ME - Guide

Master 2004 - 2005

ME - Guide

Study guide Master programme Mechanical Engineering

Colophon

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Preface

The ME-Guide 2004 –2005 has the same lay out as in previous years. The study programmes also have the same structure as in the past.

The study programme is now offered in 5 variants:

- Transportation Engineering
- Control Engineering and Mechatronics
- Process and Energy Technology
- Production Technology
- Solid and Fluid Mechanics

Biomedical Engineering is no longer a variant within the master programme Mechanical Engineering. Students interested to study biomedical engineering are referred to the new master programme in this field. A separate study guide for the master programme Biomedical Engineering is available at the Study Administration Office.
The specialisation Dredging Engineering, formerly part of the variant Transportation Engineering, is now part of the new master programme Offshore Engineering. Information can be obtained at the faculty of Civil Engineering and at the Study Administration Office of Mechanical Engineering.
Within Transportation Engineering students can choose a new specialisation on Production Engineering and Logistics. It replaces for a part the former specialisation Industrial Organisation.
The faculty further offers two other master study programmes of interest to Bachelors Werktuigbouwkunde:
Materials Science and Engineering and Systems and Control Engineering. Study Guides can be obtained from the Study Administration Office.

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.

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

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

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MSc programme

1 MSc Mechanical Engineering

1.1 Goal

The goal of the educational programme Mechanical Engineering is to educate Mechanical Engineers (MSc), who have the following qualities:

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

Lecture courses (50-70 EC)
- Obligatory courses variant (at least 20 EC)
- Obligatory courses specialisation
- Elective courses (at least 15 EC)

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

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

The assignments may involve:
- An internship in industry or a project task defined in consultation with an external party (industry, research institute, etc.) of 15 EC. This may be combined with the MSc-thesis, if performed in cooperation with and at the office of an external party.
- MSc-thesis (35 - 60 EC)
- Other individual or group assignments.

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

MSc-thesis

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

1.3 Study programme and general structure

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

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

1.4 Admission to the programme

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

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

1.4.1 Academic bachelor degree

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

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

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

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 Marine Technology of in total 45 EC or less. 15 EC of these additional courses will be part of the elective courses and max 30 EC will be part of an additional programme. The total programme will amount to: 120 + max 30 = max 150 EC.
These additional requirements will ensure that the student has at least an entrance level comparable to the second-course year of the Marine Technology BSc-programme. The lecturer of the concerning specialization may require that also a number of third year courses of the BSc-programme is done additionally.

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

The additional courses are as follows:

Course code	Course name	Credits	Bachelors				
			AP	AE	CI	IDE	MT
mk6010wb	Materiaalkunde 1	2,5 EC	X				
wb1111wb	Statica 1	4 EC	X				
wb1112wb	Sterkteleer 1	4 EC	X				
wb1126wb	Thermodynamics 1	3 EC			X	X	
wb1127wb	Stromingsleer 1	2 EC				X	
wb1212	Eindige Elementen Methode 1	3 EC	X			X	
wb1213-03	Elasticiteitstheorie	2,5 EC	X			X	
wb1214	Eindige Elementen Methode 2	1,5 EC	X			X	
wb1216	Dynamics 2	3 EC	X		X	X	X
wb1220	Stromingsleer 2	3 EC				X	
wb1224	Thermodynamics 2	3 EC	X		X	X	X
wb2104	Systems and Control Engineering 1	3 EC			X		
wb2207	Systems and Control Engineering 2	3 EC	X	X	X	X	X
wi2256th	Lin. Algebra 1 en 2 th	6 EC				X	
wb5103	Vervaardigingskunde	2,5 EC	X				
wbtp110 **1)**	2D-tekenen, ProEngineer, werkplaatsoef.	2 EC	X				
wbp524	Integraal Ontwerp Project 2	8,5 EC	X				
wbtp112	Ontwerpwedstrijd	5,5 EC	X				
	Total additional credits (EC)		**27,5**	**3**	**15**	**30**	**9**

1) In participation with 1st year instructons ME

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.

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

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

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

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

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

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

Pre-Master programme				Contact-uren p/w en tentamens of EC per semester						
Vakcode	**Vaknaam**	**Docent**	**EC**	**1A**	**1B**	**2A**	**2B**	**Herk 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**		**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**		**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 and MSc-thesis
- no internship
- no society-oriented courses
- MSc-thesis of minimal 40 EC

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

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

1.5 MSc-programme Mechanical Engineering

In order to enter the MSc-programme the student should compile a list of courses, which is to be approved by the lecturer of the chosen specialization. This list should be submitted to the examination committie by means of a form, which can be acquired at the desk of the Education support staff and at the website.
In paragraph 1.2 the general requirements concerning the study programme are described. Course schedules can be found in appendix 6.6.

Variants and specializations

There are 5 different variants and 21 specialisations Mechanical Engineering:

1 Transportation Engineering
1.1 Transport Engineering and Logistics
1.2 Production Engineering and Logistics
1.3 Marine Engineering
1.4 Dredging Engineering*

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 Maintenance Engineering

5 Solid and Fluid Mechanics
5.1 Mechanics of Materials
5.2 Engineering Dynamics
5.3 Structural optimization and Computational Mechanics
5.4 Fluid Mechanics

*As from 1 september 2004 this specialisation will be part of the new MSc-programme Offshore Engineering, coordinated by the faculty CiTG. Admission as Mechanical Engineering student will not be possible anymore.

1.5.1 Variant Transportation Engineering

Coordinator Dr.ir. Sape Miedema +31 15 27 88359 S.A.Miedema@WbMT.TUDelft-nl

Free mobility and excellent transportation and handling systems for people and goods are corner stones of the accomplished welfare in the industrialized world. Ships transport worldwide more then 90% of all goods, from raw materials to consumer goods. For inland 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 (TEL)
- Production Engineering & Logistics (PEL)
- Marine Engineering (ME)

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 (TEL)

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

1.5.1.2 Specialisation Production Engineering & Logistics

	Prof. dr. ir. G. Lodewijks	+31 15 27 88793	G.Lodewijks@wbmt.tudelft.nl
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Production Engineering and Logistics (PEL) is aimed at preparing future engineers to play an analyzing, integrating and innovating role in new developments in:

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

The notion of the "specialist" has gradually been replaced by notions of process, integration and a systems view on industrial systems. The use of these new notions in industry and service has created the need for a course program based on a methodology, which offers a coherent and integrated approach for technology, organization and information. An executive engineer has to master all the different aspects of productivity: knowledge of tools / machinery / equipment / information, operational / control systems and perception of human resources, as well as the capacity for contributing to and evaluating of new industrial situations.
PEL prepares for line and staff positions in operations management in industry and engineering consultancy. Great emphasis is put on modelling as an aid to analyse operational problems and to find acceptable solutions. The final assignment is directed to a real problem in a company or organisation.
Applied studies concern the automation and intelligent control of supply, production and

distribution networks. Another rapidly developing area for projects and assignments is predictive modelling with simulation of industrial processes.
The complexity of production organisations increased tremendously during the last decades due to changing customer demands, increased automation possibilities, the real-time availability of information and rigid environmental conditions. The challenge for an engineer is to find solutions combining all these possibilities and conditions. The design of a production organisation is considered a multidisciplinary project.
The combination of organisation and logistics offers a unique opportunity to study the complete value adding chain in industry, composed of transformation and transportation processes. Students broaden their technological knowledge by always including the organisational and informational aspects within the human business environment. They will also learn the restrictions of their knowledge and recognize the need for economical, sociological and/or psychological contributions.

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

Courses Production Engineering and Logistics (PEL)

Obligatory courses	42 EC
Elective courses	24 EC
Assignments and projects	60 EC

1.5.1.3 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, aueiliary 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 eetensive 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. Neet to that the students are eepected to follow a number of specialisation courses up to 18,5 EC. 20,5 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 eeternal 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:

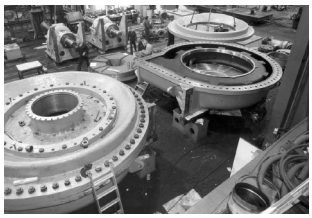
- Investigation in the dynamic behaviour of machinery systems. To realise this, much effort is paid to the development simulation models of equipment and systems and the dynamic simulation of complete systems.
- Maintenance engineering. Work is done on the development of cost effective and safe maintenance 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	39,5 EC
Elective courses	20,5 EC
Assignments and projects	60 EC



1.5.1.4 Specialisation Dredging Engineering

As from 1 september 2004 this specialisation will be part of the new MSc-programme Offshore Engineering, coordinated by the faculty CiTG. Admission as Mechanical Engineering student will not be possible anymore.

Obligatory courses for variant and specialisations (o = obligatory)

Course code	Course name	Lecture hours	Specialisations TEL	PEL	ME	EC
ct3751	Urban Development	0/0/0/4				
ct4330	OR Harbours and shipping ways		o			4
et3026wb	Electrical power drives	0/3/0/0	o	o	o	3
in4050tu	Java and object oriented design			o		6
mt212	Marine engineering B	2/0/0/0			o	3
mt213	Marine engineering C	0/2/0/0			o	2
mt215	Marine engineering A	0/3/0/0			o	2
mt216	Introduction combustion engines	0/0/0/4	o		o	3
mt518	Resistance and propulsion 1	0/0/4/0			o	2
mt518p	Tests resistance and propulsion 1	0/0/e/0			o	1
mtp205	Project 2-4 design propulsion plant	0/0/0/x			o	
mtp301	Project 3-1 design aueiliary systems	x/0/0/0			o	3
oe4625	Dredging processes 2 (old code wb3414)	4/0/0/0				4
oe4626	Dredging processes 1 (old code wb3413)	0/0/2/2				4
oe4671	Dredging design (old code wb3408)	0/0/0/2	o		o	4
wb1427-03	Advanced fluid dynamics A	2/2/0/0				5
wb2402	Hydraulic servo systems	2/2/0/0				3
wb3410-03	Large scale transport systems	0/0/2/0	o			3
wb3417-03	Discrete systems: mpsc	2/2/0/0	o	o		4
wb3419-03	Char.&handling bulk solid materials	2/2/0/0	o		o	6
wb3420-03	Introd. transport & logistic eng.	2/2/0/0	o	o	o	5
wb3421-03	Autom. & Control of Transport Syst.	0/0/2/2	o	o		5
wb3422-03	Design of transport equipment	0/0/2/2	o			5
wb3423-04	Modeling of industrial systems	2/0/0/0		o		3
wb3424-04	Production organisation principles	0/0/2/0		o		2
wb3425-04	Production engineering practical			o		5
wb5421-03	Modelling of manufacturing			o		3
	Total obligatory courses		**42**	**36**	**39,5**	

Recommended elective courses variant and specialisations (e = elective)

