ME - Guide

Colofon

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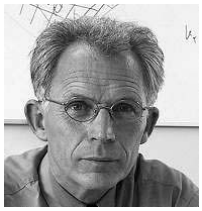

Preface

Per September 2002 Delft University of Technology has adopted the international Bachelor-Master structure for her study programmes. At the same time the international MSc study programmes have been integrated within the regular Master studies. This brochure, the ME-Guide, is the first study guide for the Master programme Mechanical Engineering.

The ME-Guide intends to be an information brochure, which answers all questions of students with regard to the Mechanical Engineering Masters study programme and to make them acquainted with the Faculty of Mechanical Engineering and Marine Technology and Delft University of Technology.
The following editors have composed the guide:
Hans van Schuppen, student Marine Technology (MT),
Maarten Vriezen, student Mechanical Engineering (ME),
Nic Jan van Bemmel, manager ME and MT study programmes,
Ewoud van Luik, manager administration for ME and MT study programmes and
undersigned.

The guide has been composed carefully, but it may happen that during the study year some changes need to be made. In those cases the most recent information can be found on the website of the faculty: http://www.wbmt.tudelft.nl.
The editors welcome suggestions to improve this guide next year. Suggestions to improve the readability or additional information could be sent to Ewoud van Luik: e.p.vanluik@wbmt.tudelft.nl

The editors hope that the ME-Guide answers all questions with regard to the educational programme and wish that all students enjoy their study with success during the examinations.

Prof. Hans Klein Woud MSc, FIMarEST
Education Director ME

Contents

1 MSc Mechanical Engineering

1.1 Goal

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

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

1.2 Educational Concept and Assessment

Based on the choice of variant and specialization the master programme involves two major parts:

Lecture courses (36-48 credits)

These courses are divided in three parts:

- Compulsory part per variant (approximately 15 credit points)
- Compulsory part for the chosen specialization
- Elective part (at least 10 credit points)

For each variant and specialization these parts are described in paragraph 1.5.

The general rules for the courses within these parts are as follows:

- At least 4 credit points society oriented courses
- At least 6 credit points mathematics, physics or other fundamental mechanical engineering courses.
- The student can select at least 10 credit points of courses at his own interest, in consultation with the lecturer responsible for the chosen specialization. For each variant an overview of recommended courses may be given.

Most courses are assessed by means of an oral or written examination.

Assignments (36-48 credits)

The assignments take place mainly in the second study year of the MSc-programme. In general the assignments are carried out individually.

The assignments may involve:

- Traineeship in industry or a project task defined in consultation with an external party (industry, research institute, etc.) of 10 credit points. In case the MSc-thesis is performed in cooperation with and at the office of an external party this part of the programme may be combined with the MSc-thesis.
- Literature study
- Laboratory exercise
- MSc-Thesis (26-42 credits)

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

1.3 Study programme and general structure

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

The credits for one study year are 42 TU Delft credit points. These credit points give an indication of the weight of a certain part of the course. One credit point involves approximately 40 hours of study. These 40 hours include all time spent on the course.
In this study guide the given credits are TU Delft credit points. One TU Delft credit point equals 1.43 ECTS credits. One study year equals 60 ECTS credit points

1.4 Admission to the programme

There are several ways to be admitted to the MSc-programme Mechanical Engineering. Usually the MSc-programme is a continuation of an academic BSc-programme, however the master's phase can also be entered after completing a BSc-programme of a polytechnic high school or the Royal Netherlands Naval College (KIM).
Admission to the MSc-programme is described in the following three subsections.

1.4.1 Academic bachelor degree

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

Every student holding a academic BSc-degree Mechanical Engineering of a Dutch Technical University (Delft, Eindhoven or Twente) or a Technical University which belongs to the IDEA-league (ETH Zürich, Imperial College London or Technische Universität Aachen) can enter the MSc-programme without selection.
A student in the BSc-programme is permitted to do examinations of the MSc-programme, if the board of examiners approves. When the student has passed it's propaedeutic examination and has a study result of the second and third year of at least 72 credit points, including the BSc-thesis, the student is conditionally admitted to the MSc-programme. It is then possible to compose a final list of courses for approval by the board of examiners. Final admittance is granted after completing the BSc-programme.
In advance to admittance to the MSc-programme, a BSc-student may obtain approval to take part in examinations of a few MSc-courses. The student has to make a request to the board of examiners. The approval will only be given in case the student can pass for less than 8 credit points in the BSc-programme in the relevant educational period.

Academic BSc-degree Marine Technolgy, Civil Engineering or Aerospace Engineering

Students in this category can enter the MSc-programme without selection. In order to enter the MSc-programme additional courses have to be followed. These are courses of the BSc-programme Mechanical Engineering of in total 10 credit points or less and will be part of the elective courses of the chosen variant.
The additional courses are:

Marine Technology:

- wb1211	Dynamics 2-1	1 cp
- wb1215	Dynamics 2-2	1 cp
- wb2207	Systems and control Engineering 2	2 cp
- wb1224	Thermodynamics 2	2 cp
	Total MT:	**6 cp**

Civil Engineering

- wb2104	Systems and control Engineering 1	2 cp
- wb1126wb	Thermodynamics 1	2 cp
- wb1211	Dynamics 2-1	1 cp
- wb1215	Dynamics 2-2	1 cp
- wb2207	Systems and control Engineering 2	2 cp
- wb1224	Thermodynamics 2	2 cp
	Total CE:	**10 cp**

Aerospace Engineering

- wb2207	Systems and control Engineering 2	2 cp
	Total AE:	**2 cp**

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 72 credit points of the initial study. It is then possible to compose a final list of courses for approval to the board of examiners. Final admittance is granted after completing the additional courses.

Other Academic BSc-degree Technical University

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

- admission without additional requirements
- admission with additional requirements of no more than 10 credit points. 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 10 and 31 credit points. In this case 10 credit points are part of the 84 cp of the normal MSc-programme and 21 credit points at most are additionally required above the standard MSc-programme.
- no admission. The candidate has to obtain the BSc-degree first. Within the BSc-programme exemption for some courses is possible, depending on earlier education.

