/0	3
wm0104wb	Psychology of organisation	2/0/0/0	2
wm0324LR	Engineering ethics	0/4/0/0	3
wm0404tu	Business sociology	2/2/0/0	3
wm0611tu	Calculation information	0/2/0/0	2
wm0621tu	Innovation management		3

wm0781tu	Patent law and - policy		3
wm0801tu	Introduction safety engineering	0/4/0/0	3
wm1102tu	Written english for technologists	-/-/-/-	3
wm1109tu	Scientific writing and oral presentations	0/2/2/0 0/0/2/2	3
		Total	**15**

Assignments and internship specialisation Maintenance Engineering		
Course code	Course name	EC
wbo?..-03	Industrial Internship	--
wbo?..-03	Literature thesis or Research Assignment	9
wbo?..-03	MSc assignment	41
	Total	**50**

1.5.5 Variant Solid and Fluid Mechanics

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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 specialization.
The program is organized on the basis of a joint curriculum and four specializations. These are:

- Fluid Dynamics
- Engineering Dynamics
- Mechanics of Materials
- Structural Optimization & Computational Mechanics

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

Obligatory courses variant	23 EC
Obligatory courses specialisation	15 EC
Elective courses	12 EC
Assignments and projects	70 EC

Obligatory courses variant Solid & Fluid Mechanics			
Course code	Course name	Lecture hours	EC
ae4-900	Continuum Mechanics	0/0/4/0	4
ct5142	Computational Methods in Nonlinear Mechanics		3
wb1409	Theory of Elasticity	2/2/0/0	4
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	**23**

1.5.5.1 Specialisation Fluid Mechanics

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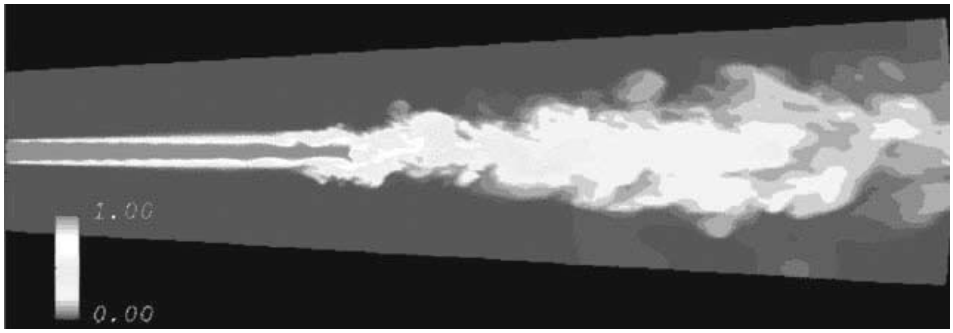
The specialization of fluid mechanics is offering training in the fundaments of incompressible fluid flow. The areas, to which most attention is directed, are turbulence and multi-phase flow and these are in particular the areas, which occur in many industrial and environmental applications. In view 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 developments in the application of numerical tools to fluid mechanics in particular with respect to the simulation of turbulence. Fluid mechanics is a strongly non-linear 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 techniques. 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.



1.5.5.2 Specialisation Engineering Dynamics

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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).

1.5.5.3 Specialisation Mechanics of Materials

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The continuous improvement of mechanical products and processes requires a flexible design method. 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 modeling of the material behavior, numerical simulation, design of appropriate optimization 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. Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of (micro-) composite materials. Because of the continuing miniaturization in this area some new concepts in mechanics as well as in experimental methods should be 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, LMS Int., Thales, Siemens, Kriton, Motorolla and DSM.

1.5.5.4 Specialisation Structural Optimization and Computational Mechanics

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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 also other disciplines are involved, for example, production, electrical, material sciences, etc. The educational program 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 program are composite structures, micro-electrical-mechanical-systems (MEMS) and biomedical applications. Master theses will typically be related to these fields of application and can be carried out in collaboration with other research institutes or industry.

Recommended elective courses (≥ 37 EC)			
Course code	Course name	Lecture hours	EC
ae4-140	Gasdynamics I	2/2/0/0	3
ae4-141	Gasdynamics II	0/0/2/2	3
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
lAe4-30	Aero-Elasticity	0/0/2/2	3
mk26	Fracture Mechanics	4/0/0/0	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
tn3782	Multiphase Flow	0/0/2/2	6
wb1310	Multibody Dynamics A	0/0/0/4	3
wb1402a	Plates and Shells	2/4/0/0	4
wb1405a	Buckling Analysis	0/0/4/2	4
wb1406	Experimental Mechanics	0/0/2/2	3
wb1408	Mechanics of pressure vessels	2/2/0/0	3
wb1412	Non-linear vibrations	0/0/2/2	3
wb1413	Multibody Dynamics B	0/0/2/2	3
wb1416	Computational Engineering Mechanics	0/0/2/2	3
wb1417	Fluid-structure interaction	0/0/0/2	2
wb1424atu	Turbulence A	0/0/2/2	6
wb1424b	Advanced turbulence	0/0/2/2	3
wb1430a	Composite Materials for Durable Structures	2/2/0/0	3
wb1430b	Fibre Reinforced Plastics - continued course	0/0/4/4	6
wb1432	Mechanics of Fibre Reinforced Plastics	2/2/0/0	4
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
wb4300a	Heat and Mass Transfer Apparatus	4/0/0/0	3
wb5303	Tribology	0/0/4/0	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		4
wm0605tu	Business Economics for Engineers		4
wm0621tu	Innovation Management		3
wm1101tu	Upper-Intermediate English (refresher)		3
wm1102tu	Written English for Technologists		3

1.5.6 Variant Biomedical Engineering

Coordinator Prof.dr.ir. F.C.T. van der Helm +31 15 2785616 f.c.t.vanderhelm@wbmt.tudelft.nl

Regarding the social and economical impact there is a great demand for engineers specialised in BioMedical Engineering (BME). Nationwide, there are large investments in medical devices and medical research. In the design of the medical devices and in the medical research, engineers with a biomedical specialisation have an important role. Most engineers receive a mono-disciplinary education, e.g. in electrical, civil or mechanical engineering. In contrast, the largest scientific progress is made in the fields where the traditional disciplines meet or even overlap. Biomedical engineering is a multi-disciplinary specialisation with great challenges, in which well-educated engineers can make a large progress. In addition to the technical challenges, BME also appeals to the social responsibility of the engineer. A more direct relation to the improvement of the quality of life is hard to find.

At Delft University of Technology two MSc educations offer a variant in BME, i.e. Electrical Engineering and Mechanical Engineering. In the BME variant there is a close collaboration with clinical partners at Leiden University Medical Center (LUMC), Erasmus University Rotterdam (EUR) and the Amsterdam Medical Center (AMC). The clinical partners participate in the teaching and in the tutoring of the MSc final year projects.

The goal of the BME specialisation is to educate engineers with excellent technical skills and knowledge, who have additional medical and biological knowledge, experience in medical applications and experience in the multi-disciplinary collaboration with physicians and other researchers in the biomedical field. Research-oriented as well as design-oriented MSc students will be educated.

Within the BME variant in the MSc Mechanical Engineering program, a choice can be made between three specialisations:

- Medical Instrumentation & Medical Safety: The development surgical instruments and medical devices; analysis of clinical procedures to reduce failures.
- Biomechatronics: The development of mechanical and electronical devices for aiding the motion control functions of the patient
- Tissue Biomechanics & Implants: Analysis of the mechanical behaviour and interaction between implanted devices and body tissues.

The specialisations are closely related to the research in the Dept. of Mechanical Engineering, especially in the subdivision Medical Technology and Mechanics, consisting of the research groups Man-Machine Systems & Control and Structural Optimization.

All students with a technical BSc can start the MSc variant in Biomedical Engineering, if the general requirements for the MSc program in Mechanical Engineering are fulfilled. In the 1st year the programme consists of roughly 50% Medical Technology and Biophysics classes and 50% fundamental technical classes. In the Medical Technology and Biophysics classes the clinical and technical partners will both participate. The physicians will explain the clinical problems and viewpoints, as well as the progress in clinically related research. From the engineering viewpoint, there will be an emphasis on the technical and biophysical aspects, i.e. what is the state of the art in design, modelling and simulation.

Here, the relation will be made with the engineering background of the students. In the 2nd year there will be a stay in a biomedical research group or company, and a MSc thesis project in Biomedical Engineering. In order to assure the multi-disciplinary nature of the BME education, the MSc thesis project will be tutored by a technical as well as a clinical staff member.

Medical Instrumentation & Medical Safety (MI & MS)	Prof.dr.ir. Peter A. Wieringa	+31 15 2785763
Medical Instrumentation & Medical Safety (MI & MS)	Prof.dr. Jenny Dankelman	+31 15 2785565
Biomechatronics (BM)	Prof.dr.ir. Frans C.T. van der Helm	+31 15 2785616
Tissue Biomechanics & Implants (TBI)	Prof.dr.ir. Fred van Keulen	+31 15 2786515
secretary	Mrs. Marianne Stolker	+31 15 2786513

Specific Biomedical Engineering courses (20 obligatory and 10 elective)	30 EC
Other Mathematics and Engineering courses (20 obligatory and 10 elective)	30 EC
Traineeship	10 EC
Literature study	10 EC
MSc thesis	40 EC
Total	**120 EC**

Specific Biomedical Engineering courses
(o: obigatory courses; r: recommended elective courses; e: elective courses).

Course code	Course name	Lecture hours	EC	MI&MS	BM	TBI
et4-126	Medical technology		3	o	o	o
et4-127	Theme course biomedical technology		3	e	e	e
et4-128	Health care systems		3	o	o	o
et4-129	Physical measurement mehods and image techniques		3	e	e	e
et4-130	Bio-electricity		3	e	e	e
ide530	Biomechanics		3	e	e	e
ide534	Ergonomical aspects data processing systems		2	e	e	e
ide5381	Design ergonomics for elderly and handicapped		3	e	e	e
ls1061	Cell biology 1		3	e	e	r
tn3433	Physical image techniques		3	e	e	r
tn3435	Pattern recognition		3	e	e	r
tn399	Radiation dosimetrie (intensive course IRI)		6	o	e	e
wb2308	Biomedical engineering design	2/0/0/0	4	o	o	e
wb2407	Human movement control	2/2/0/0	4	r	o	o
wb2408	Physiological systems	0/4/0/0	3	o	r	o
wb2431	Bone mechanics and implants	0/2/2/0	3	e	r	o
wb2432	Biomechatronics	0/0/2/2	4	r	o	o
wb2435-03	Surgical instruments and medical safety	2/0/0/0	2	o	r	r
		Total EC obligatory BME courses		21	18	20

Mathematics, Engineering and other courses
(o: obigatory courses; r: recommended elective courses; e: elective courses)