Course code	Course name	Lecture hours	Specialisations			
			TEL	PEL	ME	EC
ae4-490	Maintenance management	0/4/0/0	e			4
ae4-496	Maintenance engineering	0/0/4/0	e			3
ct3980	Realization civil projects					4
ctvk4810	Design and control public transport systems	0/4/0/0	e	e	e	4
ct4811	Foundation engineering					3
ct3320	Groundwater mechanics and -flow					4
ct4300	Introduction coastal water engineering					4
ct5305	Waterbouwkundige kunstwerken B.O.					2
ide5131	Business marketing for engineers		e	e	e	3
in2024tu	Introduction databases		e	e	e	4
in2038p	Eeercise introduction databases		e	e	e	2
in3010tu	Introduction virtual reality		e	e	e	4
in4005tu	Industrial automation		e	e	e	4
in4013tu	Expert systems		e		e	4
in4028tu	Business systems engineering		e	e	e	4
in4050tu	Object oriented programming with Java		e	e	e	6
mk3431	Welding techniques		e	e		3
mp1700	Ingenieursgeologie					2
mp3790	Soil mechanics II					3
oe4625	Dredging and slurry (old code wb3414)	4/0/0/0			e	4
oe4626	Dredging processes (old code wb3413)	0/0/2/2			e	4
sc4020	Control theory	4/0/0/0	e	e	e	6
tn3713	Advanced thermodynamics				e	3
wb1310	Multibody dynamics A	0/0/0/4	e	e	e	3
wb1406	Eeperimental mechanics	0/0/2/2	e	e		3
wb1412	Non-linear vibrations	0/0/2/2	e	e	e	3
wb1413	Multbody dynamics B	0/0/2/2	e	e	e	3
wb1416	Numerical methods for dynamics	0/0/2/2	e	e		3
wb1427-03	Advanced fluid dynamics A	2/2/0/0				5
wb2303	Measurement techniques	0/0/2/2	e	e	e	3
wb2306	Cybernetical ergonomics	0/0/0/4	e	e	e	3
wb2311	Introduction modelling	0/4/0/0			e	3
wb2400	Process control	0/0/2/2			e	3
wb2402	Hydraulic servo systems	2/2/0/0	e	e	e	3
wb2404	Man-machine systems	2/2/0/0	e	e	e	4
wb2414	Mechatronics	2/2/0/0	e	e		3
wb3303	Mechanisms	0/0/2/2	e	e		3
wb3404A	Vehicle dynamics A	0/0/2/2	e	e	e	3

Course code	Course name	Lecture hours	TEL	PEL	ME	EC
wb3404B	Vehicle dynamics B	0/0/2/2	e	e	e	3
wb3410-03	Large scale transport systems	0/0/2/0			e	3
wb3415-03	Simulation of transport systems with ADAMS	-/x/-/x	e	e	e	3
wb3416-03	Design with Finite Element Method	0/0/0/2	e	e	e	3
wb3417-03	Discrete systems	2/2/0/0			e	4
wb3418	Pro Engineer	-/-/-/x	e	e		2
wb3422-03	Design of transport equipment	0/0/2/2			e	5
wb3424-03	Modeling of ind. systems	0/0/2/0	e			2
wb3425-03	Production engineering practical		e			5
wb4300B	Introduction to pumps and compressors	0/0/2/0			e	2
wb4303	Energy in society	0/4/0/0			e	3
wb4401	Deeltjestechnologie-W	2/2/0/0				3
wb4408A	Diesel engines A	0/0/2/2			e	4
wb4408B	Diesel engines B	2/2/0/0			e	4
wb4410A	Refrigeration A1	0/0/2/2			e	3
wb4420	Gas turbines	2/2/0/0			e	3
wb4421	Gas turbines, simulation and application	0/0/2/2			e	3
wb5414-03	Design of machines and mechanisms	2/2/0/0	e	e		3
wb5420-03	Design of production systems	4/0/0/0	e	e		3
wi2061	Continuüm mechanica I					4
wi3006	Continuüm mechanica II					4
wi3015tu	Introduction stochastic operations research	0/0/2/2	e	e		4
wi3021tu	Applied statistics B		e	e	e	4
wi4014tu	Numerical analysis C2 (exercise 30 h.)	2/2/0/0	e	e	e	4
wi4019	Non-linear differential equations		e	e	e	3
wi4051tu	Introduction operations research	2/2/0/0	e	e	e	4
wi4052	Risk analysis				e	6
wm0301tu	Introduction philosophy of technology				e	3
wm0304tu	Philosophy of science	0/2/0/0	e	e	e	4
wm0324lr	Ethics and technology				e	3
wm0401tu	History of engineering	0/0/4/0	e	e		3
wm0504tu	Industrial organisation A	4/0/0/0		e		3
wm0505tu	Industrial organisation B	0/0/4/0		e		3
wm0604tu	Commercial economics	0/0/2/2	e	e		3
wm0605tu	Business economics for engineers		e	e	e	4
wm0621tu	Innovation management		e	e	e	3
wm0771	Technisch milieurecht				e	3
wm0781	Octrooirecht en octrooibeleid				e	3
wm0801tu	Introduction safety engineering	0/4/0/0	e	e	e	3
wm0903tu	Technology and global development				e	4

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.

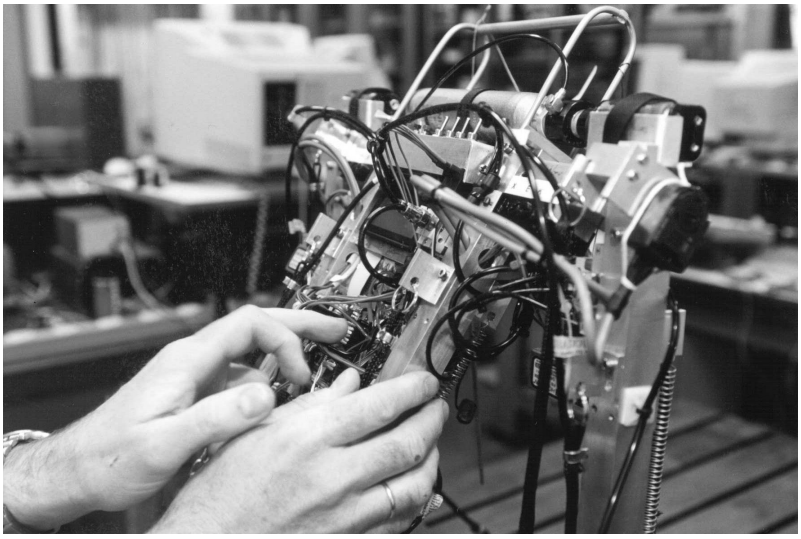
The educational program of the variant Control Engineering and Mechatronics is composed of contributions of the following 7 sections:

- 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.

The joint programme contains the following:

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 design in mechatronics	Langen, Pistecky	2/2/2/0	5
			Total	**26**



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.

Obligatory courses variant	46 EC
Elective courses	14 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	0/0/4/4	5
wb2422	Modeling 2	Bosgra	0/0/4/0	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
wb2413-04	Instrumentation	vd Weiden	0/0/0/2	2
wb2415	Robust Control	Scherer	0/0/4/0	6
wb2416	LMI's	Scherer	0/0/0/4	6
wb2421	Multivariable Control	vd Weiden	0/4/0/0	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	**14**

MSc Systems and Control versus Specialization `Systems and Control Engineering' within MSc Mechanical Engineering

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

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

We will highlight the difference between these two options, and provide arguments for choosing for one or the other.

First the main lines:

- In the MSc Systems and Control the technological area of systems and control engineering is taken as a starting point. The area is approached from its generic themes (system theory, control theory, signal analysis), and its strong multidisciplinary character

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

- In the MSc specialisation Systems and Control Engineering of the MSc programme Mechanical Engineering, the area of mechanical engineering is taken as a starting point. Attention is given to the development and application of system and control engineering concepts in mechanical engineering problems, such as high-precision motion control systems (mechatronics, robotics, microsystems) and industrial process systems.
You take an extensive number of compulsory courses (45 ECTS), in which a number of mechanical engineering subjects is collected (mechanical constructions, dynamics, mechatronic design, microsystems), as well as systems and control courses that partly overlap with the courses from the MSc Systems and Control.
Your MSc project will be executed under the responsibility of one of the professors of DCSC.
Upon successful completion, you will receive an MSc diploma Mechanical Engineering, with the addition that you graduated within the MSc variant "Control Engineering and Mechatronics".

Both options provide you with an excellent professional position after your graduation. When choosing between the two options it is also relevant to consider with which profile you would like to position yourself professionally.
If you want to be recognized as a systems and control engineer, then a combination of a BSc diploma Mechanical Engineering and an MSc diploma Systems and Control is an excellent choice. Your degrees indicate that you have a solid mechanical engineering background, and that in your MSc specialisation you have crossed the classical borders of mechanical engineering, you have mastered an abstract area as systems and control engineering, and you have included a strong multidisciplinary component in your education.
If you feel strongly committed to mechanical engineering, and if you would like to be recognized professionally as a mechanical engineer, then a combination of a BSc Mechanical Engineering and an MSc Mechanical Engineering is the best option to choose.

(by: Paul van den Hof)

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.

Obligatory courses	45 EC
Elective courses	15 EC
Assignments and projects	60 EC

Obligatory courses specialisation Advanced Mechatronics

Course code	Course name	Lecturer	Lecture hours	EC
et4245wb	Electromechanical Systems	Polinder	0/0/0/3	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
et4045	Electronic Instrumentation 1	Wolffenbuttel		4
et4119	Electric power conversion	De Haan, Bauer		4
in4024	Intro real time programming	Toeteler		6
tn4010	Electricity/ magnetism	Meijers, Bruijn		3
wb2303	Measurement techniques	Teerhuis	0/0/2/2	3
wb2402	Hydraulic servo systems	Teerhuis	2/2/0/0	3
wb2421	Multivariable Control	vd Weiden	0/4/0/0	6
			Total minimal to select	**15**

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).

Obligatory courses variant	26 EC
Obligatory courses specialisation	30 EC
Elective courses	14 EC
Assignments and projects	50 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 est.	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	e	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
sc4110	System Identification		e	0/0/4/4	5
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
wb2413-04	Instrumentation	e	e	0/0/2/2	2
wb2422	Modelling 2		e	0/0/4/0	6
wb2427	Predictive Modelling		e	0/0/4/0	3
wb2433-03	Humanoid robots	e		0/0/2/0	3
wb3303	Mechanisms	e		0/0/2/2	3
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
ME02MMS01	Progress meeting (every last Wednesday of the month)	3
ME02MMS02	Practical assignment	11
ME02MMS03	Literature study	11
ME02MMS04	Literature study colloquium	3
ME02MMS05	Introductory colloquium	9
ME02MMS06	Graduation colloquium	6
ME02MMS07	Final project report	17
	Total	**60**

1.5.2.4 Specialisation Engineering Dynamics

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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.