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

A candidate can be admitted, if the candidate has completed the TH-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.
Additional courses are:

- wb1211	Dynamics 2-1	1 cp
- wb1215	Dynamics 2-2	1 cp

- wb1212	Finite Element Method 1	2 cp
- wb1213	Elasticity	1 cp
- wb1214	Finite Element Method 2	1 cp
- wb2207	Systems and control Engineering 2	2 cp
- wb1224	Thermodynamics 2	2 cp
- wb1220	Fluid Mechanics 2	2 cp
- wi2256th	Linear Algebra for TH-students	4 cp
- wi1152th	Analysis for TH-students part 1	2 cp
- wi1153th	Analysis for TH-students part 2	2 cp
- wi1154th	Analysis for TH-students part 3	2cp
	Total:	**22 cp**

These additional requirements will ensure that the student has at least an entrance level comparable to the second-course year of the Mechanical Engineering BSc-programme. The lecturer of the chosen variant and specialization may require that also a number of third year courses of the BSc-programme, in the field of the specialization is followed. In the MSc-programme the student gets exemption for the traineeship (10 cp).

In total this results in a study programme of 22 + 84 –10 = 96 cp.

1.4.3 Bachelor degree of Royal Netherlands Naval College (RNNC)

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

  A selection between candidates will be made. Admission is possible, if the candidate has completed the TH-Bachelors-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 42 cp, including obligatory variant part
  - no traineeship
  - no society-oriented courses
  - MSc-thesis of minimal 26 cp

- *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 70 cp, according to the demands of the chosen variant. It is not necessary to do a traineeship or society oriented courses.

1.5 Variants, specializations and annotations ME

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

Variants and specializations

There are 6 different variants and 26 specializations Mechanical Engineering:

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

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

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 Mechanisation of Production
- 4.3 Mechanical Engineering Design
- 4.4 Industrial Organisation
- 4.5 Maintenance Engineering

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

6 *Biomedical Engineering*
- 6.1 Medical Instrumentation and Measurements
- 6.2 Bio Mechatronics
- 6.3 Medical Safety
- 6.4 Tissue Biomechanics and Implants

Annotations

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

a Technical Marketing
b Offshore Technology
c Sustainable Development

1.5.1 Variant Transportation Engineering

Introduction

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.

Obligatory courses variant Transportation Engineering:

Course code	Course name	Lecture hours	Credit points
et3021wb	Electrical drives	0/0/3/0	3
mt216	Introduction combustion engines	0/0/0/4	2
wb3406A	Introduction transportation engineering	2/2/0/0	2
wb3407A	Introduction logistics	0/0/2/2	2
wb3408	Dredging design	0/0/2/2	2.5
wb3419	Characterization & handling bulk solid materials		3
		Total	**14.5**

Specialization Transport Engineering & Logistics

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.

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Obligatory courses Specialization Transport Engineering & Logistics

Course code	Course name	Lecture hours	Credit points
ct3750	Transport systems and traffic networks		3
ct4330	Harbours and shipping ways		3
wb3406B	Transport engineering and crane design	0/0/2/2	2,5
wb3410	Large scale transport systems	0/0/2/0	1
wb3415	Simulation of transport systems with Adams	0/0/2/0	1
wb3416	Design with Finite Element Method	0/0/0/2	1
wb3417	Discr. syst.: mod., protot., simul. & control	2/2/0/0	2
		Total	**13,5**

Specialization Marine Engineering

Marine Engineering is the discipline that covers the design, installation and operational use of ship machinery and electrical plants. It covers a wide variety of systems, such as: ship propulsion plants, electric power generation, refrigeration and climate control, auxiliary systems for cooling and lubrication, cargo handling, loading and unloading.
The discipline is also very relevant for the design of land based power plants and process plants. The main issue is "installation technology": integration of different equipment to well functioning, efficient and cost effective systems. It requires extensive knowledge of machinery and electrical equipment (principle of operation and characteristics such as controllability and maintainability) as well as of fluid dynamics, mechanical vibrations and strength, thermodynamics, reliability and maintainability. The design of the equipment to be installed is not a main topic of study.
The students specialising in marine engineering have a wide choice with regard to elective courses. Only a limited number of courses, according to the variant rules, is mandatory. Next to that the students are expected to follow a number of specialization courses up to 11.5 credit points. 16 credit points can be used for elective courses.
The master thesis covers 42 credit points and will frequently be performed in cooperation with industry or an external research institute. The specialization has good contacts with universities abroad, which gives the opportunity to perform a part of the study (courses or the MSc- thesis) abroad.

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Obligatory courses Specialization Marine Engineering

Course code	Course name	Lecture hours	Credit points
mt212	Marine engineering B	0/2/0/0	2
mt213	Marine engineering C	0/0/0/2	1
mt215	Marine engineering A	0/3/0/0	1,5
mt518	Resistance and propulsion 1	0/0/4/0	1,5
mt518p	Tests resistance and propulsion 1	0/0/x/0	0,5
mtp204	Project 2-4 design propulsion plant	0/0/0/x	3
mtp301	Project 3-1A design auxiliary systems	x/0/0/0	2
		Total	**11,5**

Specialization Dredging Technology

Machinery for the treatment of soil and/or bulk goods are constituting an interface between Mechanical Engineering and Civil Engineering. Within this framework one must think of dredging machinery, tunnel drilling machines and equipment for the treatment of bulk goods. This field comprises excavation, transport and sedimentation processes of soil, rock and bulk goods that are brought about by human intervention and controlled by means of the appropriate machinery. The purpose in this is to realize or maintain "constructions" and to mine, transfer or treat building materials or ores. Examples of the constructions mentioned above are: ports, channels, land reclamation, cores of dykes and (drilling) tunnels. Examples of the treatment of materials are: soil treatment, mixed heap systems and the separation of materials when mining minerals. Examples of transference are: the transhipment of bulk materials, conveyor belts in the mining industry and hydraulic transport of solids. An important development in this is the drilling of tunnels in "feeble" ground. The designing of and working with the equipment mentioned above is primarily determined by physical processes, such as loosening up rock, soil or bulk materials, vertical and horizontal transport, positioning in the means of transport, treatment and positioning of the material in a desired geometry. When designing machinery, a large number of restrictions play an important part. They all relate to local circumstances, such as the availability of facilities, the condition of the soil or bulk goods, the availability of resource-rich areas for the purpose of elevation, dumping sites for the removal of materials from digged-in constructions, wind and weather conditions, environmental requirements, available energy and a large number of other technical, administrative and economic restrictions. Furthermore, it is required to possess a profound insight into the availability of highly sophisticated mechanical constructions that often have to operate under heavy and dynamic load conditions due to the aggressive environment.
The dredging and sea-mining industry moves to deeper waters. Although operation depths do not exceed 150 m today, it is expected that within 10 years, dredging and sea-mining will reach 500 to 1000 m and incidental the ultra deep waters to fulfil the requirements of the offshore industry. This means the development of new concepts for deep-sea operations, the development of monitoring and control systems for the excavation process and a sufficient level of reliability. All based on the knowledge of the physical processes.