Code code	Course name	Hours	EC	MI&MS	BM	TBI
ctxxxx	Computational modelling of materials		3	-	-	o
sc4020	Control theory	4/0/0/0	6	r	o	e
wb1409	Theory of elasticity	2/2/0/0	4	e	e	o
wb1410	Continuum mechanics	0/0/4/0	4	e	e	o

wb1413	Multibody dynamics B	0/0/2/2	3	r	o	r
wb1440	Engineering optimization: concept and applications	2/2/0/0	3	e	e	o
wb2301	System identification and parameter estimation	0/0/2/2	7	o	o	e
wb2303	Measurement techniques	0/0/2/2	3	o	e	e
wb2309	Introduction specialisation MMS and BME	2/0/0/0	1	o	o	-
wb2404	Man-machine systems	2/2/0/0	4	o	o	e
wb2413	Instrumentation	0/0/2/2	3	o	e	r
wbp202	Haptics system design		4	o	o	e
ct5142	Computational methods in non-linear mechanics		3	-	-	r
ide521	Computer visualisation		3	e	e	e
in006tu	3D computer graphics		4	e	e	e
mk26	Fracture mechanics		3	-	-	r
sc4110	System identification B	0/0/2/2	5	e	e	e
wb1310	Multibody dynamics A	0/0/0/4	3	e	e	e
wb1406	Experimental mechanics	0/0/2/2	3	e	e	e
wb1416	Computational engineering mechanics	0/0/2/2	3	e	e	e
wb1427-03	Advanced fluid mechanics A	2/2/0/0	5	-	-	e
wb1428	Computational fluid dynamics	0/0/2/2	3	-	-	e
wb1430a	Introduction to fibre reinforced plastics	2/2/0/0	3	-	-	e
wb1432	Mechanics of fibre reinforced plastics	2/2/0/0	4	-	-	e
wb1441	Engineering optimization 2	0/0/2/2	3	-	-	e
wb2306	Cybernetical ergonomics	0/0/0/4	3	e	e	e
wb2402	Hydraulic servo systems	2/2/0/0	3	e	e	e
wb2414	Mechatronical design	2/2/0/0	3	e	e	e
wb2421	Multivariable control systems	0/0/4/0	6	e	e	e
wb2422	Modelling 2	0/4/0/0	6	e	r	e
wb5303	Tribology	0/4/0/0	3	-	-	e
wb5412	Micro techniques	0/0/2/2	3	e	e	e
wi4008	Complex analysis		4	-	-	e
wi4011	Numerical fluid dynamics		6	-	-	e
wi4014tu	Numerical analysis C2		4	-	-	r
wi4017	Non-linear differential equations		6	e	e	e
wm0605tu	Business economics for engineers		4	e	e	e
wm0621tu	Innovation management		3	e	e	e
wm1101tu	Upper-Intermediate english (refresher)		3	e	e	e
wm1102tu	Written english for technologists		3	e	e	e
	Advanced dynamics (new)		4	-	-	r
		Total		**30**	**30**	**30**

1.5.7 Annotations

As an addition to the variant programme there are three 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 Offshore Technology
c Sustainable Development

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

Annotation Technical Marketing

The Technical Marketing annotation offers students the possibility to get 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 between 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 10 EC marketing courses and 16 EC of the MSc- thesis should be devoted to marketing aspects. This means that a major 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. 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.
The responsible lecturer for Technical Marketing is prof. mr. dr. ir. Sicco C.Santema (phone +31 15 27 83076; e-mail S.C.Santema@io.tudelft.nl).

Obligatory courses annotation Technical Marketing

Course code	Course name	Lecture hours	EC
ID4141	Consumer research	0/0/3/3	6
ID5131	Business marketing for engineers	0/0/2/0	3
IDE511	Integral aspect of business marketing	0/0/0/4	3
		Total	**12**

Annotation Offshore Technology

The Participant's guide to the interfaculty Offshore Technology MSc curriculum can be obtained from DICOT (W.W. Massie MSc, tel. +31 15 27 84614).
The Offshore Technology annotation offers students the possibility to get knowledge and skills with regard to the complete field of offshore engineering. It is an interfaculty study programme, which is offered via the Delft Interfaculty Centre for Offshore Technology (DICOT). The annotation can be obtained in combination with a number of variants and specialisations.

The study programme will be determined in consultation between student, lecturer responsible for the chosen variant and specialisation and the responsible lecturer for Offshore Engineering (prof. Meek or W.W. Massie). The offshore component in the study programme consists of at least 35 EC offshore courses and the master thesis should be devoted to an offshore technology subject. This means that the elective courses have to be used for offshore engineering; some of the obligatory courses for the chosen variant and specialisation may be left out in consultation with the lecturers. The offshore content of the master thesis should be complementary to the chosen variant and specialisation.
Both the lecturer of the chosen variant and specialisation and an offshore lecturer will guide the student.

Obligatory courses annotation Offshore Technology

Course code	Course name	EC
ot4600	Survey of offshore technology	10
ot4615	Oceanography and waves	6
ct4130	Probabilistic design	4
ot4620	Offshore hydromechanics	7
	total	**27**

Elective courses annotation Offshore Technology (at least 8 EC)

Course code	Course name	EC
ot4624	Offshore soil mechanics	3
ot4651	Bottom founded structure design	6
ot4652	Design of floating structures	4
ot4653	Subsea engineering and marine pipelines	4
ot4561	Offshore moorings	4
ot4654	Subsea engineering design	4
ot4662	Offshore windfarm design	4

Annotation Sustainable Development

Sustainable development is becoming of increasing importance. Questions are: "What does the world look like in 50 years?" or: "What should the world look like in 50 years?". The curriculum is based on elective courses, a colloquium and the MSc-Thesis. The aim of the colloquium is to develop broad knowledge of all kinds of environmental an technical issues and to place this in perspective.

The curriculum should include:
- colloquium in sustainable development of 3 EC
- Courses to be chosen from the following two clusters (at least 6 EC from each cluster):
  - Technology and Design
  - Organisation and society
- MSc-thesis, which shall be devoted also to sustainable development. The coordinator shall approve the problem formulation of the thesis and the extent to which sustainable development is integrated into the thesis. The coordinator shall further determine whether the theme of sustainable development has been sufficiently integrated into the problem formulation, the execution of the project and the project report.

Further information on the available courses can be obtained at the website http://www.odo.tudelft.nl and from dr.ir. C.A. Infante Ferreira (phone: +31 15 27 84894, email: c.a.infanteferreira@wbmt.tudelft.nl), who is the coordinating lecturer for Mechanical Engineering, with regard to sustainable development.
For enquiries concerning the colloquium and enrolling: Gertjan de Werk, g.dewerk@tbm.tudelft.nl.

1.5.8 Technical University Teacher Course (TULO)

Graduated Masters of Science Mechanical Engineering or Maritime 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 EC can be integrated in the MSc study programme, the other, at least, 30 EC 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: +31 15 27 82786 / +31 15 27 83768
E-mail: j.geerlings@tbm.tudelft.nl

1.6 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. Also information is available at the website: http://www.sfc.tudelft.nl.

If you got a clear idea about where you want to go to, you can ask the Coordinator for International Exchange Mechanical Engineering 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 specialization 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 is available at the website:
http://www.sfc.tudelft.nl.

Coordinator for International Exchange Mechanical Engineering
dr.ir. D. Nijveldt
Room 8B – 2 - 27
Mekelweg 2
2628 CD Delft
Phone: +31 15 27 85921
Fax: +31 15 27 88340
E-mail: d.nijveldt@wbmt.tudelft.nl

1.7 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).

1.8 Pass rules and criteria for 'honours-degree'

Pass rules To pass a course or assignment, a grade of at least 6 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.

'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 8
- not more than 2,5 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.

1.9 Honours Track

During the course year 2003-2004 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 Mechanical Engineering 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.

1.10 Profile of the Mechanical Engineer

MSc graduates of Mechanical Engineering find their jobs in nearly all branches of industry, in management, design office, research, development or technical department. An increasing number of engineers plays a role in giving advice on and selling high-grade products and capital-intensive equipment. In our technologically highly developed society government bodies constantly need people with a technical-scientific education, i.a. for policymaking. In scientific education too mechanical engineers have their jobs.
The combination of broad technical-scientific BSc-programme and large choice of specialisations within the MSc-programme, give the mechanical engineer from Delft a versatile employability. This versatility is illustrated by the variety of professions, among which there are: designer, scientific researcher, organization expert and automation consultant. Many engineers occupy management positions within a short period: between 25 and 30 % lead a team of 5 to 6 persons in average within about one year.
The labour-market perspectives for Mechanical Engineers with scientific education from Delft are excellent: 91% of the 1999/2000 graduates had a paid job within three months, 66% with a permanent appointment. The average monthly salary in 2001was € 2420 (the average for Mechanical Engineers from all universities: € 2400). 2% of the graduates received further education.

1.11 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')

Two students are writing a paper about the position taken by the World Bank regarding the construction of dams in India. Their introduction is an unmarked word-for-word transcription of an article published on the Internet, devoid of any acknowledgement of its source. They write the remainder of the paper themselves, based on various sources which they do happen to list in a bibliography. The lecturer marking the paper is familiar with the introductory article and disqualifies the

Organisation

2 Organisation

2.1 Faculty

The faculty Mechanical Engineering and Marine Technology offers the study programmes Mechanical Engineering (ME), Marine Technology (MT) and Systems and Control (SC).
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 education director. 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. ir. W. L. Dalmijn, room 8F – 1 –14, phone: 015 27 85401, e-mail: w.l.dalmijn@wbmt.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@wbmt.tudelft.nl	Tel. 015 27 81556
ir. Nic-Jan van Bemmel	Manager Educational Programmes	n.j.vanbemmel@wbmt.tudelft.nl	Tel. 015 27 88791
Fatma Çinar	Education Administration office	f.s.cinar@wbmt.tudelft.nl	Tel. 015 27 86753
Teuni Eden	Student adviser	t.eden@wbmt.tudelft.nl	Tel.015 278 2176
Lies Gesink	Education Administration office	e.g.gesink@wbmt.tudelft.nl	Tel. 015 27 86591
Aad Gutteling	Study Administration office	a.gutteling@wbmt.tudelft.nl	Tel. 015 27 86753
Louise Karreman	Study Administration office	l.m.karreman@wbmt.tudelft.nl	Tel. 015 27 83457
Ewoud van Luik	Manager Education Administration office & webmaster	e.p.vanluik@wbmt.tudelft.nl	Tel. 015 27 85734
dr. ir. Dick Nijveldt	Educational Adviser & Coordinator international exchange	d.nijveldt@wbmt.tudelft.nl	Tel. 015 27 85921
Carel Piguillet	Software Support	c.f.f.piguillet@wbmt.tudelft.nl	Tel. 015 27 86820
ir. Jaap v.d. Zanden	Student adviser	j.vanderzanden@wbmt.tudelft.nl	Tel. 015 27 82996

Education Support Staff
Mekelweg 2, 2628 CD Delft
Location 8B, 2th floor
Phone: 015 27 86959 / 015 27 83457
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
room 8C-0-01
Mekelweg 2
2628 CD Delft
phone: 015 27 85606
e-mail: s.dijkstra@wbmt.tudelft.nl

Secretary mrs. L.M. Karreman
room 8B-2-305
Mekelweg 2
2628 CD Delft
phone: 015 27 83457
e-mail: l.m.karreman@wbmt.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@wbmt.tudelft.nl

Secretary E.P. van Luik
room 8B-2-33
Mekelweg 2
2628 CD Delft
phone: 015 27 85734
e-mail: e.p.vanluik@wbmt.tudelft.nl

2.5 Students association

'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 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. Gezelschap Leeghwater manages the Lecture Response Computer ("College Responsie Computer") in front of lecture room C. 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 theeducation programme, organization and lecturers. This person can be contacted by onderwijs@leeghwater.nl

Book selling

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.
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.

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. 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.

mrs. Teuni Eden, for all students BSc-MSc WbMT.
Specialisms: exchange students, social programme exchange students
Mekelweg 2, 8B 2th floor, room 28B
Email: t.eden@wbmt.tudelft.nl
Phone: 015 27 82176
Consulting hours on mondays en wednesdays from 12.30 till 13.30 hrs.

ir. Jaap v.d. Zanden
Specialisms: MSc students, polytechnic high school students, quality control, student mentors
Mekelweg 2, 8B 2th floor, room 28A
Email: j.vanderzanden@wbmt.tudelft.nl
Phone: 015 27 82996
Consulting hours on tuesdays en thursdays from 12.30 till 13.30 hrs.

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

Working conditions and RSI

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 WbMT website, that helps you to prevent RSI: http://www.wbmt.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
- 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

2.7 Quality Control

The education quality 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, together with the education director advises the dean.