Obligatory courses	26 EC
Elective courses	34 EC
Assignments and projects	60 EC

Recommended elective courses common Mechanics

Course code	Course name	Lecture hours	EC
ae4-900	Continuum mechanics	0/0/4/0	4
ct5142	Non-linear numerical mechanics	0/4/0/0	3
wb1402a-04	Plates and shells A	0/4/2/0	5
wb1405A	Stability of thin-walled constructions	0/0/4/2	4
wb1408	Mechanics of pressure vessels	2/2/0/0	3
wb1409	Elasticitytheory	2/2/0/0	3
wb1433-04	Thermomech. modelling and char. of polymers	0/0/2/0	3

Recommended elective courses Dynamics

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

1.5.2.5 Specialisation Mechanics of Materials

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Mechanics of Materials
The continuous improvement of mechanical products and processes requires a flexible design method. For this in the design phase a profound insight in the mechanical properties during and after production is required. Engineering Mechanics offers a variety in analytical, numerical and experimental methods to gain / improve insight in the mechanical properties.
A recent development in flexible designing is the so-called "virtual prototyping". Here, in the design phase the various steps in the production process and the resulting (mechanical) product properties (of the "virtual prototype) are established by means of simulations. Subsequently the design can be adopted / improved. Each adaptation results into an alternative "virtual prototype". The procedure, combined with adequate optimisation, can result in efficient and fast product development; where with reasonable probability the resulting (mechanical) properties (of the "real prototype") will meet the preset qualifications. Therefore, in the past few years virtual (=simulation-based) prototyping is beginning to draw attention from both industries and the academic world. Virtual prototyping involves a variety of aspects such as mechanical modelling of the material behaviour, numerical simulation, design of appropriate optimisation tools and adequate experimental verification techniques. Education and research in Mechanics of Materials is directed to these aspects, with special focus on experimental characterization and modelling of (process dependent) material behaviour, simulation of production steps and related mechanical properties of products and experimental verification of simulation results.
Reliability of Microelectronics and Microsystems
Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of micro-systems. Because of the continuing miniaturization in this area new concepts in mechanics as well as in experimental methods are being developed and applied. Master theses will often be related to these challenges and will offer opportunities to co-operate with the industrial research partners, such as Philips, Fraunhofer IZM, IMEC, TNO, Thales, Siemens, Kitron, Motorola, ICI, DSM.
Key subjects of MSc research work are:

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

Educational program

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.

Obligatory courses variant	26 EC
Obligatory courses specialisation	27 EC
Elective courses	15 EC
Experimental exercise	10 EC
Thesis work	42 EC

Obligatory courses specialisation Mechanics of Materials

Course code	Course name	Lecture hours	EC
4k200 (TUE)	Mechanics of micro electronics	4/0/0/0	3
ae4-900	Continuum Mechanics	0/0/3/0	4
tm2721	Physical & Mechanical Properties part B	0/0/4/4	3/3
wb1408	Mechanics of Pressure Vessels	2/2/0/0	3
wb1409	Theory of Elasticity	2/2/0/0	4
wb1433-04	Thermomech. modelling and char. of polymers	0/0/2/0	3
wi4014tu	Numerical analysis c2	2/2/0/0	4
		Total	**27**

Recommended elective courses specialisation Mechanics of Materials

Course code	Course name	Lecture hours	EC
ae4-684	Fibre reinforced materials in aerospace structures		3
ct5142	Non-linear Computational Mechanics	0/0/4/0	3
tm2721	Physical and Mechanical Properties part A	4/0/0/0	3
wb1310	Multibody Dynamics	0/0/0/2	3
wb1402a-04	Plates and Shells	0/4/2/0	5
wb1405a	Stability of thin-walled structures	0/0/4/2	4

wb1412	Linear and nonlinear vibrations in mechanical systems	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
wb1440	Engineering optimisation	2/2/0/0	3
wb2303	Measurement Theory and Praxis	0/0/2/2	3
wi4007tu	Fourier and Laplace transforms	0/0/2/2	3
		Total to select	**15**

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.

Obligatory courses variant	26 EC
Obligatory courses specialisation	8 EC
Elective courses	16EC
Assignments and projects	70 EC

Obligatory Courses Tribology			
Course code	Course name	Lecture hours	EC
wb5400	Tribology in machine design	0/2/2/2	4
wi4014tu	Numerieke analyse C2	2/2/0/0	4
		Total	**8**

Recommended elective courses specialisation Tribology			
Course code	Course name	Lecture hours	EC
et3026wb	Electrical motion systems	0/3/0/0	3
mt216	Introduction combustion engines	0/0/0/4	3
wb1310	Multibody dynamics	0/0/0/2	3
wb2414	Mechatronics	2/2/0/0	3
wb2427	Predictive Modeling	0/0/4/0	3
wb5414-03	Design of Machines and Mechanisms	2/2/2/0	3
wb2451-03	Failure Analysis		4
wb2452-03	Machine Reliability		4
wb2453-03	Advanced Fluid/Gas Bearing Design		4
		Minimal to select	**16**

Assignments, projects, internship Tribology:

Code	Name	EC
ME02TRI01	Numerical methods applied to tribology / Design case	12
ME02TRI02	Literature survey + colloquium	12
ME02TRI03	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.

Obligatory courses variant	26 EC
Obligatory courses specialisation	17 EC
Elective courses	17 EC
Assignments and projects	60 EC

Obligatory courses specialisation Vehicle Mechatronics

Course code	Course name	Lecture hours	EC
mt216	Internal combustion engines	0/0/0/4	3
sc4110	System Identification	0/0/0/4	5
wb2311	Modeling 1	0/4/0/0	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
et4245wb	Electromechanical systems	0/0/0/3	4
in4024	Intro real time programming		6
wb1310	Multi-body dynamics A	0/0/0/2	3
wb1412	Linear and nonlinear vibrations in mech. systems	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	0/0/4/0	6
wb2416	LMI 's	0/0/0/4	6
wb2421	Multivariable Control	0/4/0/0	6
wb3404B	Vehicle dynamics B	0/0/2/2	3
	Advanced Vehicle Control		3
		Minimal to select	**17**

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
wb1427-03	Advanced Fluid Dynamics	2/2/0/0	5
wb2311	Introduction modelling	0/4/0/0	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.

Obligatory courses	47 EC
Elective courses	13 EC
Assignments and projects	60 EC

Obligatory courses Specialisation Energy Technology			
Course code	Course name	Lecture hours	EC
wb4400-03	Introduction to Energy Technology	0/2/0/0	1
wb4422	Thermal Power Plants	0/0/4/0	4
wb4423-03	Modelling and Simulation of Energy Conversion Systems	0/0/0/4	4
wb4430-03	Process flow scheme	0/0/x/x	6
	at least 9 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
		Total	**24**

Recommended elective courses specialisation Energy Technology			
Course code	Course name	Lecture hours	EC
ae4-140	Gas dynamics		3
ct5147	Wind Energy Conversion Systems		3
tn3710	Advanced thermodynamics		6
tn3782	Multiphase flow		6
wb1428	Computational Fluids Dynamics	0/0/2/2	3
wb1429	Microfluidics	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
ME03ENT01	First student project (HBO students excluded)	23
ME03ENT02	Final student project (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.

Obligatory courses	40 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	0/0/2/2	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
wb1429	Microfluidics	0/0/2/2	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

Projects in 2nd year MSc		
Code	Project name	EC
ME03PEQ01	G- group	12
ME03PEQ02	Traineeship	11
ME03PEQ03	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	38 EC
Elective courses	22 EC
Assignments and projects	60 EC

Recommended elective courses specialisation Fluid Mechanics

Course code	Course name	Lecture hours	EC
	Society oriented (>= 6 EC)		
wm0605tu	Business Economics for Engineers		4
wm0621tu	Innovation Management		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
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
wb1429-03	Microfluidics	0/0/2/2	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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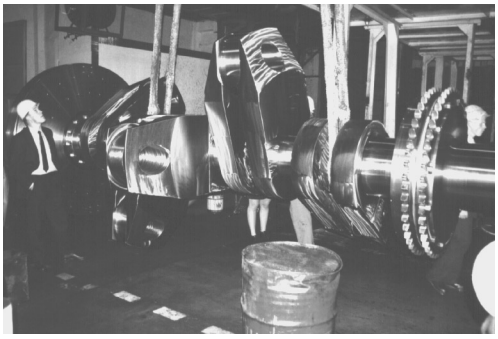
Marine Diesel Engines is a specialisation within Process and Energy with emphasis on the interaction between the components and subsystems that make up the engine (system approach). Apart from a strong emphasis on the thermodynamic side, the attention is also focussed on the (marine) application of the 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

Obligatory courses	37 EC
Elective courses	23 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
wb4430-03	Process flow scheme	0/0/x/x	6

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

Projects in 2nd year MSc

Code	Project name	EC
ME03MDE01	First student project	23
ME03MDE02	Final student project	37
	Total	**60**

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 second 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 third specialisation dealing with Maintenance engineering (ME) includes the 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.

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.
- New materials, new processes. Many new engineering materials are fabricated for advanced applications, like aerospace and bio-medical applications. The manufacturing of parts out of these materials often requires the development of new processes.
- 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 micro-products focused on contain parts from the micro-mechanical engineering domain as well as parts from the semi-conductor domain (MEMS – MicroElectroMechanical Systems). The assembly of these products in high volumes offers a considerable challenge.

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.

Educational Programs PTO

The educational program of the section PTO includes 3 specialisations. These are:
- Production Technology (PT) - Prof. Dr. Ing. habil. B. Karpuschewski
- Design and Life Cycle Engineering (DL) - Prof. dr. T. Tomiyama / Prof. dr. ir. K. van der Werff
- Maintenance Engineering (ME) - Prof. ir. K. Smit

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.

Summary specialisation curriculum in EC	PT	DL	ME
Obligatory core courses (incl PTO-lab exercises)	20	20	20
Obligatory subjects in Specialisation	15	18	35
Elective subjects	20	22	15
Industrial training	15	(15)	--
Design/research assignment, literature thesis or combination of both	15	(15)	9
Master thesis	35	45	41
Total	**120**	**120**	**120**

Overview Dutch "TH-ingenieur" programs:

Students with a Dutch "HBO-Ba-diploma wb or Hogere Zeevaartschool" can be admitted after balloting. See general information on MSc program elsewhere. A total of 139 ECTS credit points must be collected.

Curriculum subdivision in European Credits (for Dutch HBO)	PT	DL	ME
Mathematics/Mechanics	34	34	34
PTO – core obligatory subjects	20	20	20
Obligatory subjects in specialisation	15	18	35
Elective subjects	20	22	6
Design/research assignment , literature thesis or combination of both	15	-	9
Master thesis	35	45	35
Total	**139**	**139**	**139**

Core subjects PTO

Obligatory courses PTO			
Course code	Course name	Lecture hours	EC
wb2414	Mechatronics design	2/2/0/0	3
wb5414-03	Design of machines and mechanisms	2/2/0/0	3
wb5420-03	Design of production systems	4/0/0/0	3
wb5421-03	Modelling of manufacturing processes	0/0/0/2	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 on a feeding concept for feeding small parts in the context of micro-assembly, MSc assignment, in co-operation with the EPFL (Lausanne, Switzerland)
- Research into the optimal production of blanks (sheet metal) at Fokker Papendrecht.
- Modal analysis and proposals for design improvement of a vertical milling machine of Unisign, NL.