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Obligatory courses Specialization Dredging Technology

Course code	Course name	Lecture hours	Credits
ctme2090	Soil mechanics first part **or**		2 **or**
mp3780	Soil mechanics 1		2
wb1427	Advanced Fluid dynamics A	2/2/0/0	3
wb2402	Hydraulic servo systems	2/2/0/0	2
wb3413	Dredging processes 1	2/2/0/0	2.5
wb3414	Dredging processes 2	0/0/2/2	2.5
		Total	**12**

Elective courses variant Transportation Engineering

Course code	Course name	Lecture hours	Credits	TL	ME	DE
ae4-496	Maintenance technology		2		X	
ct....	Offshore morfology		1			X
ct....	Offshore design and realization		2			X
ct....	Offshore hydromechanics		2			X
ctbd3980	Realization civil projects		3			X
ctip3070	Three-dimensional lay-out		2	X		
ctvk4810	Exploitation and control of transport		3	X	X	
ctwa3030	Foundation engineering		2			X
ctwa3320	Groundwater mechanics and -flow		3			X
ctwa4300	Introduction coastal water engineering		3			X
ctwa5305	Waterbouwkundige kunstwerken B.O.		1			X
et4045 mech	Electronical Instrumentation I		2.5	X	X	
et4046 mech	Sensors		3	X	X	
et4098 mech	Robot control systems		1.5	X	X	
ide5131	Business marketing for engineers		2	X	X	
in2024tu	Introduction databases		3	X	X	
in2038p	Exercise introduction databases		1	X	X	
in3010tu	Introduction virtual reality		3	X	X	
in4005tu	Industrial automation		3	X	X	
in4013tu	Expert systems		3		X	
in4028tu	Business systems engineering		3	X	X	
in4050tu	Object oriented programming with Java		4	X	X	
mk3431	Welding techniques		2	X		
mp1700	Ingenieursgeologie		1.5			X
mp3790	Soil mechanics II		2			X
tn3713	Advanced thermodynamics		2		X	
wb1310	Multibody dynamics A	0/0/0/4	2	X	X	X
wb1330	Design in fibre reinforced plastics 0/0/2/0		1	X		
wb1406	Experimental mechanics	0/0/2/2	2	X		
wb1412	Non-linear vibrations	0/0/2/2	2	X	X	
wb1413	Multbody dynamics B	0/0/2/2	2	X	X	
wb1416	Numerical methods for dynamics	0/0/2/2	2	X		
wb1427	Stromingsleer voortgezette cursus2/2/0/0		3			X
wb2303	Measurement techniques	0/0/2/2	2	X	X	X
wb2306	Cybernetical ergonomics	0/0/0/4	2	X	X	
wb2311	Introduction modelling	4/0/0/0	2		X	
wb2400	Process control	0/0/2/2	2		X	
wb2402	Hydraulic servo systems	2/2/0/0	2	X	X	
wb2404	Man-machine systems	2/2/0/0	3	X	X	
wb2414	Mechatronics	2/2/0/0	2	X		
wb2420	Control theory	4/0/0/0	4	X	X	X
wb3300	Design methodolgy	0/0/2/0	1.5	X	X	X
wb3303	Mechanisms	0/0/2/2	2	X		
wb3404A	Vehicle dynamics A	0/0/2/2	2	X	X	

Course code	Course name	Lecture hours	Credits	TL	ME	DE
wb3404B	Vehicle dynamics B	0/0/2/2	2	X	X	
wb3406B	Transport engineering and crane design	0/0/2/2	2.5		X	X
wb3410	Large scale transport systems	0/0/2/0	1	X		
wb3412	Bulk materials handling syst. and equip.	0/0/2/2	2.5			X
wb3413	Dredging processes 1	2/2/0/0	2.5		X	
wb3414	Dredging processes 2	0/0/2/2	2.5		X	
wb3415	Simulation of transport syst. with ADAMS	0/0/2/0	1		X	
wb3416	Design with Finite Element Method	0/0/0/2	1		X	
wb3417	Discrete systems	2/2/0/0	2		X	
wb3418	Pro Engineer	-/-/-/x	1	X		
wb4300B	Introduction to pumps and compressors	0/0/2/0	1		X	X
wb4303	Energy, society and sustainability	0/4/0/0	2		X	
wb4401	Deeltjestechnologie-W	2/2/0/0	2			X
wb4408A	Diesel engines A	2/2/0/0	3		X	
wb4408B	Diesel engines B	0/0/2/2	3		X	
wb4410A	Refrigeration A1	0/0/2/2	2		X	
wb4420	Gas turbines	2/2/0/0	2		X	
wb4421	Gas turbines, simulation and application	0/0/2/2	2		X	
wb5201	Power drives	0/0/2/2	2	X		
wb5302	Design theory: information transducers	0/0/2/0	1	X		
wb5303	Introduction tribology	4/0/0/0	2	X	X	
wb5414	Design of machines and mechanisms	2/2/2/0	3	X		
wb5415	Maintenance engineering	2/2/0/0	1.5	X	X	X
wb5420	Design of production systems	4/0/0/0	3	X		
wi2061	Continuüm mechanics I		3			X
wi3006	Continuüm mechanics II		3			X
wi3015tu	Intr. stochastic operations research	0/0/2/2	3	X		
wi3021tu	Applied statistics B		3	X	X	X
wi4014tu	Numerical analysis C2 (exercise 30 h.)	2/2/0/0	3	X	X	X
wi4019	Non-linear differential equations		2	X	X	
wi4051tu	Introduction operations research	2/2/0/0	3	X	X	
wi4052	Risk analysis		4		X	
wm0301tu	Introduction philosophy of technology		2		X	
wm0304tu	Philosophy of science	0/2/0/0	3	X	X	
wm0324lr	Ethics and technology		2		X	
wm0401tu	History of engineering	0/0/4/0	2	X		
wm0504tu	Industrial organisation A	4/0/0/0	2	X		
wm0505tu	Industrial organisation B	0/0/4/0	2	X		
wm0604tu	Commercial economics	0/0/2/2	2	X		
wm0605tu	Business economics for engineers		3	X	X	
wm0621tu	Innovation management		2	X	X	
wm0771	Technisch milieurecht		2		X	X
wm0781	Octrooirecht en octrooibeleid		2		X	X
wm0801tu	Introduction safety engineering	0/4/0/0	2	X	X	
wm0903tu	Technology and global development		3		X	
wm1101tu	Upper-intermediate English (refresher)		2		X	
wm1102tu	Written English for technologists		2		X	