Internal Quality Control:

SENSOR
- To evaluate the opinion of the students the "**SENSOR-course-evaluation-system**" (CENS) exists. This system gives all students the opportunity to give their opinion on the education anonymously. The study programme and courses are evaluated for each period. The results of evaluations can be found on the website, as well as the pass rates.

Poll
- At the end of each year there is a poll: 'eindejaarsenquête'.
- Regular **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.
- The student association establishes "Lecture Response Groups". These groups publish, together with lecturers, in the 'Meer dan Konsumentengids' their comments on the courses. They also give a direct feedback to lecturers.

External quality control:

- The study is being examined every five years, by a accreditation committee. This results in index numbers and efficiency performance indicators.
  For more information see www.vsnu.nl.
- **ABET** Every six years the educational programme is examined and evaluated by the ABET (Accreditation Board for Engineering and Technology, in Baltimore, USA). This takes place on voluntary base.

2.8 Information services

Study guide

This study guide is the main information source of the study programme and is available to all students at the study administration.
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 these schedules are given.
Information that is not related directly to the study e.g. information by students association 'Gezelschap Leeghwater', will be published on publication boards. Members of 'Gezelschap Leeghwater' will be kept informed by e-mail.

2.9 Rules and Regulations

Faculty regulations

- 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 get 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 TU Delft and also serious misdemeanours (misdragingen) will be mentioned to the proper authorities.

Student Statute (Studentenstatuut)

The Education Specific Part of the Student Statute (OSDS) applies to the education and the exams of the study Mechanical Engineering.
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 Mechanical Engineering (CER, see appendix 6.1)
- Implementation Procedures (appendix 6.2)
- Regulations and guidelines for the board of examiners (appendix 6.3)

Internet facilities

Using the 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

The locations of facilities, as mentioned in this chapter, can be found at the faculty map in appendix 6.7. In this study guide is being referred to this map, with a number and a letter, which corresponds to a certain part of the building. The floor is also indicated (BG= ground floor, 1st = first floor, etc.).

3.1 Lecture Rooms / Meeting Rooms

Lecture rooms are used for lectures, (graduation) presentations and instructions. The next table shows all the lecture rooms, their capacity and their location.

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
M	20	8A, 2nd, room 17
R	70	6, BG
Meeting room 4		8B, 2nd
Meeting room 5		8B, 2nd

Meeting rooms are available for meetings, discussions etc. of small groups of students. Reservations can be made as the desk of the education administration.

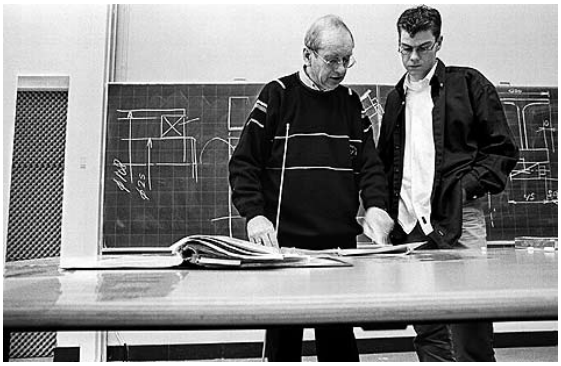
3.2 Student work facilities

Study places

At several locations in the faculty individual study places are available. Some of these study places are equipped with computers. Every student can use such a place. It is not possible to make a reservation. No student has to vacate a study place for a fellow student. Places should be left clean and tidy.

Study places in the library

Besides the study places as mentioned above, there are also places to study in the library. Individual students can use these places. 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 different study places, there are computers available in the computer rooms. Each computer room is provided with a network printer. All computers give access to the internet. The computer rooms are sometimes 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. If computer rooms are not in use for instructions or assignments, individual students can use them.
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 e.g. the MSc-Thesis or an laboratory exercise in these laboratories. The laboratories are used for research activities of Ph.D.- Students and staff.
The different laboratories are:

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: 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 Thermal Power Engineering and Refrigeration

Contact Laboratory manager: M. dr Groot
Phone: 015 27 81821
Location Leeghwaterstraat 37b

Laboratory of Dredging Technology and Bulk Transport

Facilities Cutting Tank, Deep Tank, Hydraulic Circuit
Contact Laboratory manager: A. den Hollander
Phone: 015 27 86530
Location: 3B, BG

Laboratory for process equipment

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

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 libraries in each faculty. The main building has a large collection of books, reference books and magazines. The main part of the collection can be lent from the library, a smaller part is only available within the library. The main part of the collection has to be requested and will be available at the desk within half an hour after requesting. The other part, like study books and lecture notes, is available in the bookcases in the back of the building. 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 should posses a library card. This pass can be acquired at the desk in the main building or at the library of the student's faculty.

Opening hours Monday to Thursday 9:00 - 24:00
Friday 9:00 - 18:00
Saturday and Sunday 10:00 - 18:00

Book desk Monday to Thursday 9:00 - 19:00
Friday 9:00 - 17:00
Saturday 10:00 - 13:00

Books can be borrowed for a period of 28 days. This term can be extended as long as no ther person makes a reservation for the book.
The central library is behind the auditorium (aula) at the Prometheusplein, see appendix 6.5.

Faculty Library

The faculty library is a part of the TU Delft library. It has a collection, specifically for Mechanical Engineering and Marine Technology. This doesn't mean that all books on these subjects can be found here. A part of the books on Mechanical Engineering and Marine Technology can be found in the central library. In the faculty library the lecture-notes and books, used in the study, are available. These books and lecture-notes are not lent out in general. The faculty library also offers places to study. Print and scan equipment is available and there are several recent technical magazines. The library is located at the ground floor in section 8D.

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

Most lecture notes, which are used for lectures at the faculty, are available at the selling point for lecture notes, at the repro. Also books and office articles are available.
Opening hours: Monday to Friday 9:00 - 16:00
http://www.io.tudelft.nl/repro/, 015 2783062
Location 10, BG.

3.7 Mailbox and access to the internet

E-mail account Each student has the possibility to communicate on the Internet. Therefore each student gets an e-mail account. This e-mail account is connected to the faculty server. It is also possible to use this account at home. Students also get an account on the NT-computers in the faculty. At these computers the student is able to access the Internet, print and use other network facilities.

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@wbmt.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 Available software

Software on the working places

The student is able to use a large variety of software provided on the computers at the faculty. The table below shows all available software in the computer rooms and the project tables.

Acrobat Reader 5.1
Adams 12
Ansys 5.7.1
Autocad 14
Autocad Lite 2002
Borland Pascal 7.0
Card
CMS
Corel Draw
Flash
GSP 9.111
Holtrop
Internet Explorer 6.0
Maple 8
Mathcad 5.0
Mathtype 4
Matlab 6.1
Microsoft Frontpage 2000
Microsoft Office 2000
Microsoft Visual Basic 6.0
News Xpress
Paint Shop Pro 7
Powerarchiver 6.1
Pro Engineer 2001
Qres
Real One Player
Shockwave
SMS
Sophos Antivirus
TAS
TNT Lite 6.6
WBalance
Workpace
WS-FTP LE 5.08

3.9 Catering

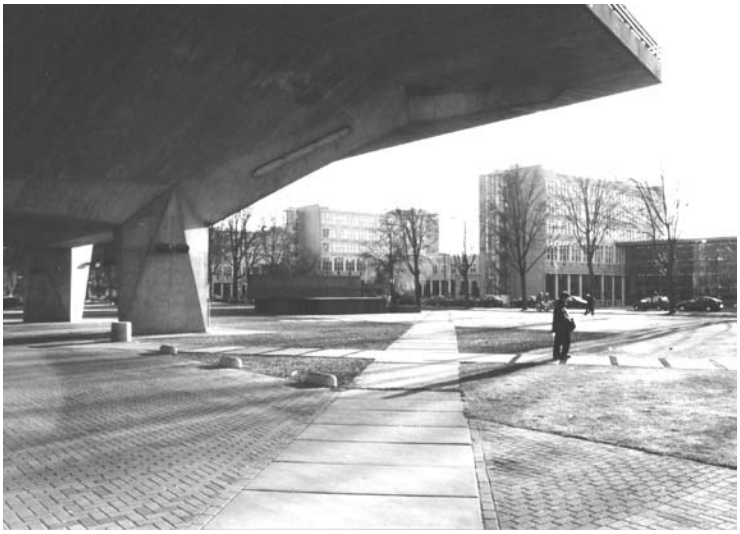
The faculty offers a variety of catering facilities.

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 in the main hall (8F). Chairs and couches are available. Opposite of the coffee corner there are dispensers for serve coffee, candy bars, sodas and soup. Paying at these dispensers is only possible by using a chipknip.

Faculty room The faculty room is a place for giving symposia, meetings or graduation drinks ("afstudeerborrels"). A reservation can be made at the reception desk (6).

Lagerhuysch The Lagerhuysch is situated in the cellar beneath section 8B. There is an access on the square in front of the faculty. The Lagerhuysch offers the possibility for giving graduation drinks (afstudeerborrels), but also for organising symposia and meetings. The students associations Gezelschap Leeghwater and William Froude regularly organise a reception. 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 appendix 6.5 for the location of the auditorium.

Service for Students

4 TU - Services for students

The TU Delft provides several service centres for students:
- Student Facility Centre
- Sports Centre
- Cultural Centre TU Delft 'Mekelweg 10'
- Library TU Delft

For all other services: refer to the TU Delft 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 the TU Delft
- 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 facilities:
- Indoors, this means accommodation 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.

Also 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, visual, communicative, musical and dancing. 'Mekelweg 10' also supports cultural activities of student organisations and members of staff of TU Delft.

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

Cultural Centre TU Delft '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 exploit 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

N.B.: All courses are given in English, otherwise a notification is given in the course descriptions:

- **NL:** means that the course is only given in Dutch
- **NLR:** means that the course is given in Dutch, on request the course is given in English
- **??:** Unknown at the time of writing

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	**NLR**

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 **NLR**

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 **NLR**

wb1330	Design in Fibre Reinforced Plastics		
Lecturer	Jansen, dr. ir. K.M.B.		
Course Material	Lecture notes: Nijhof, Ir. A.H.J., "Ontwerpen in vezelversterkte kunststoffen."		
Description	Design in fibre reinforced thermosets. Utilizing dependency on orientation of mechanical properties in building up material and objects. Laminates and sandwich constructions. Wound cylinders: pipes and vessels. Prototypes of cardan shafts and flywheels		
Education	Lecture 0/0/2/0	**EC** 2	
Assessment	Written		**??**

wb1402A	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 2/4/0/0	**EC** 4	
Assessment	Oral + assignments		**NLR**

wb1405A	Stability of Thinwall 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		**NLR**

wb1406	Experimental Mechanics		
Lecturer	Booij, 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** 3	
Assessment	Report + oral exam		**NL**

wb1408	**Mechanics of Pressure Vessels**		
Lecturer	Ernst, prof.dr.ir. L.J.		
Course Material	Copies of overhead sheets		
Description	Shells, pressure vessels, engineering codes, design for reliability, simulations		
Education	Lecture 2/2/0/0	**EC**	3
Assessment	Oral exam + exercises		**NL**

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	**Non-lineair Vibrations**		
Lecturer	Woerkom, dr.ir. P.Th.L.M. van		
Course Material	Lecture notes		
Description	Nonlinearities: engineering cases. Linearization; equivalent linearization; premature linearization; descibing functions. Phase plane analysis. General perturbation theory: asymptotic expansions; Poincaré; Lindstedt; two-variable; Duffing; Van der Pol. Stability theory: Routh-Hurwitz; Lyapunov; Mathieu; time delays; bifurcation; catastrophy. Nonlinear oscillations and chaos.		
Education	Lecture 0/0/2/2	**EC**	3
Assessment	Written report		**NLR**

wb1413	**Mulitbody Dynamics B**		
Lecturer	Schwab, dr.ir. A.L.		
Course Material	Lecture notes		
Description	Dynamics of Mechanical Systems, Multibody System Dynamics, Kinematics, Finite Element Method.		
Education	Lecture 0/0/2/2	**EC**	3
Assessment	Written report of individual assignment		**??**