The 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.

Characteristics of the micro-assembly application area are part sizes down to the sub-millimetre range and high accuracy in part joining between 0.1 and 10.0 µm. Parts come from different technological domains, the semi-conductor domain with silicon as most important material and the advanced precision mechanical engineering domain with

a wide range of materials such as steel, ceramics, glass or composites. The goal is to develop an arsenal of technologies for micro-assembly with a current emphasis on micro-gripping, self-adjustment and micro-factories. The technology oriented research program is clearly linked to the domain of Mechatronics and Microsystems.

Obligatory courses specialisation Production Technology			
Course code	Course name	Lecture hours	EC
wb5422-03	Industrial assembly	0/0/4/0	3
wb5425-03	Fundamentals of machine tools	0/2/0/0	3
wb5432-03	Fundamentals of material removal processes	0/0/0/2	3
wb1442	Introduction microsystems	2/2/0/0	3
wb2427	Predictive modelling	0/0/4/0	3
		Total	**15**

Recommended elective courses specialisation Production Technology			
Course code	Course name	Lecture hours	EC
ae4-485	Manufacturing engineering		3
ae4-786	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	0/0/2/2	3
wb2415	Robust control	0/0/0/4	6
wb2427	Predictive modelling	0/0/4/0	3
wb2428-03	Mechanical construction principles	2/2/2/0	3
wb5430-04	Engineering informatics	0/4/0/0	4
wb5431-04	Life cycle engineering	0/0/0/4	4
wm0610tu	Elementary business economics		2
Subtotal minimum of elective courses PT to be selected			20

Assignments, traineeship specialisation Production Technology		
Course code	Course name	EC
ME04PRT01	Small research assignment	15
ME04PRT02	Traineeship	15
ME04PRT03	MSc assignment	35
	Subtotal individual assignments PT	**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.

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
id4125	Product Life Cycle Engineering and Design A	0/0/4/0	3
wb3417-03	Discrete systems	2/2/0/0	4
wb5430-03	Engineering Informatics	0/4/0/0	4
wb5431-03	Life Cycle Engineering	0/0/0/4	4
		Subtotal obligatory courses DL	**15**

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	0/0/4/0	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
id5561	Product Service Systems		3
in4010/4011	AI (Intro + Knowledge Based)	2/2/0/0	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

wb2428-03	Mechanical Construction Principles	2/2/2/0	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
wm0506TU	Management of Innovation		6
	Subtotal minimum of elective courses DL to be selected		**22**

Assignments and traineeship specialisation Design and Life Cycle Engineering		
Course code	Course name	EC
ME04DLC01	Small research assignment	15
ME04DLC02	Industrial Traineeship	15
ME04DLC03	MSc assignment	45
	Subtotal individual assignments DL	**60**

1.5.4.3 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	Lecturehours	EC
ae4-490	Maintenance management	2/2/0/0	3
ae4-496	Maintenance technology	0/0/4/0	3
ide343	Development operational safety	0/2/2/0	4
In2041TU	Introduction databases	3/0/0/0	4
wb3417-03	Discrete systems	2/2/0/0	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
		Subtotal obligatory courses ME	**35**

Recommended elective courses specialisation ME			
Course code	Course name	Lecture hours	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
wb5400	Tribology in machine design	0/2/2/2	4
wb5431-03	Life Cycle Engineering	0/0/0/4	4
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
	Subtotal minimum elective courses ME to be selected		**15**

Assignments and traineeship specialisation Maintenance Engineering		
Course code	Course name	EC
ME04MNE01	Literature thesis or Research Assignment	9
ME04MNE02	MSc assignment	41
	Subtotal individual assignments ME	**50**

1.5.4.4 Specialisation Industrial Organisation

This specialisation will be canceled from course year 2004-2005.
Interested students are advised to think about the new specialisation Production Engineering & Logistics within the variant Transportation Engineering. Information about this specialisation can be given by dr.ir. H.P.M. Veeke.

1.5.5 Variant Solid and Fluid Mechanics

Coordinator Prof.dr.ir. A. van Keulen +31 15 27 86515 a.vankeulen@wbmt.tudelft.nl

Design, modeling and control of most practical structures and systems relies on solid or fluid mechanics. In cases of fluid-structure interaction both solid and fluid mechanics are needed. Prompted by rapid developments in computer and information technology, attention has been shifted from analytical approaches towards numerical models and techniques during the last decades. For these reasons, (computational) mechanics and (computational) fluid dynamics are among the keystones of many engineering disciplines, for example aeronautics, civil and mechanical engineering, and bioengineering.

Obviously, new theories and models require rigorous experimental validation. The master programme Solid and Fluid Mechanics is organized as a two-year study devoted to the fundamentals of contemporary mechanics. This implies that a variety of courses are embedded, addressing the formulation and fundamentals of governing (continuum) theories, numerical solution procedures and discretization techniques, among others. The Solid and Fluid Mechanics programme gives an excellent basis for those aiming at a research carreer in industry or academia. However, also for those planning a carreer in advanced engineering the programme yields a solid basis for further 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.

Obligatory courses	23 EC
Elective courses	27 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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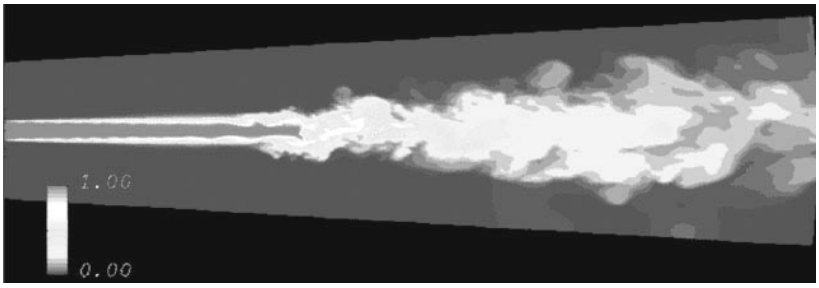
The specialization of fluid mechanics is offering training in the fundamentals of incompressible fluid flow. The areas to which most attention is directed are turbulence and multi-phase flow and these are in particular the areas which occur in many industrial and environmental applications. In view of modern developments in technology, much attention is given to numerical fluid dynamics (CFD) and its uses to various practical problems. Furthermore, the fluid mechanics group carries out extensive research on new developmentes in the application of numerical tools to fluid mechanics, in particular with respect to the simulation of turbulence. Fluid mechanics is a strongly nonlinear physical phenomenon and therefore we cannot do without experiments in this field. Most of the numerical work is, therefore, combined with experimental research in which emphasis is put on the use of new measuring techyniques. As a result, the student will be trained in all aspects of modern fluid mechanics both by means of courses and by means of research work.



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

Reliability of Microelectronics and Microsystems
Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of micro-systems. Because of the continuing miniaturization in this area new concepts in mechanics as well as in experimental methods are being developed and applied. Master theses will often be related to these challenges and will offer opportunities to co-operate with the industrial research partners, such as Philips, Fraunhofer IZM, IMEC, TNO, Thales, Siemens, Kitron, Motorola, ICI, DSM.
Key subjects of MSc research work are:

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

1.5.5.4 Specialisation Structural Optimization and Computational Mechanics

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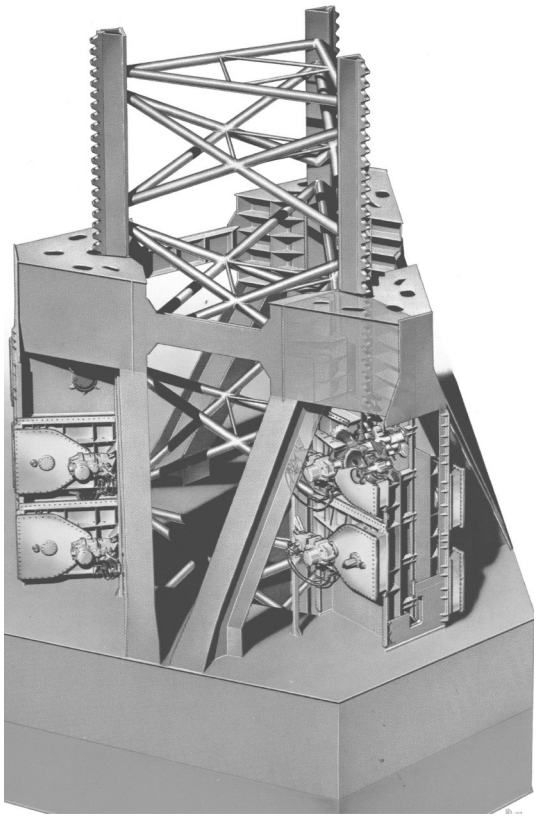
Recent developments in computer technology have opened possibilities for automated design and optimization. This requires a solid understanding and knowledge of both (computational) mechanics and optimization. However, nearly always other disciplines are involved as well, for example, production, electrical,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

Recommended elective courses specialisations (≥ 27 EC)

Course code	Course name	Lecture hours	EC
ae4-30	Aero-Elasticity	0/0/2/2	3
ae4-140	Gasdynamics I	2/2/0/0	3
ae4-141	Gasdynamics II	0/0/2/2	3
Ctme5145	Random vibrations	4/0/0/0	3
ide521	Computer Visualisation	2/0/0/2	3
in006tu	3D Computer Graphics	0/3/0/0	4
tm2721	Physical and Mechanical Properties part B	0/0/4/4	3/3
tn3713	Advanced thermodynamics	0/0/3/0	6
tn3733	Turbulent reacting flows	2/2/0/0	6
tn3753	Transport phenomena II	0/0/3/0	6
tn3782	Multiphase Flow	0/0/2/2	6
wb1310	Multibody Dynamics A	0/0/0/4	3
wb1402a-04	Plates and Shells	0/4/2/0	5
wb1405a	Buckling Analysis	0/0/4/2	4
wb1406	Experimental Mechanics	0/0/2/2	3
wb1408	Mechanics of pressure vessels	0/0/4/0	3
wb1412	Linear and nonlinear vibr. in mech. systems	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
wb1429-03	Microfluidics	0/0/2/2	3
wb1433-04	Thermomech. modelling & char. of polymers	0/0/3/0	3

wb1440	Engineering Optimization	2/2/0/0	3
wb1441	Optimization II	0/0/2/2	3
wb2303	Measurement Theory and Praxis	2/2/0/0	3
wb2414	Mechatronics	2/2/0/0	3
wb4300a	Heat and Mass Transfer Apparatus	4/0/0/0	3
wb5414-03	Design of Machines and Mechanisms	2/2/0/0	3
wi3001	Num.Meth.for Partial Differential Equations	2/2/0/0	6
wi4006	Special functions	2/2/0/0	6
wi4008	Complex analysis	2/2/2/2	4
wi4010	Advanced Course on Numerical Linear Algebra	4/0/0/0	6
wi4011	Numerical fluid Dynamics	2/2/2/2	6
wi4014tu	Numerical Analysis C2		4
wm0605tu	Business Economics for Engineers		4
wm0621tu	Innovation Management		3



Hydraulic rack and pinion elevating system, IHC Gusto Engineering

1.5.6 Annotations

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

a Technical Marketing
b Sustainable Development

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

Annotation Technical Marketing

The responsible lecturer for Technical Marketing is prof. mr. dr. Sicco C.Santema (tel. +31 15 27 83076). The Technical Marketing guidance of students will be co-ordinated by dr. H.M.J.J. Snelders (tel. +31 15 27 83108).