1.5.2 Variant Control Engineering and Mechatronics

Obligatory courses variant Control Engineering and Mechatronics

Course code	Course name	Lecture hours	Credit points
wb1406	Experimental mechanics	0/0/2/2	2
wb2305	Digital control systems	0/4/0/0	2
wb2414	Mechatronical Design	2/2/0/0	2
wb2420	Mech. construction principles	4/0/0/0	2
wb2428	Control theory	4/0/0/0	4
wb	Introduction to microsyst.		2
wb	Engineering dynamics		2
		Total	**16**

Recommended elective courses Variant Control Engineering and Mechatronics

Course code	Course name	Lecture hours	Credit points
ae4-524	Head load of airplane constructions	0/4/0/0	2
ae4-537	Space travel constructions	0/2/2/0	2
ide521	Computer visualisation	2/0/0/2	2
ot4652	Floating offshore constructions	0/0/0/3/3	3
wb1430A	Introduction fibre reinforced plastics	2/2/0/0	2
wb1430B	Fibre reinforced plastics continuation	0/0/4/4	4
wb2303	Measurement techniques	0/0/2/2	2
wb3400	Vehicle engineering A	0/0/2/2	2
wb3406A	Transportation engineering A	2/2/0/0	2
wb5400	Tribology of machines	0/2/2/2	3
wb5414	Design of machines and mechanisms	2/2/2/0	3
wm0611tu	Cost information	2/0/0/0	1
wm0621tu	Innovation management	2/2/0/0	2
wm1101tu	Upper-intermediate English	x/x/x/x	2
wi2021tu	Numerical analysis C1	0/0/2/2	3
wi3001	Num. methods partial differential equations	2/2/0/0	4
wi4010	Num. methods large linear algebraic systems	4/0/0/0	4
wi4014tu	Numerical analysis C2	2/2/0/0	3
wi4017	Parallel calculate	0/0/4/0	4
wi4054	Large scale models special subjects	n.n.b.	4
	FORTRAN course	n.n.b.	n.n.b.
	Advanced course FEM software	p.m.	p.m.

Specialization System and Control Engineering

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.

Systems and Control Engineering	prof.ir. O.H. Bosgra	phone 015 27 85610
secretary	mrs. Debby van Vondelen	phone 015 27 85572

Obligatory courses Specialization Systems and Control Engineering

Course code	Course name	Lecture hours	Credit points
tn3111	System Identification	0/0/4/0	3
wb2422	Modeling 2	0/4/0/0	4
wb2423	Introduction Project SC	x/0/x/0	2
wb2425	Integration Project	x/x/x/x	4
		Total	**13**

Elective courses Specialization System and Control Engineering

Course code	Course name	Lecture hours	Credit points
wb2303	Measurement techniques	0/0/2/2	2
wb2400	Process Control	0/0/2/2	2
wb2402	Hydraulic servo systems	2/2/0/0	2
wb2413	Instrumentation	0/0/2/2	2
wb2415	Robust Control	0/0/0/4	4
wb2416	LMI's	4/0/0/0	4
wb2421	Multivariable Control	0/0/4/0	4
wb2424	Mathemethics for SR	2/2/2/2	4
wb2426	Chenistry and chemical plant	0/0/2/2	2
wb2429	Electromechanical systems		3
		Total minimal to select	**13**

requirements 5th year

- literature study 10 cp
- Master's Thesis 32 cp

Specialization Advanced Mechatronics

Advanced Mechatronics richt zich vooral op het ontwikkelen van hoogwaardige servo-systemen, zoals CD- spelers, harddisks, wafersteppers, terwijl de Systeem- en Regeltechniek zich ook richt op het beheersen van complexe industriële processen.
Binnen de opleiding wordt getracht de studenten een grondige kennis mee te geven die bij de diverse toepassingen wordt gebruikt op het gebied van de modelvorming, analyse en ontwerp.
In het afstudeerproject worden de verschillende aspecten verder uitgediept en ook operationeel gemaakt.
De afgestudeerde ingenieur is breed inzetbaar en de vraag naar ingenieurs met mechatronische en regeltechnische achtergrond overtreft het aanbod de laatste jaren ruimschoots.

Advanced Mechatronics	prof.dr.ir.J. van Eijk	phone 015 27 85396
secretary	mrs. Debby van Vondelen	phone 015 27 85572

Obligatory courses Specialization Advanced Mechatronics

Course code	Course name	Lecture hours	Credit points
wb2423	Introduction Project SC	x/0/x/0	2
wb2427	Predictive Modeling	0/0/4/0	2
wb2429	Electromechanical Systems		3
wb2430	Mechatronic Project	x/x/x/x	6
		Total	**13**

Elective courses Specialization Advanced Mechatronics

Course code	Course name	Lecture hours	Credit points
et3021wb	Electrical motion systems	0/0/3/0	3
et4045	Electronic Instrumentation 1		2.5
et4119	Electric power conversion		2.5
tn4010	Electricity/ magnetism		2
in4024	Intro real time programming		4
wb2303	Measurement techniques	0/0/2/2	2
wb2402	Hydraulic servo systems	2/2/0/0	2
wb2421	Multivariable Control	0/0/4/0	4
wb5302	Ontwerpleer 3B	0/0/2/0	1
wb5412	Microtechniek	0/0/2/2	2
		Total minimal to select	**13**