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 **NLR**

wb1417	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** 2
Assessment	Written report + ANSYS assignment **NLR**

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 **NLR**

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 **NLR**

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	**NL**

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

wb1427-03	Advanced Fluid Dynamics A	
Lecturer	Delfos, dr. R., Nieuwstadt, prof.dr.ir. F.T.M.	
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	**NLR**

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	**NLR**

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		**??**

wb1430a	Composite Materials for Durable Structures		
Lecturer	Marissen, Prof.dr.ir. R.		
Course Material	Lecture notes		
Description	Introduction to fibre reinforced plastics. Functions of fibres and plastic. Mechanical properties, weight saving, raw materials and intermediates. Thermosets and thermoplastics, processing to final products. Applications. Recycling and other environmental aspects. Reinforcement efficiency of fibres plates and spheres. Adhesion. Critical and effective fibre length. Costs and cost estimations. Interlaminar edge stress fields. Laminating rules. 2-dimensional anisotropy.		
Education	Lecture 2/2/0/0	**EC**	3
Assessment	Oral exam		**NL**

wb1430b	Fibre Reinforced Plastics, extended course		
Lecturer	Marissen, Prof.dr.ir. R.		
Course Material	Lecture notes		
Description	Fracture mechanics, fracture mechanisms, statistics for material strength, fibres, natural materials, polymers, composites, notches, cracks, fatigue.		
Education	Lecture 0/0/4/4	**EC**	6
Assessment	Oral exam		**NL**

wb1432	Mechanics of Fibre Reinforced Plastics		
Lecturer	Jansen, dr.ir. K.M.B.		
Course Material	Lecture notes		
Description	Application of continuum mechanics of homogeneous anisotropic materials in case of composite materials like fibre reinforced plastics. Hygrothermal effects. Relation between stiffness and strength of components and composite. Failure criteria. Laminate theory. First Ply Failure. Interlaminar edge stresses, influence on stacking sequence. Viscoelasticity and fatigue of laminates.		
Education	Lecture 2/2/0/0	**EC**	4
Assessment	Oral		**??**

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 **NLR**

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	**NLR**

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/-/- **NL**

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	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	**Medical Engineering Design**			
Lecturer	Plettenburg, dr. ir. D.H., Herder, dr.ir. J.			
Course Material	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 2/0/0/0		**EC**	4
Assessment	Design project			**NLR**

wb2309	**Introduction Man and Machine Systems**			
Lecturer	Wieringa, prof.dr.ir. P.A. and others			
Course Material	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			**NL**

wb2311	**Introduction Modelling**			
Lecturer	Bosgra, prof.ir. O.H., Vergouwen, ir. F.J., Kramer, dr.ir. H.J.M., Korving, ir. A.			
Course Material	- "Modelling of Dynamic Process systems", O.H. Bosgra - Course notes for wb2405			
Description	Physical modelling of dynamic systems. Basic notions of modelling. Methodology, goals, purpose of the model. System boundaries, subsystems, conservation laws. Causality, time scales. Macroscopic versus microscopic models. Non-linear model behaviour. Spatially distributed models, formulated in terms of partial differential equations. Model approximation and reduction, based on time scales and time moments. Bilaterally coupled physical subsystems. Examples from the field of process technology.			
Education	Lecture 4/0/0/0		**EC**	3
Assessment	Oral			**??**

wb2400	**Proces Control**			
Lecturer	Dijkstra, dr. S.			
Course Material	– 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 2/2/0/0	**EC**	4
Assessment	Oral		**NLR**

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 2/2/0/0	**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	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.		
Education	Lecture 2/2/0/0	**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		
Education	Lecture 0/0/0/4	**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		
Education	Lecture 4/0/0/0	**EC**	6
Assessment	Written and computer exercises		**??**

wb2418	Seminar System and Control Theory	
Lecturer Course Material	Scherer, prof.dr. C.W.	
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		**??**

wb1421	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 0/0/4/0	**EC** 6
Assessment	Oral exam and MATLAB exercise	**??**

wb2422	Modelling 2		
Lecturer Course Material	Bosgra, prof.ir. O.H.		
Description	Modellen in differentiaal- algebraïsche vergelijkingen. Koppeling van deelsystemen, objectgeoriënteerde modellen. Index-problemen, systeemmatrix van Rosenbrock. Modelvereenvoudiging gebaseerd op balancering. Ruimtelijk verdeelde systemen, simulatiegereedschappen, modelvereenvoudiging. Niet-lineaire eigenschappen, globaal en lokaal gedrag.Modelvorming van onzekerheden, gevoeligheidsanalyse. Voorbeelden, zoals chemische reactoren, walsmechanismen, aandrijfsystemen.		
Education	Lecture 0/4/0/0	10 Practical exercises	**EC** 6
Assessment			**??**

wb2423	Introduction project SC
Lecturer	Teerhuis, ir.P.C., Weiden, dr.ir.A.J.J. van der
Course Material	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	**??**

wb2424	Mathematics in Systems and Control
Lecturer	Scherer, prof.dr. C.
Course Material	Slide-handouts
Description	- Linear algebra: vector spaces, linear mappings, linear manifolds, eigenvalues/ eigenvectors, norms, inner products - Analysis: Continuity, differentiation, linearization, implicit function theorem, non-linear manifolds, differential equations - Optimization: Simplex-method, optimality conditions, Lagrange-multipliers, Kuhn-Tucker conditions, Newton- and descent algorithms, penalty and barrier techniques
Education	Lecture 2/2/2/2 **EC** 6
Assessment	Paper and computer **??**

wb2425	Integration Project Systems and Control
Lecturer	Heusman, ir. A.E.M.
Course Material	
Description	In dit afsluitende project wordt de stof uit de grote hoofdvakcolleges operationeel gemaakt op een grotere en meer complexe opstelling. Tevens zullen hierbij een aantal praktische problemen aan de orde komen. De gebieden waar met name op wordt ingegaan zijn, theoretische en experimentele modelvorming, simulatie van systeem en regeling, implementatie en beproeving van ontworpen regelstrategie. Er zijn mechanische opstellingen zowel als processen beschikbaar voor het experimentele werk.
Education	**EC** 6
Assessment	**??**

wb2426	Chemistry and Chemical Plant	
Lecturer	Huesman, ir. A.E.M.	
Course Material		
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	Lecture notes, handed out during lecture	
Description	See website	
Education	Lecture 0/2/2/0	**EC** 3
Assessment	Oral	**NL**

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	**NLR**

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	
Education	Lecture 0/0/2/0	**EC** 2
Assessment	Oral	**NEE**

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	
Education	Lecture 2/0/0/0	**EC** 2
Assessment	Oral exam	**??**

wb3303	Mechanisms		
Lecturer	Klein Breteler, dr.ir. A.J.		
Course Material	Lecture notes		
Description	Kinematics, kinetostatics and dynamics of (co-planar) mechanisms, kinematic optimization, numerical method (FEM), system drive+mechanism+process.		
Education	Lecture 0/0/2/2	**ECP**	3
Assessment	Exercise		**??**

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		**??**

wb3408	Dredging Design		
Lecturer	Vlasblom, prof.ir. W.J.		
Course Material	Syllabus, collegebook (Vlasblom wb3408B)		
Description	dredging equipment, mechanical dredgers, hydraulic dredgers, boundary conditions, design criteria, instrumentation and automotion.		
Education	Lecture 0/0/2/2	**EC**	4
Assessment	Written, oral		**??**

wb3410-03	Large Scale Transportsystems		
Lecturer	Rijsenbrij, prof.ir. J.C.		
Course Material	Inauguration speech, 2008 and globalisation		
Description	This course treats of mondial cargo flows in the non-bulk area the so called general cargo. This college concentrates on the phenomenon containertransport, a spectecular logistical break-through in the sixties. Initially the container was succesful for sea transportation, but more and more intermodal developments will also control the long distance landtransportation. Technological development, social economisch consequences and particularly the role of containertransport by the proces of globalisation of the industrial production will be treated.		
Education	Lecture 0/0/2/2	**EC**	3
Assessment	Written		**??**

wb3413	Dredging Processes 1		
Lecturer	Vlasblom, prof.ir. W.J., Miedema, dr.ir. S.A., Matousek, dr.ir. V.		
Course Material	Syllabus, collegebook (Vlasblom wb3408B), dissertation (Miedema)		
Description	cutting of sand and clay, excavation of rock, plain suction dredging, sedimentation.		
Education	Lecture 2/2/0/0	**EC**	4
Assessment	Written		**NLR**

wb3414	Dredging Processes 1		
Lecturer	Vlasblom, prof.ir. W.J., Miedema, dr.ir. S.A., Matousek, dr.ir. V.		
Course Material	Collegebook (Vlasblom and Matousek)		
Description	dredge pumps, pump engine, hydraulic transport of sand, clay and rock, pump pipeline system.		
Education	Lecture 0/0/2/2	**EC**	4
Assessment	Written		**NLR**

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, Ir. D.L. Schott		
Course Material	Lecture book (in preparation) and book "Introduction to Particle Technology" by Martin Rhodes, John Wiley & Sons, ISBN 0-471-98482-5, 2000.		
Description	Bulk solid materials, conveyors, particle characterisation, storage and flow, silo's, hoppers, mixing, segregation.		
Education	Lecture 2/2/0/0	**EC**	6
Assessment	Report + oral exam		**??**

wb3420-03	Introduction Transport and Logistic Engineering		
Lecturer Course Material	Lodewijks,prof.dr.ir. G., Rijsenbrij, prof.ir.J.C.		
Description	In preparation		
Education	Lecture 0/0/0/0	EC	5
Assessment			??

wb3421-03	Automatisation and control transportsystem		
Lecturer Course Material	Lodewijks,prof.dr.ir. G., Rijsenbrij, prof.ir.J.C.		
Description	In preparation		
Education	Lecture 0/0/0/0	EC	5
Assessment			??

wb3422-03	Design of Transport Equipment		
Lecturer Course Material	Klein Breteler,dr.ir. A.J., Drenth, ir. K.F.		
Description	In preparation		
Education	Lecture	EC	
Assessment			??

wb4300A	Equipment for heat and mass transfer		
Lecturer Course Material	Kramer, dr.ir. H.J.M. J.M. Coulson, J.F. Richardson, Sinnott; Chemical Engineering vol. 6; Scheidingsprocessen		
Description	diffusion, convective mass transfer, absorbers, strippers, extractors, convective heattransfer, condensation, boiling, tube heatexchangers, plate heatexchangers, condensors, evaporators, materials of construction.		
Education	Lecture 0/4/0/0	EC	3
Assessment	Written, open book		NLR

wb4300B	Introduction to pumps and compressors
Lecturer	Infante Ferreirra, dr.ir. C.A.
Course Material	Touber, S., "Pompen en compressoren", collegedictaat, Faculteit WbMT, 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 **??**

wb4303	Energy, Society and Sustainability
Lecturer	Spliethoff, prof.dr.ing. H.
Course Material	Lecture notes and sheets
Description	This course gives a thorough introduction in the world of energy. The course wants to show the importance of energy in our society and especially the interdependencies between energy and worldwide developments in our society, economy and requirements towards sustainability and environmental protection. The course covers the worldwide energy supply and consumption, discusses resources of fossil and renewable energies, and describes technologies of fuel exploration and the variety of energy conversion technologies in large, medium and small scale.
Education	Lecture 0/4/0/0 **EC** 3
Assessment	Written **??**

w4401	Particle Technology-W	
Lecturer Course Material	Scarlett, prof.B. MSc.	
Description	Deeltjesgrootte en verdeling. Principes en ontwerp van gasreinigingsapparatuur. Vloeistof filtratie. Granulatie. Gefluïdiseerde systemen. Poedermechanica. Mengen. Hopperontwerp.	
Education	Lecture 2/2/0/0	**EC**
Assessment	Written	**??**

wb4402	Project Engineering in the Processindustries	
Lecturer Course Material	Dhillon, prof.dr. J.S., Paijens, ir. A.F.M. 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	**NLR**

wb4403	Design of Separation Equipment	
Lecturer Course Material	Olujic, dr. Z. Z. Olujic; Introduction to the Design of Equilibrium Separation Processes (WbMT 1994) O.S.L. Bruinsma, J de Graauw; Inleiding in de industriële kristallisatie - (WbMT 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	**NLR**

wb4405	Fuel Conversion	
Lecturer Course Material	Hein, prof.dr.ing. K.R.G. 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 2/2/0/0 **EC** 4
Assessment	Exercises + discussion **NLR**