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. Sicco S. Santema). The marketing component in the study programme consists of at least 15 EC marketing courses and 23 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 in 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.

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**

Reommended elective courses annotation Technical Marketing (at least 3 EC)			
Course code	Course name	Lecture hours	EC
wm0720	Business law A / Company law	0/0/4/0	3
wm0115	Conflict handling and negotiation	0/3/0/0	2
	Other courses relevant for TM		

Annotation Sustainable Development

Sustainable Development (SD) is a growing concern in many research projects and is becoming a more essential element of political and organisational decision making. Nowadays technology plays an important role in the approaches to sustainability related problems. For this reason the Delft University of Technology offers students the possibility to specialise in SD.
The annotation tackles both the broad and in-depth knowledge regarding SD and technology. Sufficient in-depth knowledge is realized with the MSc-thesis, which has to incorporate SD issues. Students make SD a central element in the thesis focussed on their own disciplines. Every faculty has a SD lecturer, with specific expertise to assess the thesis.
The broad knowledge is guaranteed through the colloquium 'Technology in Sustainable Development' (wm0922tu, 4 EC) and a number of elective courses in the field of SD (at least 11 EC).
(Based on flyer 'What's your contribution to a sustainable world?'.)

Further information on the available courses and the possibilities can be found at the website http://www.odo.tudelft.nl and from dr.ir. C.A. Infante Ferreira (phone: 015 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.

1.5.7 Technical University Teacher Course (TULO)

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

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

1.6 Enrolling for courses and tests

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

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

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

Using TAS When first using TAS the student must choose a personal password. This can be done by using the campus card in a card reader. At the faculty there are two card readers: one is located near the Pallas / Parthemus computerroom (4, 1st) and one is located at Education support staff (8B, 2th).

1.7 Pass rules and criteria for 'honours-degree'

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

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

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

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

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

1.8 Honours Track

During the course year 2004-2005 it is possible to follow an honours track for excellent students. An honours track is a special individual programme, in addition to the regular Master programme, of 30 EC (840 hours) and is related to Marine Technology and / or to the role of technology within society. The extra programme has to be finished during the Master programme of the student. Students who have successfully completed their honours track receive a special certificate of the university. Students, who have finished the Bachelor programme with a weighted averaged mark of 7.5 or higher and students who have shown an excellent performance during the first semester (no fails and weighted averaged mark 7.5 or higher), are eligible for following the honours track in their Master programme. The Director of Education is responsible for the programme of each individual honours track.

1.9 Study and internship abroad

Study abroad offers a lot of attractive prospects. You become acquainted with a different (organisational) culture, a different university life and a different educational system. Besides you enlarge your personal network, you learn to live within a foreign environment, and you improve your knowledge of languages. To put it briefly: a period of study abroad will make a valuable contribution to your personal education and you will draw much benefit from it at your search for a proper job.

You can make use of one of many exchange agreements with European and non-European universities for your study at a foreign university. Within such an agreement you do not pay the foreign university any tuition fee. In addition to this, grants are available

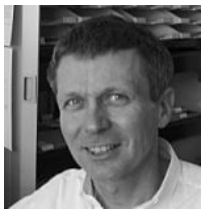
for financing the additional expenses for staying abroad. For your first information on studying abroad it is recommended to visit the Back Office International Programmes of the Student Facility Centre. Much documentation about study abroad is available at this Centre, like information on all universities with which an exchange agreement exists, possibilities of financing, and travel reports from students.
If you got a clear idea about where you want to go to, you can ask the Coordinator for International Exchange Marine Technology for advise about your programme at the foreign university and about the recognition of your results at the host university. Your graduation professor will judge your work afterwards according to the rules you agreed upon, prior to departure.

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

Internship

Usually a internship is arranged via one of the staff members of the section to which your 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 on both study and internship abroad is available at the TUDelft website (http://www.tudelft.nl); via Campus Portal choose under the heading STUDENT AFFAIRS: 'Internship, study, jobs'.



Coordinator for International Exchange
dr.ir. D. Nijveldt
Room 8B – 2 - 27
Mekelweg 2
2628 CD Delft
Phone: 015 27 85921
Fax: 015 27 88340
E-mail: d.nijveldt@wbmt.tudelft.nl

Internship, Santiago de Cuba 2003

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 2001 was € 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')

Organisation

2 Organisation

2.1 Faculty

The faculty Mechanical Engineering and Marine Technology offers the study programmes Biomedical Engineering (BME), Materials Science and Engineering (MSE), Mechanical Engineering (ME), Marine Technology (MT) and Systems and Control (SC). The faculty also participates in the interfaculty MSc programmes Offshore Engineering (OE) and Transport, Infrastructure and Logistics (TIL).
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. drs. M. Waas, room: 8F-1-14, phone: 015 27 85401, email: m.waas@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
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
Mascha Toppenberg	International MSc-coordinator	m.p.i.toppenberg@wbmt.tudelft.nl	Tel. 015 27 86959
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 "Leeghwater"

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

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

The first aim, support to the study, is taken care of by organising excursions, case studies and by taking a seat in the organisation of the "Delftse Bedrijvendagen". Gezelschap Leeghwater also publishes a year book, an agenda and five times a year the magazine 'de Slurf'.
The second aim, to look after the interests of the students, is taken care by organizing "lecture response groups" in order to give feedback to teachers. Every year one member of the board of Gezelschap Leeghwater is responsible to represent the students in discissions with the faculty and education staff about education. He or she is the person, who canalizes complaints and wishes about the education programme, organization and lecturers. This person can be contacted by onderwijs@leeghwater.nl

Books

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

Other student associations ('Disputen', see website for more information):
API (Apparatenbouw voor de Procesindustrie), Eiffel (technische mechanica, micromechanica en vvk), Energievoorziening en Koudetechniek en Klimaatregeling, Meet- en Regeltechniek, Mens Machine Systemen, Offshore Technologie, Pandora (industriële organisatie), Panta Rhei (stromingsleer),Taylor (productietechniek en organisatie), Transportkunde (transporttechniek & logistieke techniek), Voertuigtechniek

2.6 Student guidance

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

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

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

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

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

Mrs. Teunie Eden, student adviser for all students BSc-MSc WbMT, as well as counsellor in case of harassment (see down this page)
Specialisms: Exchange students, International MSc-students, social programme international students.
Mekelweg 2, 8B 2th floor, room 28B
Email: t.eden@wbmt.tudelft.nl
Phone: 015 27 82176

Ir. Jaap v.d. Zanden, student adviser for all students BSc-MSc WbMT.
Specialisms: Graduate 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

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

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

2.7 Working conditions, RSI and harassment

RSI (Repetitive Strain Injury) is a well known problem by now. Within the TU Delft the number of complaints caused by RSI is increasing. Still too many employees and students neglect the first symptoms of RSI, without knowing where to go with their questions and complaints. On the internet there is a lot of information to be found on this matter. An example is http://www.rsi.pagina.nl.
Free software, can be downloaded on the 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
- Labour and environmental adviser Leen Paauw, l.paauw@wbmt.tudelft.nl
- Student Health Care (SGZ), tel: 015 2121507, studentenartsen@sgz.nl
- Student Facility Centre (SFC), http://www.sfc.tudelft.nl
- VSSD support, tel: 015 27 82057, http://www.vssd.nl

Harassment

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

Counsellor

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

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

The Counsellor for our department is:
Mrs. T.Eden
Mekelweg 2, 8B 2th floor, room 28B, email: vertrouwenspersoon@wbmt.tudelft.nl
Phone: 015 27 82176

2.8 Quality Control

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

Internal Quality Control:

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.
- **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 direct feedback to lecturers.

External quality control:

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

2.9 Information services

Study guide

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

Blackboard

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

Grades

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

2.10 Rules and Regulations

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

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

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

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

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

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

Internet facilities

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

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

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

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

Facilities

3 Facilities

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

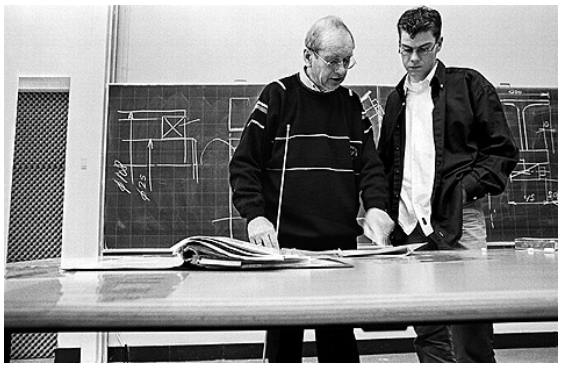
3.1 Lecture Rooms / Meeting Rooms

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

Room	Capacity	Location
A	300	6, BG
B	200	6, BG
C	150	6, BG
D	150	6, BG
E	70	6, BG
F	70	6, BG
J	50	8D, 1st
K	30	8G, 1st
L	30	8G, 1st
Meeting room 4		8B, 2nd
Meeting room 5		8B, 2nd

3.2 Individual study facilities

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



3.3 Computer rooms

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

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

3.4 Research facilities

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

Fluid Mechanics laboratory

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

Delft Bio-robotics Laboratory

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

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

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

Faculty Library

The faculty library is a part of the TU Delft library. It has a collection, focussed on Mechanical Engineering and Marine Technology. Part of the books on Mechanical Engineering and Marine Technology, however 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 and books

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

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

3.7 Mailbox and access to the internet

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

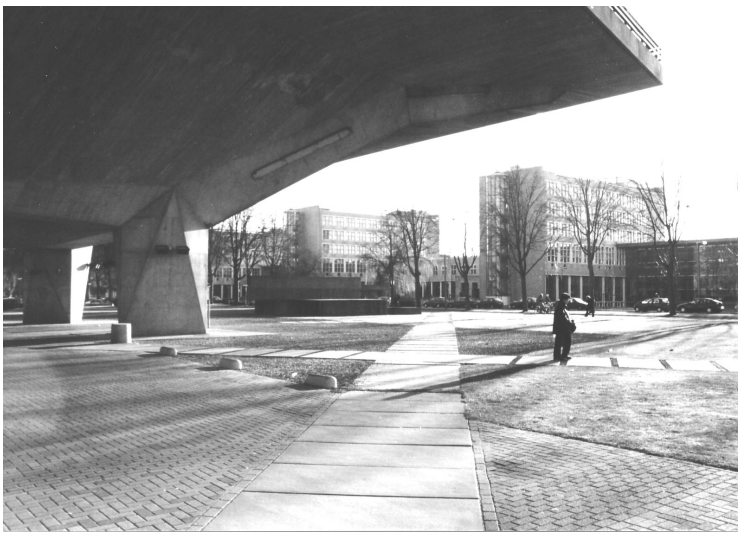
Printing Printing is paid for by a print account. Each student gets a welcome account of €11.50 to start with. At the reception desk the account can be upgraded, from 8:30 till 16:30. It is possible to check the print account at all time, by pointing with the mouse on the 'dollar sign'-symbol in the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

The services mentioned above are taken care of by:

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

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

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

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

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

Service for Students

4 DUT - Services for students

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

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

SFC

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

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

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

Sports Centre

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

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

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

Cultural Centre 'Mekelweg 10'

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

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

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

ICT Infrastructure

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

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

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

Course descriptions

In general courses are given in English, with some exceptions:

- **E:** means that the course is given in english
- **NL:** means that the course is only given in Dutch
- **ER:** means that the course is given in Dutch, on request the course is given in English

For complete course descriptions see website.