Requirements 5th year

- Preliminary study 10 credits
- Master's Thesis 32 credits

Specialization Man-Machine-Systems and Control

Man-Machine Systems are found in all areas of Mechanical Engineering: the (manual-)operation of instruments, tools, machines and vehicles, but also the protection and control of complex industrial installations, production lines and medical and transport systems. A human being controlling a technical system carries out certain actions on the basis of information exchange with that system. In the field of Man-Machine Systems this interaction between the human and the technical system is central. Fundamental insights gained from system, measurement and control theory are in this respect essential: identification, perceptibility, responsiveness, open-loop behaviour and regulated behaviour. When a human operates a technical system dynamically, we can consider the human as a regulator: the human finds himself then "in the loop". Dynamic functions with a cognitive (neural) and muscular nature become important elements in such a loop.

Graduation projects typically deal with topics associated with: 1) Support systems for handicapted people, (Walking) Robotic systems (MMS-Direct Control), and 2) Operational aspects of Automation (MMS-Supervisory Control). Applications are found in the medical and rehabilitation domain as well as in the industrial domain. A special class of robotic system, namely Haptic Interfaces which offer a dynamic interaction of forces and displacements between the human and e.g. a virtual 3D body, is of key interest because of its use in (trainings) simulators and telemanipulations.

Man-Machine-Systems and Control	prof.dr.ir. P.A. Wieringa	phone 015 27 85763
	prof.dr.ir. F.C.T. van der Helm	phone 015 27 85616
secretary	mrs .M.C.S. Macherhi	phone 015 27 86400

Obligatory courses Specialization Man-Machine-Systems and Control

Course code	Course name	Direct Control	Supervisory Control	Lecture hours	credit points
wb2301	Syst ident. and param. estimation	o	o	0/0/2/2	5
wb2404	Man-machine mystems	o	o	2/2/0/0	3
wb2407	Human movement control	o	o	2/2/0/0	3
wb2432	Biomechatronics	o	o	0/0/2/2	3
wbp201	Phantom-practical	o	o		2
wb1413	Multibody dynamics B	o	e	0/0/2/2	2
wb2400	Process control	e	o	0/0/2/2	2
wb2408	Fysiological systems	e	o	0/4/0/0	2
wb5412	Micro Engineering	o	e	0/0/2/2	2
	Total	**20**	**20**		

Students should have a basic knowledge of System Modeling and Cybernetic Ergonomics. If not these topics become obligatory as well.
Students are encouraged to consider courses provided by the MSc-BioMedical Engineering and MSc-Systems & Control programmes.

Requirements 5th year

Course code	Course name	cp
wbo104-1B	Progress meeting (every last Wednesday of the month)	2
wbo104-2B	Practical assignment	8
wbo104-3B	Literature study	8
wbo104-4B	Literature study colloquium	2
wbo104-5B	Introductory colloquium	6
wbo104-6B	Graduation colloquium	4
wbo104-7B	Final project report	12
	Total	**42**

Specialization Engineering Dynamics

Within this theme we concentrate on the development of methods for the calculation and optimization of the dynamic behaviour of, especially, nonlinear mechanical systems and the application of the acquired methods in actual practice. The mechanical behaviour of nonlinear dynamic systems is much more complicated than that of linear systems. Therefore, one of the objectives is to characterize the dynamic behaviour by means of modern numerical methods depending on various model parameters. Thus, it can be indicated when periodic solutions are possible and when "chaotic behaviour" may be expected. Another objective is the development of models for the simulation of flexible "multibody systems" and the implementation within special software, through which these can be used for optimization within a wide range of application areas. A method developed within this section and based on the finite element method, has been laid down in the computer programme system SPACAR95. Applications can be found in the simulation of, e.g., the dynamic behaviour of manipulators (robots), railway vehicles, cranes, offshore constructions and biomechanics.

Engineering Dynamics	prof.dr.ir.D.J. Rixen	phone 015 27 81523
secretary	mrs. Corine du Burck	phone 015 27 85733

Recommended elective courses Common Mechanics

Course code	Course name	Lecture hours	cp
ct5142	Non-linear numerical mechanics	0/0/4/0/0	2
wb1402A	Plates and shells A	2/4/0/0	3
wb1405A	Stability of thinwalled constructions	0/0/4/2	3
wb1408	Strength of materials 4	2/2/0/0	2
wb1409	Elasticitytheory	2/2/0/0	2
wb1410	Continuum mechanics	0/0/4/0	3
wb1432	Mechanics of fibre reinforced plastics	2/2/0/0	3
wb5303	Tribology	4/0/0/0	2
		Total	**23**

Recommended elective courses Dynamics

Course code	Course name	Lecture hours	cp
ae4-399	Dynamics & control aerospace systems	0/0/4/0	2
ct5145wb	Stochastic vibrations	6/0/0/0	2
wb1310	Multi-body dynamics A	0/0/0/4	2
wb1412	Non-linear vibrations	0/0/2/2	2
wb1413	Multi-body dynamics B	0/0/2/2	2
wb1416	Numerical methods for dynamics	0/0/2/2	2

Requirements

- Total obligatory credits for courses 46 cp
- Traineeship 10 cp
- MSc- thesis 28 cp

Specialization 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.
Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of (micro-) composite materials. Because of the continuing miniaturization in this area some new concepts in mechanics as well as in experimental methods should be developed and applied. Master theses will often be related to these challenges and will offer opportunities to co-operate with the industrial research partners, such as Philips, Fraunhofer IZM, IMEC, TNO, Thales, Siemens, Kriton, Motorola, ICI, DSM.
The 1st year of the educational programme 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 programme 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.