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 0/0/2/2 **EC** 4
Assessment	Oral exam **NLR**

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. Economics of 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 energy removal. Reactor materials. Three Miles Island and Chernobil accidents	
Education	Lecture 0/0/4/4	**EC** 3
Assessment	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	**NLR**

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	**NLR**

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		**??**

wb4428-03	Thermal Waste Treatment		
Lecturer			
Course Material			
Description	Course in preparation		
Education	Lecture 0/0/2/2	**EC** 3	
Assessment			**??**

wb4429-03	Thermodynamics of Mixtures		
Lecturer	Jong, dr. W. de		
Course Material	J.M.Smith & H.C. Van Ness, Introduction to Chemical Engineering Thermodynamics, 6th ed, McGraw-Hill Book Company		
Description	Heat capacity and heat- and Gibbs energy of reaction data,and equations of state nescessary for the calculation of thermodynamic quantities.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, the fugacity and the activity will be considered.The notion of exergy as used for chemical conversions. Application to physical processes such as separations and chemical reactions such as combustion.		
Education	Lecture 0/0/4/0	**EC** 3	
Assessment	Written		**??**

wb5201	Power Drives		
Lecturer	Werff, prof.dr.ir. K. van der		
Course Material	K. van der Werff, Aandrijfsystemen.		
Description	Power Drives, Characteristics, Transmissions, Dynamic Behavior		
Education	In consult wirh lecturers	**EC** 3	
Assessment	Project work		**NLR**

wb5302	Design Theory: Information Transducers
Lecturer	Pistecky, ir. P.V.
Course Material	P.V. Pistecky, Ontwerpleer 3B, Informatieomzetters, lecture notes, TU Delft, Faculty of Mechanical Engineering and Marine Technology
Description	The course deals with design principles in the field of transducers for information handling. Four particular types of transducers form the basic content of the course: mass and force determination devices, rotating coil electric current meters and optical mass information storage devices (CD players). In addition, current research projects of the Man Machine Systems and Control group are discussed with respect to their design aspects.
Education	Lecture 0/0/2/2 **EC** 2
Assessment	Written **NL**

wb5400	Tribology in Machine Design
Lecturer	Dr.ir. A. van Beek, Dr.ir. R.A.J. van Ostayen
Course Material	A. van Beek, "Tribology / Reliability and performance in machine design", 400 pp., first edition 2003, for sale at Leeghwater shop.
Description	In this course one can choose to perform either a literature survey or an experimental investigation. – The literature survey consists of a study of a current research area in tribology, the search and comparison of related research efforts in the world and the analysis of the potential for new research. – The experimental investigation includes the set up of an experiment, data acquisition and data analysis.
Education	After consultation **EC** 4
Assessment	Report **NL**

wb5412-03	Modelling of Manufacturing
Lecturer	Steinhoff, K., Hoogstrate, dr.ir. A.M.
Course Material	Lecture notes
Description	1 afstemming van bewerkingen en behandelingen binnen een fabricagemethode 2 modellen van bewerkingen 3 begrenzingen van bewerkingen 4 begrenzingen van de maakbaarheid 5 milieuvriendelijk fabriceren
Education	Lecture 0/0/2/0 **EC** 3
Assessment	Written, open book **NL**

wb5414-03	Design of machines and mechanisms
Lecturer	Werff, prof.dr.ir. K. van der, Tomiyama, prof.dr. T.
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
Education	Lecture 2/2/0/0 **EC** 3
Assessment	Written Report **NL**

wb5417	Innovation of Manufacturing
Lecturer	Steinhoff, K.
Course Material	Lecture notes wb5417 Innovations in manufacturing, available at Mr. G.C. Schrumpf, Landbergstraat 3, room 309
Description	1 lecture: introduction, aims of course, procedures 2 lecture: aims andprinciples of technological innovation 3 lecture: attention points in implementation of technological innovations 4 to 9: consulting hours 10 to 12: oral presentations by student groups
Education	Lecture 0/2/2/0 **EC** 3
Assessment	Written, open book **NLR**

wb5420-03	Design of Production Systems
Lecturer	Meijer, ir B.R., Neve, ir. J.J.L., Tichem, dr.ir. M.
Course Material	N. Sing, Systems approach to Computer-Integrated Design and Manufacturing, John Wiley & Sons,
Description	CIM, design, process planning, production control & scheduling, system design, reference models, manufacturing, assembly, logistics, computer vision
Education	Lecture 4/0/0/0 **EC** 3
Assessment	Written, open book **NL**

wb5422-03	Industrial Assembly
Lecturer	Tichem, dr.ir. M., Buiting-Csikos, mw.ir. Cs.
Course Material	reader, will be made available at the start of the course.
Description	Characteristics of assembly in industry, assembly process models on structure and operation level, Design For Assembly, Poka Yoke, assembly automation, assembly systems and system design. Micro-assembly: applications, typical methods and techniques, micro-gripping.
Education	Lecture 0/0/4/0 Laboratory project **EC** 3
Assessment	Written + project + case study **NLR**

wb5425	Fundamentals of machine tools		
Lecturer	Prof. Dr.-Ing. habil. B. Karpuschewski		
Course Material	Werkzeugmaschinen Fertigungssysteme, Band 1, 2, 3.1, 3.2, 4, M. Weck Werkzeugmaschinen, H.K. Tönshoff, Springer Verlag 1995		
Description	machine tool design, structure, guideways, drives, control, dynamic behaviour		
Education	Lecture 0/0/0/2	**EC**	2
Assessment	Written		**NLR**

wb5428	Applied Systems Engineering		
Lecturer	Dekkers, ir. R.		
Course Material	Prof. ir. J. in't Veld, Analyse van Organisatie Problemen, Stenfert Kroese, 8e druk, 2002 Syllabus Wb5100		
Description	system, sub system, aspect system, input, throughput, output, function, task, black box approximation, process control, feedback control, modeling		
Education	Lecture 2/0/0/0	**EC**	2
Assessment	Written + Report + Presentation		**NL**

wb5430-03	Engineering Informatics		
Lecturer	Prof.dr. T. Tomiyama, Ir. B.R. Meijer		
Course Material	Benny Raphael, Ian F. C. Smith, Fundamentals of Computer Aided Engineering, ISBN: 0-471-48715-5, (2003), Wiley & Sons.		
Description	The subjects may include: 1. Fundamental logic and reasoning for engineering applications, 2. Numerical computation, 3. Complexity, 4. Data structures, 5, Object oriented methodology, 6. Databases, 7. Computer-aided engineering, 8. Constraint-based reasoning, 9. Search, 10. Knowledge-based system, 11. Geometric modeling. The course emphasizes homework (mostly programming). While any preference is given to a particular programming language, basic programming capabilities are needed.		
Education	Lecture 0/4/0/0	**EC**	3
Assessment	Written		**NLR**

wb5431	Life Cycle Engineering		
Lecturer	Prof.dr. T. Tomiyama, Ir. B.R. Meijer		
Course Material	See blackboard		
Description	Discussion of concepts of life cycle and life cycle stages including marketing, design, production, logistics, operation (use), maintenance, recovery, reuse, remanufacturing, and recycling.Discussion of motivation behind life cycle engineering and its philosophy. Highlighting maintenance and remanufacturing. Design methodologies (Design for Environment) as a technology. Some excersises will be included.		
Education	Lecture 0/0/0/4 Exercises	**EC**	3
Assessment	Written report		**NL**

wb5432-03	Fundamentals of material removal processes		
Lecturer	Prof. Dr.-Ing. habil., B. Karpuschewski		
Course Material	Reader		
Description	Classification of material removal processes, processes with geomtrically well-defined cutting edges (turning, drilling, milling, etc.), processes with geomtrically non-defined cutting edges (grinding, honing, lapping, etc.), other processes, tool characteristics, process parameters, recent developments, state-of.the-art machine tools		
Education	Lecture 0/0/0/2	**EC**	2
Assessment	Written		**??**

wb0203-1	Combined Assignment Process Equipment		
Lecturer	Olujic, dr. Z.		
Course Material	Sinnott (Coulson & Richardson) Chemical Engineering, Vol.6 Design.		
Description	G-opdracht is een gecombineerde opdracht waarin zowel de technologische als de constructieve aspecten van een proces naar voren komen en wordt in teamverband als een volle dagtaak uitgewerkt. De opdracht, gekregen vanuit de industrie, wordt uitgevoerd door een gecombineerd team van WB/API (2/3) en ST (1/3) studenten. Voor uitwerking van de opdracht wordt een ruimte beschikbaar gesteld. Door ongeveer drie maanden met elkaar "opgesloten" te zijn, wordt praktisch het werk van een proces design groep ("task force") van een proces-engineering firma nagebootst.		
Education	Assignment 40/40/0/0, 0/0/40/40	**EC**	17
Assessment	See website		**??**

wb0402-1	PTO-practical		
Lecturer	Prof.dr.ir.K.van der Werff, Ir. B.R.Meijer, Ir. J.J.L.Neve, Dr. ir. M. Tichem en anderen		
Course Material	Handed during course		
Description	Integrated Manufacturing, Strategie/Technologie en Organisatie, Modelleren en Probleemoplossen, Basispracticum Productietechniek en Organisatie. groepsontwerpopdracht.		
Education	Practical x/x/0/0, 0/0/x/x	**EC**	11
Assessment	See website		**NLR**

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 that are part of the propedeuse (i.e. first year), kandidaats or doctoraal phases 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'S PROGRAMME MECHANICAL ENGINEERING

This Master's programme is intended to prepare graduates in Mechanical Engineering for the practice of engineering at an academic level,

- capable to identify, define and analyse problems, for the solution of which mechanical engineering principles and techniques can contribute
- capable to systematically design and produce a sound solution to the problem
- capable to present this solution in a convincing way.

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 issued by the TU Delft, 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 EXIT QUALIFICATIONS OF THE MASTER'S PROGRAMME MECHANICAL ENGINEERING

The Master's programme Mechanical Engineering has the following exit qualifications:
Graduates will:

- have broad and deep knowledge of the basic engineering sciences
- have broad basic technical and scientific knowledge of the mechanical engineering disciplines: production, transport, process technology, energy conversion and mechatronics
- be specialized in at least one mechanical engineering discipline

- be able to innovate, to model and to design systems and equipment
- be able to contribute to solving multidisciplinary problems and to work both in multidisciplinary teams and independently in an international industrial context
- be able to communicate effectively with team members and environment
- be well aware of their responsibilities with regard to sustainability, economy, health, safety and social welfare
- be able to 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. Students can enter the programme at the beginning of each semester.
3. 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. The interim examinations be sat as specified in the implementation procedures. Practical skills be tested during the hours allocated for practical training.
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. 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.
4. 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.
5. 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.
6. 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.

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 2003.

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 and Mechatronics
   - Process and Engergy Technology
   - Production Technology and Organization
   - Solid and Fluid Mechanics
   - Biomedical Engineering

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
   - Offshore Technology
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 Engineering and Marine Technology , after the approval of the Faculty's Student Council, and after considering the recommendations provided by the education committee on 10-6-2002.