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

wb1405A	Stability of Thin-walled structures 1	
Lecturer	Keulen, prof.dr.ir. A. van	
Course Material	Every student must prepare his own lecture notes. Some handouts will be provided. In addition, references to literature and textbooks will be given during the lectures.	
Description	Functional description, General buckling phenomena, Initial post-buckling behaviour, Linear and nonlinear pre-buckling solution, Buckling of discrete systems, Buckling of finite element models, Geometrical stiffness, Geometrically nonlinear finite element analysis, Eigenvalue analysis Sensitivity analysis.	
Education	Lecture 0/0/4/2	**EC** 4
Assessment	Oral + assignments	**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 0/0/4/0	**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	**Linear and nonlinear vibrations in mechanical systems**		
Lecturer	Woerkom, dr.ir. P.Th.L.M. van		
Course Material	See website		
Description	- Introduction and review of linear vibration theory. - Occurrence and types of linear and nonlinear mechanical vibrations. - Analysis of linear and nonlinear vibrations in discrete mechanical systems. - Suppression of vibrations. - Introduction of nonlinear vibrations in continuum systems.		
Education	Lecture 0/0/2/2	**EC** 3	
Assessment	Written report		**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 **??**

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

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 Course Material	Teerhuis, ir. P.C.	
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 Course Material	Dijkstra, dr. Sj. 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 Course Material	Helm, prof.dr. F.C.T. van der 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 Course Material	Plettenburg, dr. ir. D.H., Herder, dr.ir. J. reader: "Ontwerpen in de medische techniek" edited by Just L. Herder and Dick H. Plettenburg (partly in Dutch).	
Description	Medical systems design, Diagnosis; Treatments, Orthopaedics, Rehabilitation.	
Education	Lecture 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	**??**

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

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

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

wb2416	Linear Matrix Inequalities in Control		
Lecturer Course Material	Scherer, prof.dr. C.W. 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 0/0/0/4	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			??

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

wb2422	**Modelling 2**
Lecturer	Bosgra, prof.ir. O.H.
Course Material	
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	Slides and lecture notes on blackboard		
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		**NLR**

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	Vehicle 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	Vehicle 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	Transport sytems. Logistics. Importance for the economy. Basic models. Multimodal transportation. Terminals. Equipment. Belt conveyors. Dynamic characteristics. Containers. Load units. Logistic chains. Production and distribution. Service systems. Inventory models. Decision analysis. Mechanisation and automation.
Education Assessment	Lecture 0/0/0/0 **EC** 5 **??**

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

wb3422-03	Design of Transport Equipment
Lecturer Course Material	Klein Breteler,dr.ir. A.J., Drenth, ir. K.F.
Description	Overview of typical transport equipment , including crane configurations (mainly non-bulk goods). Application of mechanisms (kinematics and dynamic aspects). Stability, balancing and vibration problems. Mechanical power and selection of a driving motor. Typical components like grabs, spreaders, wheels, belts and cables. Large structures (lattices): details regarding stress, deformation and fatigue. Construction standards for mechanical design. Application of design methodology (morphological matrix, multi-criteria analysis). CE-marking and tender documents
Education Assessment	Lecture **EC** **??**

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

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

wb4300A	**Equipment for heat and mass transfer**
Lecturer	Kramer, dr.ir. H.J.M.
Course Material	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 **Course Material**	Stapersma, prof. D. MSc. FIMarE 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 **Course Material**	Stapersma, prof. D. MSc. FIMarE 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 **Course Material**	Infante Ferreira, dr.ir. C.A. 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 Course Material	Paassen, prof.dr.ir. A.H.C. van 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 Course Material	Woudstra, ir. N. 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 Course Material	Paassen, prof.dr.ir. A.H.C. van 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

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**

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 **??**

Appendices

6.1 Course and Examination Regulations

Section 1 GENERAL

Article 1 SCOPE AND APPLICABILITY OF THESE REGULATIONS

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

Article 2 DEFINITIONS

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

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

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

Article 3 OBJECTIVE OF THE MASTER'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. The examination for a Master's Degree is an integral part of the programme. The study load for this examination totals 120 EC.

Section 3 INTERIM EXAMINATIONS

Article 9 THE NUMBER, PERIOD AND FREQUENCY OF INTERIM EXAMINATIONS

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

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

2. In the event that a course component is not taught within the Faculty itself, and therefore there

is no indication of the number of times it is possible to sit an interim examination as referred to in paragraph 1, the course and examination regulations of the relevant Faculty or degree programme will be applicable, provided no decision to the contrary has been taken by the board of examiners.

3. Notwithstanding the provisions of the first clause under 1a, at least one opportunity shall be given per year to take an interim examination in a course component that has not been taught in that year.
4. In certain cases the board of examiners may allow departures from the specified number of times that an interim examination can be sat.

Article 10 THE ORDER OF INTERIM EXAMINATIONS

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

Article 11 THE PERIOD OF VALIDITY OF INTERIM EXAMINATIONS

1. Students who have interrupted their studies, or who have delayed their studies for other reasons, shall resit any component they passed ten years or more ago if its contents have since been modified.
2. The board of examiners may, in a student's favour, depart from the provisions of paragraph 1.

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

1. Per year, the form in which each interim examination is to be taken shall be specified in the study guide for the actual course year under the unit of study concerned.
2. If no specification is made of the way in which an interim examination can be taken, because that examination applies to a unit of study that is not taught within the Faculty, and because it involves a unit of study that is not specific to students taking part in a programme administered by the Faculty of Mechanical Engineering and Marine Technology, the relevant conditions in the Course and Examination Regulations for that unit of study shall be applicable. Each year, the board of examiners under which the interim examination falls shall determine the way in which the interim examination is to be taken.
3. The appointed examiner may depart from the provisions of paragraphs 1 and 2 in a student's favour.
4. Each student with a physical or sensory disability shall be given the opportunity to take all interim examinations and practical training in a way that, to the greatest possible extent, is adapted to the disability in question. Under this facility, the form or length of the interim examinations shall be adapted to the individual situation, or practical aids shall be made available.
5. The facilities specified in the previous paragraph should be requested from the board of examiners by the student concerned. This request should be accompanied by a medical certificate issued no more than one year previously by a doctor, psychologist or student counsellor. All requests involving dyslexia should be backed by a recognised dyslexia testing body.

Article 13 ORAL INTERIM EXAMINATIONS

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

Article 14 THE ESTABLISHMENT AND NOTIFICATION OF RESULTS

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

Article 15 CANDIDATES' RIGHT TO INSPECT THEIR EXAMINATION DOCUMENTS

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

Article 16 OPTIONS FOR DISCUSSING THE RESULTS OF AN INTERIM EXAMINATION

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

Section 4 EXEMPTION FROM INTERIM EXAMINATIONS

Article 17 EXEMPTION FROM INTERIM EXAMINATIONS OR PRACTICAL EXERCISE

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

Section 5 THE MASTER'S EXAMINATIONS

Article 18 PERIODS AND FREQUENCY OF EXAMINATIONS

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

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

Article 19 REPORTING ON STUDENTS' PROGRESS

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

Section 6 PROVISIONS FOR IMPLEMENTATION

Article 20 MODIFICATION OF THE REGULATIONS

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

Article 21 TRANSITIONAL RULING

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

Article 22 PUBLICATION OF THE TRANSITIONAL RULING

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

Article 23 DATE OF COMMENCEMENT

These regulations shall come into force on 1 September 2004.

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 5 variants:
   - Transportation Engineering
   - Control Engineering and Mechatronics
   - Process and Engergy Technology
   - Production Technology and Organization
   - Solid and Fluid Mechanics

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

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

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

Laid down by the Dean of the Faculty Mechanical Engineering and Marine Technology , after the approval of the Faculty's Student Council, and after considering the recommendations provided by the education committee on june 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 examiner for that subject. In general, programmable calculating equipment is not allowed. (Generally examination assignments should be formulated such that they can be carried out with a simple calculator; at no times should candidates with more complex calculators have an advantage.)

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

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

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

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

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

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

Article 7 CHEATING

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

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

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

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

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

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

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

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

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

Article 8 CRITERIA

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

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

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

[1] Course and Examination Regulations

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

Article 9 QUESTIONS AND ASSIGNMENTS

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

Article 10 ASSESSMENT

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

Article 11 THE ESTABLISHMENT OF EXAMINATION RESULTS[2]

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

Article 12 CUM LAUDE

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

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

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

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

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

Article 13 MASTER'S DEGREE CERTIFICATES AND STATEMENTS

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

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

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

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

Article 14 PROCEDURE FOR APPROVAL

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

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

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

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

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

Article 15 TIME PERIODS

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

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

Article 16 RIGHT OF APPEAL

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

Article 17 MODIFICATION OF THESE REGULATIONS AND GUIDELINES

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

Article 18 DATE OF COMMENCEMENT

These regulations will come into effect on 1 September 2004.