Mechanics of Materials	prof.dr.ir. L.J. Ernst	phone 015 27 86519
secretary	mrs. C. du Burck	phone 015 27 85733

Educational programme

- Total credit points for courses 46
- Credit points for preliminary study 8
- Credit points for Msc. Thesis work 30

Obligatory courses specialization Mechanics of Materials

Course code	Course name	Lecture hours	Cp
mk5751	Rheology of polymeric liquids		2
mk6261TU	Fracture Mechanics		2
wb1408	Mechanics of Pressure Vessels	2/2/0/0	2
wb1409	Theory of Elasticity	2/2/0/0	3
wb1410	Continuum Mechanics	0/0/3/0	3
wb1432	Mechanics of Fibre Reinforced Plastics	2/2/0/0	2
wi4007tu	Fourier and Laplace transforms	0/0/2/2	2
		Total	**16**

Elective courses specialization Mechanics of Materials

Course code	Course name	Lecture hours	Cp
ct.....	Computational Modelling of Materials		2
ct5142	Non-linear Computational Mechanics	0/0/4/0	2
ct4150	Plasticiteitsleer		3
wb1310	Multibody Dynamics	0/0/0/2	2
wb1402a	Plates and Shells	2/4/0/0	3
wb1405a	Stability of thin-walled structures	0/0/4/2	3
wb1412	Non linear Vibrations	0/0/2/2	2
wb1413	Multibody Dynamics B	0/0/2/2	2
wb1416	Numerical methods for dynamics	0/0/2/2	2
wb1417	Fluid-Structure interaction	0/0/0/2	1
wb1419	Engineering Dynamics and Mechanisms	2/3/0/0	3
wb1430a	Introduction to Fibre Reinforced Plastics	2/2/0/0	2
wb1430b	Fibre Reinforced Plastics - continued course	0/0/4/4	4
wb1440	Engineering optimisation	2/2/0/0	2
wb2303	Measurement Theory and Praxis	0/0/2/2	2
wb5303	Tribology	4/0/0/0	2
wi4014tu	Numerical Analysis C2	2/2/0/0	3
	Fortran course	to be announced	
	Advanced FEM software course	to be announced	
		Total to be chosen:	**14**

Specialization Tribology

Tribology is the science aimed to control and predict friction and wear between moving parts. Knowledge of those aspects is fundamental in order to tune lifetime and performance of mechanical systems in relation with design demands. This field of research is related to most aspects of mechanical engineering, physics, science of materials, chemistry and mathematics. New materials, coating systems, surface textures, lubricants and innovative constructions are developed and tested to improve lifetime and performance of mechanical systems. Mechanical engineering is imaginary without moving parts. Considering the necessity to control friction and wear, the meaning of tribology is clear.
Due to progress in industrial engineering there is a growing demand on engineers with interest for tribology. Some examples of these progresses result from the growing need for improved lifetime, performance, quality, less maintenance and environmental aspects like the attention for material and engergy consumption.
The research is focussed beyond design aspects of tribology. This implies the development of design tools to predict and to optimize lifetime and performance. Modelling plays an important part. Recent subjects are: thin films in metal forming, transport of ceramic rods on air cushions, lock gates running on thin water films, counter rotating propeller systems, dynamic aspects of grinders, the design of a waterjet rotor.

Tribology	dr.ir.A. van Beek	phone 015 27 86984
secretary	mrs. C. du Burck	phone 015 27 85733

Recommended courses Specialization Tribology

Course code	Course name	Lecturer	Lecture hours	cp
et302wb	Electrical drives	Bauer	0/0/3/0	3
mt216	Introduction combustion engines	Klein Woud	0/0/0/4	2
wb1432	Mechanics of fibre reinforced plastics	Marissen	2/2/0/0	3
wb2414	Mechatronics	Teerhuis	2/2/0/0	2
wb2427	Predictive Modeling	Van Eijk	0/0/4/0	2
wb5303	Tribology	van Beek	4/0/0/0	2
wb5400	Tribology in machine design	van Beek / vanOstayen	0/2/2/2	3
wb5414	Design of Machines and Mechanisms	Crone, vd Werff	2/2/2/0	3
wi4014tu	Numerieke analyse C2		2/2/0/0	3

1.5.3 Variant Process and Energy Technology

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 programme `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" programme 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 programme is organized on the basis of a joint curriculum and three specializations. The responsible people for the variant and specializations are:
For the first year there is joint compulsory curriculum of 15 credits for each of the three specializations. The rest of the programme has to be selected in consultation with the responsible lecturer.

Obligatory courses variant Process and Energy

Course code	Course name	Lecture hours	cp
st310	Thermodynamics of mixtures	0/0/2/2	2
wb1427	Advanced Fluid Dynamics	2/2/0/0	3
wb2311	Introduction to model formulation	4/0/0/0	2
wb4300A	Equipment for heat and mass transfer	4/0/0/0	2
wb4300B	Introduction to pumps and compressors	0/0/2/0	1
wb4302	Thermodynamics of energy conversion	4/0/0/0	3
wb4303	Energy, society and sustainability	0/4/0/0	2

Specialization Energy Technology

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 programme 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.

Energy Technology	prof.dr.ir. H. Spliethoff	phone 015 27 86071
secretary	mw. drs. M.T.J. Van	phone 015 27 86734

Courses Specialization Energy Technology

Course code	Course name	Lecture hours	cp
obligatory courses			
wb4422	Thermal Power Plants	0/0/4/0	3
wb4423	Modelling and Simulation of Energy Conversion Systems	0/0/4/0	2
wb201-1	Process Design and Calculation		4
at least 8 credits from the following courses			
wb4405	Fuel conversion	2/2/0/0	2
wb4410A	Refrigeration Fundamentals	2/2/0/0	2
wb4416	Nuclear engineering	0/4/0/0	2
wb4420	Gas turbines	2/2/0/0	2
wb4426	Indoor Climate Control Fundamentals	2/2/0/0	2
10 credits optional courses, recommmended			
ae4-140	Gas dynamics		2
ct5147	Wind Energy Conversion Systems		2
st314	Process Engineering		2
tn3710	Advanced thermodynamics		4
tn3782	Multiphase flow		4
wb1428	Computational Fluids Dynamics	0/0/2/2	2
wb4402	Project engineering	2/2/0/0	4
wb4421	Gasturbines Application and Simulation	0/0/2/2	2
wb4424	Indoor Climate Control Design	0/0/2/2	3

Course code	Course name	Lecture hours	cp
wb4425	Fuel cell systems	no lectures	1
wb4427	Refrigeration Technology and Applications	0/0/2/2	3
Second year			
wb201-2	First assignment		16
wb201-3	MSc-thesis (within research Energy Technology)		26
		Total	**84**

Specialization Process Equipment

The section of Process Equipment is located at the Laboratory for Process Equipment (API). At API there is a close cooperation with the chair of Separation Processes from TNW. The recommended educational programme includes separation equipment and processes, Scaling up of equipment for crystallization, distillation, extraction, new hybrid processes is treated in various courses from point of view of physical processes rather than "black box" rules. In the "G-assignment" assignment a design is made of a real production plant by students from mechanical engineering and from chemical engineering together. In the course Project Engineering and Management all aspects from basic process to business are treated, again with a real example. The research assignments mostly consist of a mixture of modelling or simulation, laboratory equipment design and construction and experimental work and are mostly carried out in the framework of the industrially sponsored projects at API. These include supercritical technologies, industrial crystallization and new hybrid separation technologies.