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 lecturer 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.
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.
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:
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;

[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.

b the candidate concerned shall have completed the Master's degree programme in no more than two and a half years;
c the mark awarded for the thesis project shall be no less than 8;
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 APPROVALS

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 2003.

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

6.4 Lecturers

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Grimbergen, prof. dr. ir. C.A.	85419	c.a.grimbergen@wbmt.tudelft.nl	8C-1-24	WbMT
Haaf, ir. W. ten	86781	w.tenhaaf@wbmt.tudelft.nl	8D-3-25	WbMT
Hein, prof. dr. ing. K.R.G.	82186	k.r.g.hein@wbmt.tudelft.nl	8D-2-10	WbMT
Helm, prof. dr. ir. F.C.T. van der	85616	f.c.t.vanderhelm@wbmt.tudelft.nl	8C-1-19	WbMT
Herder, dr. ir. J.L.	84713	j.l.herder@wbmt.tudelft.nl	5A-2-06	WbMT
Hof, prof. dr. ir. P.M.J. van den	84509	p.m.j.vandenhof@tnw.tudelft.nl	F 218	TNW
Hooghiemstra, dr. G.	82589	g.hooghiemstra@its.tudelft.nl	HB 06.090	ITS-et
Hoogstrate, dr. ir. A.M.	86804	a.m.hoogstrate@wbmt.tudelft.nl	8D-4-08	WbMT
Huesman, ir. A.	88131	a.huesman@wbmt.tudelft.nl	8C-0-19	WbMT
Infante Ferreira, dr. ir C. A.	84894	c.a.infanteferreira@wbmt.tudelft.nl	8D-2-19	WbMT
Janssen, dr. ir. K.M.B.	86905	k.m.b.janssen@wbmt.tudelft.nl	8C-2-07	WbMT
Jong, dr. W. de	89476	w.dejong@wbmt.tudelft.nl	8D-2-14	WbMT
Karpuschewski, prof. dr. ing. B.	83204	karpu@wbmt.tudelft.nl	8D-3-08	WbMT
Keulen, prof. dr. ir. A. van	86515	a.vankeulen@wbmt.tudelft.nl	8C-3-23	WbMT
Klein Breteler, dr.ir. A.J.	83130	a.j.kleinbreteler@wbmt.tudelft.nl	8C-4-18	WbMT
Klein Woud, prof. ir. J.	81556	j.kleinwoud@wbmt.tudelft.nl	7-1-121	WbMT
Knoester, ing. J.	86569	j.knoester@wbmt.tudelft.nl	4-0-05	WbMT
Kramer, dr. ir. H.J.M.	85593	h.j.m.kramer@wbmt.tudelft.nl	1-18	API
Linden, mw. J.C. van der	82704	j.c.vanderlinden@wbmt.tudelft.nl	8C-3-21	WbMT

Naam	Tel[1]	E-Mail	Kamer	Gebouw[2]
Kramer, dr. ir. H.J.M.	85593	h.j.m.kramer@wbmt.tudelft.nl	1-18	API
Linden, mw. J.C. van der	82704	j.c.vanderlinden@wbmt.tudelft.nl	8C-3-21	WbMT
Lodewijks, prof. dr. ir. G.	88793	g.lodewijks@wbmt.tudelft.nl	8C-4-11	WbMT
Makkee, dr. ir. M.	81391	m.makkee@tnw.tudelft.nl	0.467	TNW
Marissen, Prof. dr. ir. R.	83918	r.marissen@wbmt.tudelft.nl	8C-2-20	WbMT
Massie, W.W.	84614	w.w.massie@offshore.tudelft.nl	3.77.1	CiTG
Mast, C.A.P.G. van der	82549	c.a.p.g.vandermast@its.tudelft.nl	HB 10.120	ITS-et
Matousek, dr. ir. V.	83717	v.matousek@wbmt.tudelft.nl	3B-0-430	WbMT
Meijer, ir. B.R.	86876	b.r.meijer@wbmt.tudelft.nl	8D-4-06	WbMT
Miedema, dr. ir. S.A.	88359	s.a.miedema@wbmt.tudelft.nl	3B-0-410	WbMT
Moulijn, prof. dr. J.A.	85008	j.a.moulijn@tnw.tudelft.nl		TNW
Mulder, K.F.	81043	k.f.mulder@tbm.tudelft.nl	c1.170	TBM
Neve, ir. J.	86581	j.j.l.neve@wbmt.tudelft.nl	8D-4-07	WbMT
Nieuwstadt, prof. dr. ir. F.T.M.	81005	f.t.m.nieuwstadt@wbmt.tudelft.nl	5B-1-26	WbMT
Nijhof, ir. A.H.J.	86663	a.h.j.nijhof@wbmt.tudelft.nl	8C-2-20	WbMT
Olujic, dr. Z.	86674	z.olujic@wbmt.tudelft.nl	1-17	API
Ostayen,dr. ir. R.A.J. van	81647	r.a.j.vanostayen@wbmt.tudelft.nl	5A-1-20	WbMT
Ottjes, dr. ir. J.A.	84318	j.a.ottjes@wbmt.tudelft.nl	8C-4-14	WbMT
Paassen, dr. ir. A.H.C. van	86675	a.h.c.vanpaassen@wbmt.tudelft.nl	8D-2-13	WbMT
Paijens, Ir. A.F.M.	87078	a.f.m.paijens@wbmt.tudelft.nl	1-08	API
Pistecky, ir. P.V.	86583	p.v.pistecky@wbmt.tudelft.nl	5A-2-04	WbMT
Plettenburg, dr. ir. D.H.	85615	d.h.plettenburg@wbmt.tudelft.nl	5A-2-05	WbMT
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Post, ir. F.H.	82528	f.h.post@its.tudelft.nl	HB 12.270	ITS-et
Pourquie, dr. ir. M.J.B.M.	82997	m.j.b.m.pourquie@wbmt.tudelft.nl	5B-1-32	WbMT
Rijlaarsdam, mr. ir. A.	83556	a.rijlaarsdam@tbm.tudelft.nl	b.3.030	TBM
Rijsenbrij, prof. ir. J.C.	86573	j.c.rijsenbrij@wbmt.tudelft.nl	8C-4-06	WbMT
Rixen, prof. dr. ir. D.J.	81523	d.j.rixen@wbmt.tudelft.nl	8C-2-11	WbMT
Rongen, van F.I.J.M.	86852	f.j.i.m.vanrongen@wbmt.tudelft.nl	5A-0-29B	WbMT
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Scarlett, prof. MSc B.	83577	b.scarlett@stm.tuelft.nl		
Scherer, prof. dr. C.W.	85899	c.w.scherer@wbmt.tudelft.nl	8C-0-03	WbMT
Schott, ir. D.L.	833.6	d.l.schott@wbmt.tudelft.nl	3B-0-400	WbMT
Schwab, dr. ir. A.L.	82701	a.l.schwab@wbmt.tudelft.nl	8C-2-21	WbMT
Sepers, ir. M.	83614	m.sepers@its.tudelft.nl	HB 12.290	ITS-et
Smit, prof. ir. K.	84978	k.smit@lr.tudelft.nl	1006	LR
Snelders, dr. H.M.J.J.	83108	h.j.m.m.snelder@io.tudelft.nl	4A-25	IO
Sopers, ir. F.P.M.	85343	f.p.m.sopers@wbmt.tudelft.nl	8D-4-24	WbMT
Spliethoff, prof. dr. ing. H.	86071	h.spliethoff@wbmt.tudelft.nl	8D-2-07	WbMT
Spronck ir. J.W.	81824	j.w.spronck@wbmt.tudelft.nl	5A-0-29A	WbMT
Stapersma, prof. D. MSc. FIMarE	83051	d.stapersma@wbmt.tudelft.nl	7-1-122	WbMT
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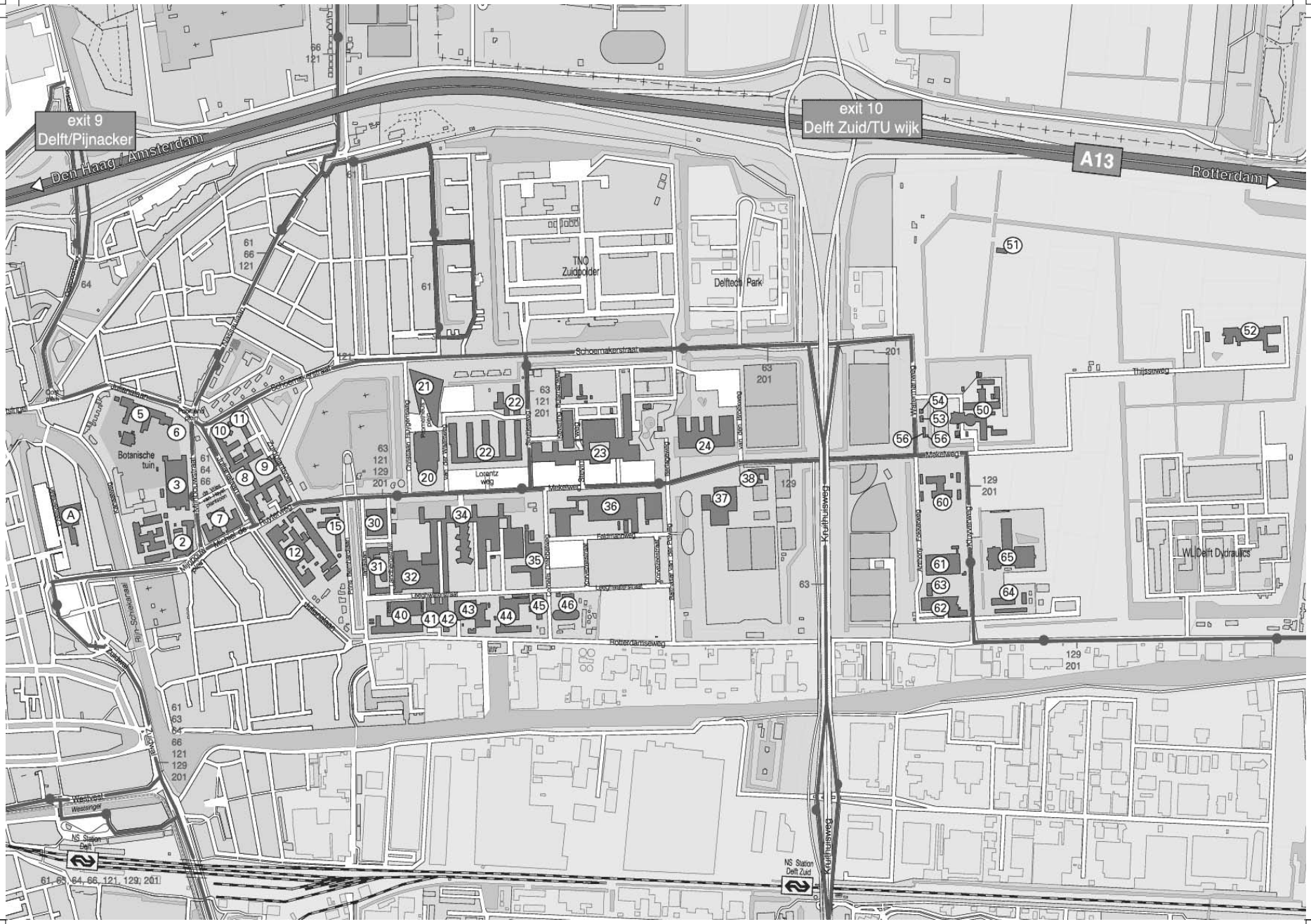
Tomiyama, prof. dr. T.	81021	t.tomiyama@wbmt.tudelft.nl	8D-3-21	WbMT
Toetenel, H.	82518	w.j.toetenel@its.tudelft.nl	HB 08.120	ITS-et
Valstar, dr. ir. E.R.	83538	e.r.valstar@tnw.tudelft.nl	F232	TNW
Veeke, ir. H.P.M.	82706	h.p.m.veeke@wbmt.tudelft.nl	8D-4-25	WbMT
Verheul, ir. C.H.	86720	c.h.verheul@wbmt.tudelft.nl	8C-4-22	WbMT
Vergouwen, ir. F.J.	85603	f.j.vergouwen@wbmt.tudelft.nl	8C-0-05	WbMT
Verkooijen, prof. dr. ir. A.H.M.	86687	a.h.m.verkooijen@wbmt.tudelft.nl	8D-2-24	WbMT
Vlasblom, prof. ir. W.J.	83973	w.j.vlasblom@wbmt.tudelft.nl	3B-0-450	WbMT
Vries, ir. E.J.H. de	86980	e.j.h.devries@wbmt.tudelft.nl	8C-3-18	WbMT
Weiden, dr. ir. A.J.J.	85609	a.j.j.vanderweiden@wbmt.tudelft.nl	8C-0-04	WbMT
Werff, prof. dr. ir. K. van der	85729	k.vanderwerff@wbmt.tudelft.nl	8D-4-17	WbMT
Westerweel, prof. dr. ir. J.	86887	j.westerweel@wbmt.tudelft.nl	5B-1-13	WbMT
Wieringa, prof. dr. ir. P.A.	85763	p.a.wieringa@wbmt.tudelft.nl	8C-1-13	WbMT
Wijting, mr. W.	84710	w.wijting@tbm.tudelft.nl	b3.060	TBM
Wisse, ir. G.	82702	g.wisse@wbmt.tudelft.nl	8C-2-12	WbMT
Wisse, ir. M.				
Woerkom, dr. ir. P.Th.L.M. van	82792	p.vanwoerkom@wbmt.tudelft.nl	8C-2-18	WbMT
Wolffenbuttel, dr. ir. R.F.	86287	R.F.Wolffenbuttel@ITS.TUDelft.nl	HB 13.030	ITS-et
Woudstra, ir. N.	82178	N.Woudstra@WbMT.TUDelft.nl	8D-2-12	WbMT