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

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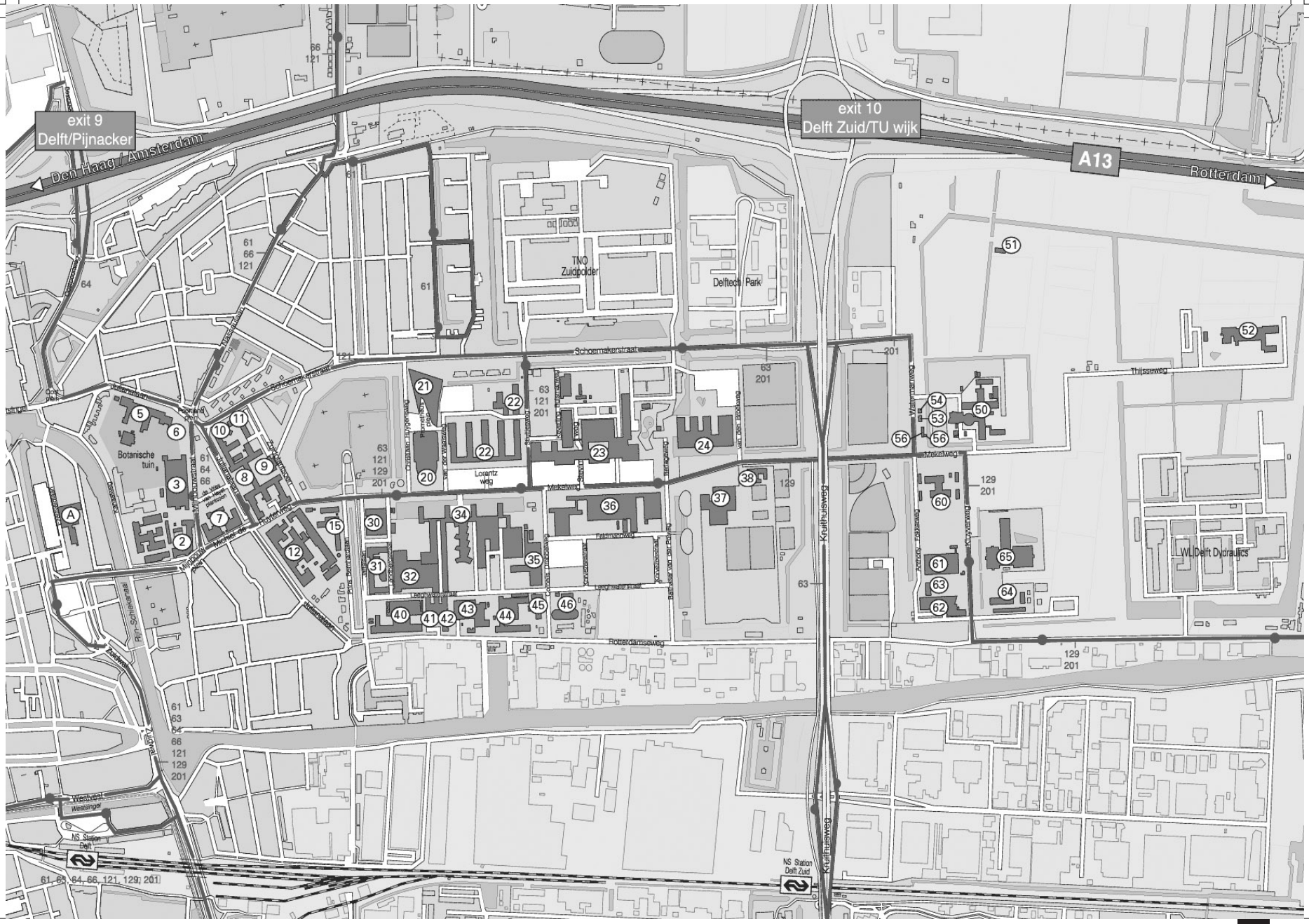
Wolffenbuttel, dr. ir. R.F.	86287	R.F.Wolffenbuttel@ITS.TUDelft.nl	HB 13.030	ITS-et
Woudstra, ir. N.	82178	N.Woudstra@WbMT.TUDelft.nl	8D-2-12	WbMT

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
Rotterdamseweg
Kluyverweg
Thijsseweg
Westvest
Westerpoort
NS Station
Delft
NS Station
Delft Zuid
WL|Delft Dydraulics
61, 63, 64, 66, 121, 129, 201

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.

1A WK 37-43	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 0830-1030	control theory	sc4020	th.dyn.of energy systems	wb4302						
	bosgra	34C	woudstra	34K						
mon 3,4 1030-1230	introduction mms	wb2309	des. machines & mechan.	wb5414-03						
	wieringa	34A	tomiyama / vd werff	34J						
mon 5,6 1330-1530	biomed.eng.design	wb2308	Engineering dynamics	wb1418/wb 1419						
	plettenburg	34C	Rixen	34E						
mon 7,8 1530-1730	mathematics in SC	wb2424								
	scherer	34C								
tue 1,2 0830-1030	human movem.control	wb2407	modelling industrial systems	wb3423-04	dredging proc. 2 (wb3414)	oe4625				
	vd helm	34C	veeke	34K	vlasblom e.a.	34J				
tue 3,4 1030-1230	eng.optimization	wb1440	design prod.systems	wb5420-03	refrigeration fund.	wb4410a				
	v. keulen	34K	Meijer / Neve / Tichem	34D	infante ferreira	34L				
tue 5,6 1330-1530	mech.design mechatron.	wb2428-03	fuel conversion	wb4405						
	langen / pistecky	34E	hein / andries / de jong	34L						
tue 7,8 1530-1730	th.of elasticity (start 16:30)	wb1409	Discrete systems	wb3417-03						
	v keulen	34K	ottjes e.a.	34E						
wed 1,2 0830-1030	indoor clim.contr.fund	wb4426	marine engineering B	mt212	surgical instr.med.safety	wb2435-03				
	paassen van	34K	klein woud	34L	dankelman	34J				
wed 3,4 1030-1230	mechatronical design	wb2414	th.dyn.of energy systems	wb4302	char.handling bulk solid mat.	wb3419-03				
	teerhuis/v eijk	34C	woudstra	34K	lodewijks	34D				
wed 5,6 1330-1530	adv.fluid dynamics	wb1427-03								
	delfos	34J								
wed 7,8 1530-1730	adv.fluid dyn. Seminar	wb1427-03	diesel engines A	wb4408a						
	delfos	34J	stapersma	34K						
thur 1,2 0830-1030	hydrolic servosyst.	wb2402	design prod.systems	wb5420-03	fuel conversion	wb4405	dredging proc. 2 (wb3414)	oe4625		
	teerhuis	34D	Meijer / Neve / Tichem	34E	hein / andries / de jong	34L	vlasblom e.a.	34J		
thur 3,4 1030-1230	dredging proc. 1 (wb3413)	oe4626								
	miedema e.a.	34J								
thur 5,6 1330-1530	man machine systems	wb2404								
	wieringa	34D								
thur 7,8 1530-1730	intr.transport & log.eng.	wb3420-03								
	lodewijks/rijsenbrij	34D								
fri 1,2 0830-1030										
fri 3,4 1030-1230	intr.to microsystems	wb1442	gas turbines	wb4420						
	v.keulen e.a.	34D	v buijtenen	34E						
fri 5,6 1330-1530	project engineering	wb4402	control theory	sc4020						
	dhillon/paijens	46A	bosgra	34C						
fri 7,8 1530-1730										
Changes in course schedules may occur, see website.										

1B WK 46-52	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										
mon 3,4 1030-1230	physiol. systems	wb2408	des. machines & mechan.	wb5414-03	introd. modelling	wb2311				
	dankelman e.a.	34C	tomiyama / vd werff	34J	bosgra	34A				
mon 5,6 1330-1530	digital control	wb2305	eq heat & mass transf.	wb4300a						
	dijkstra	34C	kramer / jansens	46A						
mon 7,8 1530-1730	mathematics in SC	wb2424	Engineering dynamics	wb1418/wb1419						
	scherer	34C	Rixen	34E						
tue 1,2 0830-1030	energy, society & sust.	wb4303	human movem.control	wb2407	engineering informatics	wb5430-04	maintenance managem,	ae4-490		
	Spliethoff	34F	vd helm	34C	tomiyama / meijer	34J	smit	62		
tue 3,4 1030-1230	refrigeration fund.	wb4410a	eng.optimization	wb1440						
	infante ferreira	34L	keulen van	34K						
tue 5,6 1330-1530	mech.design mechatron.	wb2428-03	num.analysis c2	wi4014tu	design proces equipm.	wb4417	multivar. control systems	wb2421		
	langen / pistecky	34E	v kan	8	paijens	46A	vd weiden	34J		
tue 7,8 1530-1730	th.of elasticity (start 16:30)	wb1409	Discrete systems	wb3417-03						
	keulen van	34K	ottjes e.a.	34E						
wed 1,2 0830-1030	bone mech.implants	wb2431	indoor clim.contr.fund	wb4426						
	vd Linden/Valstar	34J	paassen van	34K						
wed 3,4 1030-1230	mechatronic design	wb2414	char.handling bulk solid mat.	wb3419-03						
	teerhuis/v eijk	34C	lodewijks	34D						
wed 5,6 1330-1530	adv.fluid dynamics	wb1427-03	hydrolic servosystems	wb2402	plates & shells A	wb1402A				
	delfos	34J	teerhuis	34C	Ernst	34L				
wed 7,8 1530-1730	adv.fluid dyn. Seminar	wb1427-03	diesel engines A	wb4408a	plates & shells A	wb1402A				
	delfos	34J	stapersma	34K	Ernst	34L				
thur 1,2 0830-1030	maintenance managem.	ae4-490	engineering informatics	wb5430-04	multivar. control systems	wb2421				
	smit	62	tomiyama / meijer	34L	vd weiden	34J				
thur 3,4 1030-1230	physiol. systems	wb2408	dredging proc. 1 (wb3413)	oe4626	introd. modelling	wb2311	fund. machine tools	wb5425-04		
	dankelman e.a.	34C	miedema e.a.	34J	bosgra	34D	karpuschewski	34E		
thur 5,6 1330-1530	man machine systems	wb2404	energy, society & sust.	wb4303						
	wieringa	34C	Spliethoff	34F						
thur 7,8 1530-1730	intr.transport & log.eng.	wb3420-03								
	lodewijks/rijsenbrij	34C								
fri 1,2 0830-1030	eq heat & mass transf.	wb4300a	digital control	wb2305						
	kramer / jansens	46A	dijkstra	34D						
fri 3,4 1030-1230	gas turbines	wb4420	marine engineering C	mt213						
	v buijtenen	34E	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										

Changes in course schedules may occur, see website.