Process Equipment	prof.dr.ir. G.J. Witkamp	phone 015 27 83602
secretary	mrs. Annemieke van Dusseldorp	phone 015 27 86678

Specialization Fluid Mechanics

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 programme the student will be trained in all aspects of modern fluid mechanics both by means of courses and by means of specialized research work.

Fluid Mechanics	prof.dr.ir. F.T.M. Nieuwstadt	phone 015 27 81005
secretary	mrs. Ria van der Brugge	phone 015 27 82904

Courses for Specializations Process Equipment and Fluid Mechanics

Every student has to follow the 15 credit points of obligatory courses of the variant Process and Energy. For the remaining 27 credit points the student has to make a selection (in consultation with his supervising lecturer) out of the courses mentioned below. These courses are subdivided in three categories with an indication of the number of credit points one should select from each category. The second year is devoted to a traineeship and a the MSC-thesis.

Recommended courses Specializations Process Equipment & Fluid Mechanics

Course code	Course name	Lecture hours	cp
Society oriented (>= 4 credits)			
wm0605tu	Business Economics for Engineers		3
wm0621tu	Innovation Management		2
wm1102tu	Written English for Technologists		2
Additional Fundamental subjects (>= 6 credits)			
tn3713	Advanced thermodynamics		4
tn3753	Physical Transport Phenomena II		4
tn3782	Multiphase flow		4
wb1428	Computational Fluid Dynamics	0/0/2/2	2
wb4417	Mechanisch-hydraulisch Ontwerpen	2/0/0/0	2
General topics			
ae4-140	Gasdynamics I		2
ae4-141	Gasdynamics II		2
ct5147	Wind energy Conversion Systems		2
et4-149	Solar cells		2
mt212	Marine Engineering 3		2
st314	Proceskunde		2
tn3733	Turbulent reacting flows		4
wb1408	Mechanics of Materials 4	2/2/0/0	2
wb1424ATU	Turbulence A	0/0/2/2	4
wb1424B	Advanced turbulence		2
wb4402	Project engineering	2/2/0/0	4
wb4403	Fysische scheidingsmethoden	0/4/0/0	2
wb4405	Fuel conversion	2/2/0/0	2
wb4408A	Diesel Engines A	0/0/2/2	3
wb4410A	Refrigeration fundamentals	2/2/0/0	2
wb4416	Nuclear Engineering	0/4/0/0	2
wb4418	Olie en gaswinning buitengaats	0/0/4/4	2
wb4419	Modelvorming voor systemen	0/0/4/0	3
wb4420	Gasturbines	2/2/0/0	2
wb4421	Gasturbines application and simulation	0/0/2/2	2
wb4422	Thermal power plants	0/0/4/0	3
wb4424	Indoor Climate Control Design	0/0/2/2	3
wb4425	Fuel cell systems	no lectures	1
wb4426	Indoor climate control fundamentals	2/2/0/0	2
wb4427	Refrigeration Design & Applications	0/0/2/2	3
wi4006	Special functions		4
wi4011	Numerical fluid Dynamics		4
wi4008	Complex analysis		3
wi4017	Non-linear differential equations		4
	Experimental techniques in Fluid mechanics		

Specialization Marine Diesel Engines

Marine Diesel Engines is a specialization within Process and Energy Technolgy with emphasis on the interaction between the components and subsystems that make up the engine (system approach). Apart from a strong emphasis on the thermodynamic side, the attention is also focussed on the (marine) application of the diesel engine and on the user aspects (maintenance).
Diesel Engines as a subject for a Master Degree Programme covers a wide field, not only because of the wide application of the diesel engine but also because all basic disciplines of mechanical engineering, such as construction and fluid mechanics, thermodynamics, materials, design and engineering, control theory etc., are necessary in an approach to make the diesel engine an environmentally friendly, low cost and low maintenance element in mechanical installations.

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

Marine Diesel Engines	prof.ir. D. Stapersma	phone 015 27 83051
secretary	mrs. Dineke Heersma	phone 015 27 86868

Obligatory courses specialization Marine Diesel Engines

Course code	Course name	Lecture hours	cp
wb4408A	Diesel engines A	2/2/0/0	3
wb4408B	Diesel engines B	0/0/2/2	3
		Total	**6**

Elective courses specialization Marine Diesel Engines

Course code	Course name	Lecture hours	cp
wb1428	Computional Fluid Dynamics	0/0/2/2	2
wb4405	Fuel conversion	2/2/0/0	2
wb4416	Nuclear Engineering	2/2/0/0	2
wb4420	Gasturbines	0/4/0/0	2
wb4422	Thermal Power Plants	0/0/4/0	3
wb4423	Modeling and Simulation of Energy Conversion Systems	0/0/4/0	2
		At least	**8**

1.5.4 Variant Production Technology and Organisation

Research and education in the domain of production play a significant role in any modern society. In order to stay on the competitive edge the production of capital goods and consumer goods asks for continuous renewal and improvement. Main issues are innovation, cooperation, and integration. The section PTO encompasses the whole scope of activities in production technology and organisation from product marketing, product design, via manufacturing and assembly, to after sales service and recycling.

Some of the industrial driving forces in the field of production are:

- Production for "small and precise". Miniaturisation of products in combination with product variation. Short lead time and realisation of a short Time to Market is a specific challenge.
- Influence of customer driven design on production. Products and means of production are studied from the point of view of competitive product realisation.
- Best practices approach. Managing processes and systems for the best technology and organisation for the whole production chain. A major challenge is quality improvement of technology, organisation and information.