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
CiTG: Stevinweg 1, 2628 CN, Delft
IO: Landberghstraat 15, 2628 CE Delft
ITS-et: Mekelweg 4, 2628CD Delft
LR: Kluyverweg 1, 2629 HS Delft
TBM: Jaffalaan 5, 2628 BX Delft
TNW: Lorentzweg 1, 2628 CJ Delft
WbMT: Mekelweg 2, 2628CD Delft


exit 9
Delft/Pijnacker
Den Haag / Amsterdam
exit 10
Delft Zuid/TU wijk
A13
Rotterdam
TNO
Zuidpolder
Delftech Park
Botanische tuin
Schoemakerstraat
Lorentz weg
Mekelweg
Thijsseweg
Kluyverweg
Rotterdamseweg
Leeghwaterstraat
Kruithuisweg
Rijn-Schiekanaal
Westvest
Weesinger
NS Station Delft
NS Station Delft Zuid
WL|Delft Hydraulics

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.

COLLEGEROOSTER PRE MASTER TH/HZS WB

		SEMESTER 1A week 36 t/m 42				SEMESTER 1B week 45 t/m 51				SEMESTER 2A week 5 t/m 11				SEMESTER 2B week 14 t/m 21 (week 18 vakantie)			
Dag	**uur**	**Vak**	**Docent**	**Code**	**Zaal**	**Vak**	**Docent**	**Code**	**Zaal**	**Vak**	**Docent**	**Code**	**Zaal**	**Vak**	**Docent**	**Code**	**Zaal**
MA	1																
	2																
	3	Analyse 1 TH	Tholen	wi1152th	34C					Lin.alg. 2 TH	Beek v	wi2256th d2	34C				
	4	Analyse 1 TH	Tholen	wi1152th	34C					Lin.alg. 2 TH	Beek v	wi2256th d2	34C				
	5	Eindige elem.meth. 1	Paraschiv	wb1212	34A												
	6	Eindige elem.meth. 1	Paraschiv	wb1212	34A												
	7					Thermodynamica 2	Woudstra N	wb1224	34A	Stromingsleer 2	Nieuwstadt	wb1220	34A	Dynamica 2	Woerkom v	wb1216	34A
	8					Thermodynamica 2	Woudstra N	wb1224	34A	Stromingsleer 2	Nieuwstadt	wb1220	34A	Dynamica 2	Woerkom v	wb1216	34A
DI	1									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104	34A				
	2									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104	34A				
	3					Analyse 2 TH	Tholen	wi1153th	34B	Analyse 3 TH	Tholen	wi1154th	34B				
	4					Analyse 2 TH	Tholen	wi1153th	34B	Analyse 3 TH	Tholen	wi1154th	34B				
	5																
	6																
	7																
	8																
WO	1													Dynamica A **1)**	Paraschiv	wb1113wb	34A
	2													Dynamica A **1)**	Paraschiv	wb1113wb	34A
	3																
	4																
	5	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Elasticiteitsleer	Paraschiv	wb1213	34A	Stromingsleer 2	Nieuwstadt	wb1220	34A				
	6	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Elasticiteitsleer	Paraschiv	wb1213	34A	Stromingsleer 2	Nieuwstadt	wb1220	34A				
	7					Elasticiteitsleer	Paraschiv	wb1213	34A								
	8																
DO	1																
	2																
	3									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104	34A				
	4									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104	34A				
	5	Eindige elem.meth. 1	Paraschiv	wb1212	34A					Lin.alg. 2 TH	Beek v	wi2256th d2	34C				
	6	Eindige elem.meth. 1	Paraschiv	wb1212	34A					Lin.alg. 2 TH	Beek v	wi2256th d2	34C				
	7	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Thermodynamica 2	Woudstra N	wb1224	34A	Eindige elem.meth. 2	Paraschiv	wb1214	34A	Dynamica 2	Woerkom v	wb1216	34A
	8	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Thermodynamica 2	Woudstra N	wb1224	34A	Eindige elem.meth. 2	Paraschiv	wb1214	34A	Dynamica 2	Woerkom v	wb1216	34A
VR	1	Lin.alg. 1 TH	Beek v	wi2256th d1	34E	Lin.alg. 1 TH	Beek v	wi2256th d1	34E					Dynamica A **1)**	Paraschiv	wb1113wb	34A
	2	Lin.alg. 1 TH	Beek v	wi2256th d1	34E	Lin.alg. 1 TH	Beek v	wi2256th d1	34E					Dynamica A **1)**	Paraschiv	wb1113wb	34A
	3	Analyse 1 TH	Tholen	wi1152th	34F	Analyse 2 TH	Tholen	wi1153th	34B	Analyse 3 TH	Tholen	wi1154th	34B				
	4	Analyse 1 TH	Tholen	wi1152th	34F	Analyse 2 TH	Tholen	wi1153th	34B	Analyse 3 TH	Tholen	wi1154th	34B				
	5																
	6																
	7																
	8																

1) Alleen verplicht voor HZS-studenten

1) Alleen verplicht voor HZS-studenten

1A WK 36-42	COURSE SCHEDULE MSC MECHANICAL ENGINEERING SEMESTER 1A									
	course	code	course	code	course	code	course	code	course	code
Day/hours	lecturer	room	lecturer	room	lecturer	room	lecturer	room	lecturer	room
mon 1,2	control theory	sc4020	th.dyn.energy conv.	wb4302						
0830-1030	bosgra	34B	woudstra	46A						
mon 3,4	introduction mms	wb2309	mech.pressure vessels	wb1408	des. machines & mechan.	wb5414-03				
1030-1230	wieringa	34D	ernst	34K	tomiyama / vd werff	34J				
mon 5,6	biomed.eng.design	wb2308	maintenance engineering	ae4-490	Engineering dynamics	wb1418/w				
1330-1530	plettenburg	34C	smit	62..	Rixen	34D				
mon 7,8	mathematics in SC	wb2424	introd. modelling	wb2311	applied systems eng.	wb5428				
1530-1730	scherer	34C	bosgra	34D	dekkers	34K				
tue 1,2	human movem.control	wb2407								
0830-1030	vd helm	34C								
tue 3,4	eng.optimization	wb1440	design prod.systems	wb5420-03	plates & shells A	wb1402A	refrigeration fund.	wb4410a		
1030-1230	v. keulen	34K	Meijer / Neve / Tichem	34C	Ernst	34L	infante ferreira	34F		
tue 5,6	lin.matrix inequalities	wb2416	mech.design mechatron.	wb2428-03						
1330-1530	scherer	34K	langen / pistecky	34C						
tue 7,8	theory of elasticity	wb1409	Discrete systems	wb3417-03						
1530-1730	v keulen	34K	ottjes e.a.	34C						
wed 1,2	indoor clim.contr.fund	wb4426	marine engineering B	mt212	surgical instr.med.safety	wb2435-03				
0830-1030	paassen van	34K	klein woud	34L	dankelman	34B				
wed 3,4	mechatronical design	wb2414								
1030-1230	teerhuis/v eijk	34C								
wed 5,6	adv.fluid dynamics	wb1427-03								
1330-1530	delfos	34C								
wed 7,8	adv.fluid dyn. Seminar	wb1427-03	diesel engines A	wb4408a						
1530-1730	delfos	34C	stapersma	34K						
thur 1,2	hydrolic servosyst.	wb2402	design prod.systems	wb5420-03			fuel conversion	wb4405		
0830-1030	teerhuis	34D	Meijer / Neve / Tichem	34C			hein	34L		
thur 3,4	dredging processes 1	wb3413	mech.fibre reinf.plastics	wb1432	ind. organisation A	wm0504tu	fuel conversion	wb4405	introd. modelling	wb2311
1030-1230	miedema e.a.	34K	jansen, kmb	34M	bikker	34A	hein	34L	bosgra	34B
thur 5,6	intr.fibre reinf.plastics	wb1430a	man machine systems	wb2404	ind. organisation A oef.	wm0504tu				
1330-1530	marissen	34M	wieringa	34D	bikker	34C				
thur 7,8	intr.fibre reinf.plastics	wb1430a	intr.transport & log.eng.	wb3420-03	ind. organisation A oef.	wm0504tu				
1530-1730	marissen	34M	lodewijks/rijsenbrij	34D	bikker	34C				
fri 1,2	th.dyn.asp.en.omz.	wb4302	lin.matrix inequalities	wb2416	char.handling bulk solid mat.	wb3419-03				
0830-1030	woudstra	34D	scherer	34K	lodewijks/schott	34C				
fri 3,4	intr.to microsystems	wb1442	gas turbines	wb4420	ind. organisation A	wm0504tu				
1030-1230	v.keulen e.a.	34D	v buijtenen	34E	bikker	34C				
fri 5,6	project engineering	wb4402	control theory	sc4020						
1330-1530	dhillon/paijens	46A	bosgra	34B						
fri 7,8										
1530-1730										