2A WK 6-12	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	num.meth.dynamics	wb1416								
	rixen									
mon 3,4 1030-1230	largescale transp.syst.	wb3410-03	gas & oil processing offsh.	wb4418	optimization 2	wb1441	ind.assemblage	wb5422-03	thermodyn.of mixtures	wb4429-03
	rijsenbrij		olujic e.a.		keulen van		tichem	34J	jong w de	34B
mon 5,6 1330-1530	modelling 2	wb2422	refrig.techn. & appl	wb4427						
	bosgra		infante ferreira							
mon 7,8 1530-1730	mathematics in SC	wb2424	thermal power plants	wb4422	multibody dynamics B	wb1413				
	scherer		spliethoff		schwab					
tue 1,2 0830-1030	maintenance engineering	ae4-496	syst.identif.param.est.	wb2301	des.seperation equipm.	wb4403	control systems lab	sc4070		
	smit	62..	vd helm		olujic/bruinsma		babuska			
tue 3,4 1030-1230	stab.thinwalled structures 1	wb1405a	nucleair engineering	wb4416	humanoid robots	wb2433-03	fund.mat.removal proc.	wb5432-04		
	v keulen		verkooijen		wisse m, vd linde		karpuschewski			
tue 5,6 1330-1530	robust control	wb2415	plates & shells A	wb1402A						
	scherer		Ernst							
tue 7,8 1530-1730	chem. & chemical plant	wb2426	continuum mechanics	ae4-900	mech.design mechatron.	wb2428-03				
	huesman		turteltaub	62	langen / pistecky					
wed 1,2 0830-1030	bone mech.implants	wb2431	nucleair engineering	wb4416	robust control	wb2415	aut.& contr.transp.&prod.syst.	wb3421-04		
	vd Linden/Valstar		verkooijen		scherer		lodewijks/rijsenbrij/veeke			
wed 3,4 1030-1230	indoor clim.control design	wb4424	diesel engines B	wb4408b	bio mechatronics	wb2432				
	v paassen		stapersma		vd helm					
wed 5,6 1330-1530	syst. identification	sc4110	resistance propulsion 1	mt518	predictive modelling	wb2427	intr.pumps & compressors	wb4300b	production org. principles	wb3424-04
	vd hof/bombois		terwisga van		v eijk		infante ferreira		veeke	
wed 7,8 1530-1730	(non) lin.vibr.in mech.syst.	wb1412	thermal power plants	wb4422	predictive modelling	wb2427				
	v woerkom		spliethoff		v eijk					
thur 1,2 0830-1030	dredging proc. 1 (wb3413)	oe4626	vehicle dynamics A	wb3404a	comp. fluid dynamics	wb1428	maintenance engineering	ae4-496		
	miedema e.a.		vries ejh de		boersma		smit	62..		
thur 3,4 1030-1230	vehicle dynamics B	wb3404b	ind.assemblage	wb5422-03	stab.thinwalled structures 1	wb1405a				
	de vries		tichem		v keulen					
thur 5,6 1330-1530	design transport equipment	wb3422-03	proces control	wb2400	des.seperation equipm.	wb4403	microfluidics	wb1429-03		
	klein breteler / drenth		dijkstra		olujic/bruinsma		lindken			
thur 7,8 1530-1730	thermodyn.of mixtures	wb4429-03	syst. identification	sc4110						
	jong w de		vd hof/bombois							
fri 1,2 0830-1030	modelling 2	wb2422	humanoid robots	wb2433-03	mech.pressure vessels	wb1408				
	bosgra		wisse m, vd linde		ernst					
fri 3,4 1030-1230	measurement theory praxis	wb2303	continuum mechanics	ae4-900	mech.pressure vessels	wb1408	turbulence A	wb1424atu		
	teerhuis		turteltaub	62	ernst		Westerweel			
fri 5,6 1330-1530	experimental mechanics	wb1406	gas & oil processing offsh.	wb4418	gasturb.simul.& applic.	wb4421	control systems lab	sc4070		
	booij / v woerkom		olujic e.a.		v buijtenen		babuska			
fri 7,8 1530-1730										
Changes in course schedules may occur, see website.										

2B WK 15-22	DRAFT COURSE SCHEDULE MSC MECHANICAL ENGINEERING SEMESTER 2B									
	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	num.meth.dynamics	wb1416								
	rixen									
mon 3,4 1030-1230	gas & oil processing offsh.	wb4418	modelling of manufacturing	wb5421-03	optimization 2	wb1441	cybern. ergonomics	wb2306		
	olujic e.a.		Steinhoff / Hoogstrate		keulen van		vd helm			
mon 5,6 1330-1530	chem. & chemical plant	wb2426	design with fin.elem.method	wb3416	life cycle engineering	wb5431-04				
	huesman		vd bos	pcz sectie	tomiyama / meijer					
mon 7,8 1530-1730	mathematics in SC	wb2424	design with fin.elem.method	wb3416	multibody dynamics B	wb1413				
	scherer		vd bos	pcz sectie	schwab					
tue 1,2 0830-1030	lin.matrix inequalities	wb2416	syst.identif.param.est.	wb2301						
	scherer		vd helm							
tue 3,4 1030-1230	stab.thinwalled structures 1	wb1405a	Dredging design (wb3408)	oe4671	multibody dynamics A	wb1310	mod.sim.energy systems	wb4423		
	v keulen		vlasblom		schwab		colonna			
tue 5,6 1330-1530	fluid-structures interaction	wb1417								
	rixen									
tue 7,8 1530-1730	int. combustion engines	mt216								
	klein woud									
wed 1,2 0830-1030	comp.fluid dynamics	wb1428	electro mech.systems	et4245wb	cybern. ergonomics	wb2306	dredging proc. 1 (wb3413)	oe4626		
	boersma		polinder		vd helm		miedema e.a.			
wed 3,4 1030-1230	indoor clim.control design	wb4424	electro mech.systems	et4245wb	aut.& contr.transp.&prod.syst.	wb3421-04				
	v paassen		polinder (only 3rd hour)		lodewijks/rijsenbrij/veeke					
wed 5,6 1330-1530	syst. identification	sc4110	bio mechatronics	wb2432						
	vd hof/bombois		vd helm							
wed 7,8 1530-1730	(non) lin.vibr. mech.syst.	wb1412	diesel engines B	wb4408b						
	v woerkom		stapersma							
thur 1,2 0830-1030	mod.sim.energy systems	wb4423	life cycle engineering	wb5431-04	lin.matrix inequalities	wb2416				
	colonna		tomiyama / meijer		scherer					
thur 3,4 1030-1230	instrum.proces industry	wb2413-04	vehicle dynamics B	wb3404b	fund.mat.removal proc.	wb5432-04				
	vd weiden		de vries		karpuschewski					
thur 5,6 1330-1530	design transport equipment	wb3422-03	proces control	wb2400	vehicle dynamics A	wb3404a	microfluidics	wb1429-03		
	klein breteler / drenth		dijkstra		vries ejh de		lindken			
thur 7,8 1530-1730	syst. identification	sc4110								
	vd hof/bombois									
fri 1,2 0830-1030	refrig.techn. & appl	wb4427								
	infante ferreira									
fri 3,4 1030-1230	measurement theory praxis	wb2303	turbulence A	wb1424atu						
	teerhuis		Westerweel							
fri 5,6 1330-1530	experimental mechanics	wb1406	gas & oil processing offsh.	wb4418	gasturb.simul.& applic.	wb4421	Introd. Methodology	wm0503tu		
	booij / v woerkom		olujic e.a.		v buijtenen		ten haaf			
fri 7,8 1530-1730										
Changes in course schedules may occur, see website.										

COLLEGEROOSTER AANVULLEND VAKKENPAKKET TH/HZS WB

		SEMESTER 1A week 37 t/m 43				SEMESTER 1B week 46 t/m 52				SEMESTER 2A week 6 t/m 12				SEMESTER 2B week 15 t/m 22 (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					
	4	Analyse 1 TH	Tholen	wi1152th	34C					Lin.alg. 2 TH	Beek v	wi2256th d2					
	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		Dynamica 2	Woerkom v	wb1216	
	8					Thermodynamica 2	Woudstra N	wb1224	34A	Stromingsleer 2	Nieuwstadt	wb1220		Dynamica 2	Woerkom v	wb1216	
DI	1																
	2																
	3					Analyse 2 TH	Tholen	wi1153th	34C	Analyse 3 TH	Tholen	wi1154th					
	4					Analyse 2 TH	Tholen	wi1153th	34C	Analyse 3 TH	Tholen	wi1154th					
	5	ANSYS-PRACTICUM BIJ WB1212 OP DI 14/9 EN DI 12/10 STUDENTEN MET NAMEN A T/M J															
	6																
	7																
	8																
WO	1					ANSYS-PRACTICUM BIJ WB1212 OP WO 24/11 EN WO 1/12 STUDENTEN MET NAMEN A T/M J								Dynamica A **1)**	Paraschiv	wb1113wb	
	2													Dynamica A **1)**	Paraschiv	wb1113wb	
	3									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104					
	4									Syst.- regeltechn.1 **1)**	Dijkstra	wb2104					
	5	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Elasticiteitsleer	Paraschiv	wb1213	34A	Stromingsleer 2	Nieuwstadt	wb1220					
	6	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Elasticiteitsleer	Paraschiv	wb1213	34A	Stromingsleer 2	Nieuwstadt	wb1220					
	7					Elasticiteitsleer	Paraschiv	wb1213	34A								
	8																
DO	1					ANSYS-PRACTICUM BIJ WB1212 OP DO 25/11 EN DO 2/12 STUDENTEN MET NAMEN K T/M Z													
	2																
	3																
	4																
	5	Eindige elem.meth. 1	Paraschiv	wb1212	34A					Lin.alg. 2 TH	Beek v	wi2256th d2					
	6	Eindige elem.meth. 1	Paraschiv	wb1212	34A					Lin.alg. 2 TH	Beek v	wi2256th d2					
	7	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Thermodynamica 2	Woudstra N	wb1224	34A	Eindige elem.meth. 2	Paraschiv	wb1214		Dynamica 2	Woerkom v	wb1216	
	8	Syst.- en regeltechn.2	Dijkstra	wb2207	34A	Thermodynamica 2	Woudstra N	wb1224	34A	Eindige elem.meth. 2	Paraschiv	wb1214		Dynamica 2	Woerkom v	wb1216	
VR	1	Lin.alg. 1 TH	Beek v	wi2256th d1	34C	Lin.alg. 1 TH	Beek v	wi2256th d1	34F	Syst.- regeltechn.1 **1)**	Dijkstra	wb2104		Dynamica A **1)**	Paraschiv	wb1113wb	
	2	Lin.alg. 1 TH	Beek v	wi2256th d1	34C	Lin.alg. 1 TH	Beek v	wi2256th d1	34F	Syst.- regeltechn.1 **1)**	Dijkstra	wb2104		Dynamica A **1)**	Paraschiv	wb1113wb	
	3	Analyse 1 TH	Tholen	wi1152th	34C	Analyse 2 TH	Tholen	wi1153th	34F	Analyse 3 TH	Tholen	wi1154th					
	4	Analyse 1 TH	Tholen	wi1152th	34C	Analyse 2 TH	Tholen	wi1153th	34F	Analyse 3 TH	Tholen	wi1154th					
	5	ANSYS-PRACTICUM BIJ WB1212 OP VR 1/10 EN VR 8/10 STUDENTEN MET NAMEN K T/M Z															
	6																
	7																
	8																

Veranderingen in roosters kunnen optreden, zie website.

1) Alleen verplicht voor HZS-studenten

1) Alleen verplicht voor HZS-studenten