1B WK 45-51	COURSE SCHEDULE MSC MECHANICAL ENGINEERING SEMESTER 1B									
	course	code	course	code	course	code	course	code	course	code
Day/hours	lecturer	room	lecturer	room	lecturer	room	lecturer	room	lecturer	room
mon 1,2 0830-1030	innov. manufacuring	wb5417								
	Steinhoff	34C								
mon 3,4 1030-1230	physiol. systems	wb2408	mech.pressure vessels	wb1408	modelling 2	wb2422	des. machines & mechan.	wb5414-03		
	dankelman e.a.	34F	ernst	34K	bosgra	34C	tomiyama / vd werff	34J		
mon 5,6 1330-1530	maintenance engineering	ae4-490	digital control	wb2305	eq heat & mass transf.	wb4300a				
	smit	62..	dijkstra	34C	kramer	34D				
mon 7,8 1530-1730	mathematics in SC	wb2424	Engineering dynamics	wb1418/w						
	scherer	34E	Rixen	34C						
tue 1,2 0830-1030	energy, society & sust.	wb4303	human movem.control	wb2407	engineering informatics	wb5430-03				
	Spliethoff	34B	vd helm	34J	tomiyama / meijer	34K				
tue 3,4 1030-1230	plates & shells A	wb1402A	eng.optimization	wb1440	refrigeration fund.	wb4410a	bedr.ec.ingen.	wm0605tu		
	Ernst	34L	keulen van	34K	infante ferreira	34F	storm	31		
tue 5,6 1330-1530	mech.design mechatron.	wb2428-03	num.analysis c2	wi4014tu	design proces equipm.	wb4417				
	langen / pistecky	34D	v kan	8/1bb	paijens	46A				
tue 7,8 1530-1730	theory of elasticity	wb1409	Discrete systems	wb3417-03						
	keulen van	34L	ottjes e.a.	34C						
wed 1,2 0830-1030	bone mech.implants	wb2431	indoor clim.contr.fund	wb4426						
	vd Linden/Valstar	34K	paassen van	34L						
wed 3,4 1030-1230	mechatronic design	wb2414								
	teerhuis/v eijk	34C								
wed 5,6 1330-1530	adv.fluid dynamics	wb1427-03	electrical drives	et3026wb						
	delfos	34D	bauer	34B						
wed 7,8 1530-1730	adv.fluid dyn. Seminar	wb1427-03	diesel engines A	wb4408a						
	delfos	34D	stapersma	34K						
thur 1,2 0830-1030	hydrolic servosystems	wb2402	engineering informatics	wb5430-03					fuel conversion	wb4405
	teerhuis	34J	tomiyama / meijer	34K					hein	34L
thur 3,4 1030-1230	physiol. systems	wb2408	dredging processes 1	wb3413	mech. fibre reinf.plastics	wb1432	modelling 2	wb2422	fuel conversion	wb4405
	dankelman e.a.	34F	miedema e.a.	34K	jansen, kmb	34J	bosgra	34C	hein	34L
thur 5,6 1330-1530	intr.fibre reinf.plastics	wb1430a	man machine systems	wb2404	energy, society & sust.	wb4303	electrical drives (6e uur)	et3026wb		
	marissen	34M	wieringa	34D	Spliethoff	34F	bauer	34B		
thur 7,8 1530-1730	intr.fibre reinf.plastics	wb1430a	digital control	wb2305	intr.transport & log.eng.	wb3420-03				
	marissen	34M	dijkstra	34C	lodewijks/rijsenbrij	34D				
fri 1,2 0830-1030	eq heat & mass transf.	wb4300a	char.handling bulk solid mat.	wb3419-03						
	kramer	34D	lodewijks/schott	34C						
fri 3,4 1030-1230	gas turbines	wb4420	marine engineering C	mt213						
	v buijtenen	34J	grimmelius	34K						
fri 5,6 1330-1530	intr.to microsystems	wb1442	project engineering	wb4402						
	v.keulen e.a.	34D	dhillon/paijens	46A						
fri 7,8 1530-1730										

2A WK 5-11	COURSE SCHEDULE MSC MECHANICAL ENGINEERING SEMESTER 2A									
	course	code	course	code	course	code	course	code	course	code
Day/hours	lecturer	room	lecturer	room	lecturer	room	lecturer	room	lecturer	room
mon 1,2 0830-1030	micro engineering	wb5412	innovations manufacturing	wb5417	num.meth.dynamics	wb1416	thermodyn.of mixtures	st3101		
	pistecky	34L	Steinhoff	46A	rixen	34M	kooi vd / jong de	12A		
mon 3,4 1030-1230	largescale transp.syst.	wb3410	gas & oil processing offsh.	wb4418	optimization 2	wb1441				
	rijsenbrij	34J	olujic e.a.	46A	keulen van	34L				
mon 5,6 1330-1530	des.in fibre reinf.plastics	wb1330	chem. & chemical plant	wb2426						
	jansen, kmb	34L	huesman	34F						
mon 7,8 1530-1730	mathematics in SC	wb2424	thermal power plants	wb4422						
	scherer	34K	spliethoff	34F						
tue 1,2 0830-1030	dredging processes 2	wb3414	syst.identif.param.est.	wb2301	experimental mechanics	wb1406	Industrial organisation B	wm0505tu	des.seperation equipm.	wb4403
	vlasblom e.a.	34E	vd helm	34D	booij	34L	ten haaf	34C	olujic/bruinsma	46A
tue 3,4 1030-1230	stab.thinwalled structures 1	wb1405a	nucleair engineering	wb4416	humanoid robots	wb2433	Industrial organisation B	wm0505tu		
	v keulen	34L	verkooijen	34K	wisse m, vd linde	34E	ten haaf	34C		
tue 5,6 1330-1530	multivar. control systems	wb2421	des. machines & mechan.	wb5414	mod.sim.energy systems	wb4423				
	vd weiden	34F	crone/vd werff	34J	colonna	34K				
tue 7,8 1530-1730	design inform.transducers	wb5302	continuum mechanics	wb1410						
	pistecky	34K	turteltaub	34L						
wed 1,2 0830-1030	intr.pumps & compressors	wb4300b	bone mech.implants	wb2431						
	infante ferreira	34F	vd Linden/Valstar	34C						
wed 3,4 1030-1230	indoor clim.control des.	wb4424	diesel engines B	wb4408b	bio mechatronics	wb2432				
	v paassen	46A	stapersma	34M	vd helm	34L				
wed 5,6 1330-1530	syst. identification	tn3111wb	resistance propulsion 1	mt518	elctrical drives	et3021wb	predictive modelling	wb2427		
	vd hof/bombois	34C	terwisga van	34E +7e	Bauer	34L	v eijk	34J		
wed 7,8 1530-1730	design considerations	wb3300	non-linear vibrations	wb1412	thermal power plants	wb4422	predictive modelling	wb2427		
	drenth	34L	v woerkom	34K	spliethoff	34C	v eijk	34J		
thur 1,2 0830-1030	dredging design	wb3408	vehicle dynamics A	wb3404a	comp. fluid dynamics	wb1428				
	vlasblom	34K	vries ejh de	34L	boersma	34A				
thur 3,4 1030-1230	instrum.proces industry	wb2413	ind.assemblage	wb5422	stab.thinwalled structures 1	wb1405a	vehicle dynamics B	wb3404b	mod.sim.energy systems	wb4423
	vd weiden	34L	tichem	34F	v keulen	34D	de vries	34E	colonna	34B
thur 5,6 1330-1530	transp.eng.hoisting equipm.	wb3406b	fibre reinforced plastics ec	wb1430b	proces control	wb2400	des.seperation equipm.	wb4403		
	gerstel	34D	marissen	34L	dijkstra	34E	olujic/bruinsma	46A		
thur 7,8 1530-1730	multivar. control systems	wb2421	fibre reinforced plastics ec	wb1430b	thermodyn.of mixtures	st3101	logistics: introduction	wb3407A		
	vd weiden	34F	marissen	34L	kooi vd / jong de	12A	lodewijks	34D		
fri 1,2 0830-1030	refrig.techn. & appl	wb4427	char.handling bulk solid mat.	wb3419	turbulence A	wb1424atu				
	Machielsen	34K	lodewijks/schott	34B	Westerweel	34C				
fri 3,4 1030-1230	electrical drives	et3021wb	measurement theory praxis	wb2303	continuum mechanics	wb1410	nucleair engineering	wb4416		
	Bauer	34L	teerhuis	34A	turteltaub	62C	verkooijen	34K		
fri 5,6 1330-1530	fibre reinforced plastics ec	wb1430b	gas & oil processing offsh.	wb4418	gasturb.simul.& applic.	wb4421	Ind. organisation B pract	wm0505tu		
	marissen	34L	olujic e.a.	46A	v buijtenen	34E	ten haaf	34J		
fri 7,8 1530-1730	fibre reinforced plastics ec	wb1430b					Ind organisation B pract.	wm0505tu		
	marissen	34L					ten haaf	34J		

2B WK 14-21	COURSE SCHEDULE MSC MECHANICAL ENGINEERING SEMESTER 2B							
	course	code	course	code	course	code	course	code
Day/hours	lecturer	room	lecturer	room	lecturer	room	lecturer	room
mon 1,2 0830-1030	micro engineering	wb5412	num.meth.dynamics	wb1416				
	pistecky	34K	rixen	34M				
mon 3,4 1030-1230	gas & oil processing offsh.	wb4418	modelling manufacturing	wb5421	optimization 2	wb1441	cybern. ergonomics	wb2306
	olujic e.a.	46A	vluttervelt e.a.	34F	keulen van	34M	vd helm	34D
mon 5,6 1330-1530	chem. & chemical plant	wb2426	design with fin.elem.method	wb3416				
	huesman	34K	vd bos	pcz sectie				
mon 7,8 1530-1730	mathematics in SC	wb2424	design with fin.elem.method	wb3416				
	scherer	34K	vd bos	pcz sectie				
tue 1,2 0830-1030	dredging processes 2	wb3414	syst.identif.param.est.	wb2301	experimental mechanics	wb1406		
	vlasblom e.a.	34E	vd helm	34D	booij	34L		
tue 3,4 1030-1230	stab.thinwalled structures 1	wb1405a	fund. machine tools	wb5425				
	v keulen	34L	karpuschewski	34D				
tue 5,6 1330-1530	robust control	wb2415	fluid-structures interaction	wb1417				
	scherer	34L	rixen	34M				
tue 7,8 1530-1730	int. combustion engines	mt216						
	klein woud	34K						
wed 1,2 0830-1030	comp.fluid dynamics	wb1428	electro mech.systems	et4245wb	cybern. ergonomics	wb2306		
	boersma	34C	compter/polinder	34E	vd helm	34D		
wed 3,4 1030-1230	robust control	wb2415	indoor clim.control des.	wb4424				
	scherer	34L	v paassen	34K				
wed 5,6 1330-1530	syst. identification	tn3111wb	bio mechatronics	wb2432				
	vd hof/bombois		vd helm	34J				
wed 7,8 1530-1730	non-linear vibrations	wb1412	diesel engines B	wb4408b				
	v woerkom	34K	stapersma	34L				
thur 1,2 0830-1030	Dredging design	wb3408						
	vlasblom	34K						
thur 3,4 1030-1230	instrum.proces industry	wb2413	vehicle dynamics B	wb3404b				
	vd weiden	34K	de vries	34L				
thur 5,6 1330-1530	transp.eng.hoisting equipm.	wb3406b	fibre reinforced plastics ec	wb1430b	proces control	wb2400	vehicle dynamics A	wb3404a
	gerstel	34D	marissen	34L	dijkstra	34E	vries ejh de	34K
thur 7,8 1530-1730	logistics: introduction	wb3407A	fibre reinforced plastics ec	wb1430b				
	lodewijks	34D	marissen	34L				
fri 1,2 0830-1030	refrig.techn. & appl	wb4427	char.handling bulk solid mat.	wb3419	Turbulence A	wb1424atu		
	Machielsen	34L	lodewijks/schott	34D	Westerweel	34C		
fri 3,4 1030-1230	measurement theory praxis	wb2303						
	teerhuis	34J						
fri 5,6 1330-1530	fibre reinforced plastics ec	wb1430b	gas & oil processing offsh.	wb4418	gasturb.simul.& applic.	wb4421	Introd. Methodology	wm0503tu
	marissen	34L	olujic e.a.	46A	v buijtenen	34F	ten haaf	34M
fri 7,8 1530-1730	fibre reinforced plastics ec	wb1430b						
	marissen	34L						