The research themes of PTO focus on 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 integration of production technological innovations with the design of organisations and the product design process itself is the second important area of attention. The research is structured in three programmes:

- Innovative part manufacturing processes. This programme aims at the development of new techniques, or of combinations of current techniques with which new materials can be processed better. High-speed machining, high-pressure waterjet cutting and thixoforming are examples of such processes.
- Production technologies for micro-scale systems. This programme aims at the development of techniques for the production of small parts, such as Abrasive Air Jetting, and at the assembly of these parts into products (micro-assembly).
- Organisation design for manufacturing control and product design support. This programme aims at the development of methods and techniques for structuring organisations, especially designing processes within organisations. Design for Production is one of the areas of attention.

Joint curriculum variant PTO
(o = obligatory; e = elective)

Course code	Course name	Lect.h.	CP	PT	MP	ED	IO-ME	IO-LR	ME	cat (4
wb2414	Mechatronical design	2/2/0/0	2	o	o	o	o	-	-	f
wb3417	Discrete systems	2/2/0/0	2	o	o	o	o	o	o	d**1)**
wb5414	Design of machines and mech.	2/2/2/0	3	o	o	o	o	-	-	d
wb5417	Innovation of manufacturing	0/2/2/0	2	o	o	o	o	e	-	d
wb5420	Design of production systems	4/0/0/0	3	o	o	o	o	o	o	d
wbo402-1	PTO lab exercises	6/6/6/6	8	o	o	o	o	o	o	d
wm0504TU	Industrial organisation A	4/0/0/0	2	o	o	o	o **2)**	o **2)**	o **2)**	m **3)**
Subtotal obligatory main subjects				**22**	**22**	**22**	**22**	**15**	**15**	

1) New (per 2002/2003).
2) 6 exercises with case-studies in the afternoon obligatory.
3) For a better understanding of wm0504TU " Industrial Organisation A" and other courses it is strongly recommended to study the course wm0501TU " Introduction to Business Engineering" in particular the book " Fundamentals of Business Engineering and Management; a Systems Approach to People and Organisations".
4) Category of subjects/courses:
   f = science oriented
   d = design oriented
   m = society oriented

Specialization Production Technology (PT)

Production Technology involves the technical knowledge, and management of the entire manufacturing system including processes, machines, and tools. The scope is aimed at the design of the most suitable manufacture and assembly processes for discrete products. Research topics are advanced new manufacturing processes like abrasive air jetting, ultra-high pressure waterjet cutting, precision grinding, thixo-forming, high speed machining and micro-assembly.

Production Technology	prof.Dr.-Ing.habil.B.Karpuschewski	83204	8D-3-08
Production Technology	ir.J.J.L. Neve	86581	8D-4-07
Secretary	Chr.M.P. de Wilde	83152	8D-3-06
	mrs.drs.M.E.M.Guffens	86578	8D-3-06

Specialization Mechanisation of Production (MP)

Mechanisation of Production is engaged in the design of new, and the analysis and improvement of existing (mass) production machines and processes. Knowledge of the design process and the available technical means like controllers, actuators, sensors is necessary. This knowledge is applied in industry related assignments. Research topics are computer support for the machine design process, and synthesis and analysis of mechanisms.

Mechanisation of Production	prof.ir.H.A. Crone	85207	8D-4-13
Secretary	Chr.M.P. de Wilde	83152	8D-3-06
	mrs.drs.M.E.M.Guffens	86578	8D-3-06

Specialization Mechanical Engineering Design (ED)

Mechanical Engineering Design is dedicated to the methodology of design. The existing methodologies of design are rather abstract theories. For that reason the research is connected to problems occurring in practical situations in industry as much as possible. The research assignments are always related to industrial applications. Example topics of the final assignments are: design calculations and procedures, engineering databases, geometric and physical modelling.

Mechanical Engineering Design	prof.dr.ir.K.v.d.Werff	85729	8D-4-17
Secretary	Chr.M.P. de Wilde	83152	8D-3-06
	mrs.drs.M.E.M.Guffens	86578	8D-3-06

Specialization Industrial Organisation (IO)

Industrial organisation, prepares for designing industrial processes and for positions in line- and staff management in industry and in engineering consultancy. The student learns to analyse a complex industrial problem in a scientific methodological way and to generate an acceptable solution. Great emphasis is put on modelling as an aid to analyse a certain organisational problem, respectively to engineer improved organisations in particular concerning control. The final assignment is directed to a real problem in a company or organisation in Holland or abroad.

Industrial Organisation	prof.ir.H.Bikker	82711	8D-3-23
	mrs.D.J.W.M.Brouwer	83302	8D-3-12
	mrs.S.D.W.M.van der Meer	87428	8D-3-12
Secretary	Chr.M.P. de Wilde	83152	8D-3-06
	mrs.drs.M.E.M.Guffens	86578	8D-3-06

Specialization Maintenance Engineering (ME)

Maintenance engineering and -management 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. 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 programmes, application of condition monitoring techniques, and determination of residual life.

Maintenance Engineering	prof.ir.K.Smit	84978	LR 10th
Secretary	mrs. N.O. Saaneh	85176	LR 10th

Study programme

Besides a common part for all specializations, the educational programmes for the different specializations 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 MSc-thesis.

Usually 70% of the obligatory courses have to be finished before the student can start with his research assignments. The MSc- thesis starts when all obligatory and elective courses and all other individual assignments have been completed succesfully.

A mentor will be assigned to each student, with whom he can discuss his study-plan and progress.

Summary of specialization curriculum	**PT**	**MP**	**ED**	**IO-ME**	**IO-LR**	**ME**	
Obligatory core courses	14	14	14	14	7	7	
PTO lab exercises (wbo402-1)	8	8	8	8	8	8	**4)**
Obligatory subjects in Specialization	4	9	7	9	12	17	
Elective subjects	10	11	13	11	9	10	
Industrial training **1)** or							
Traineeship **2)**	10	10	10	10	10	10	**4)**
Design/research assignment , literature							
Thesis or combination of both **3)**	12	6	6	6	6	6	**4)**
Master's thesis	26	26	26	26	32	26	**4)**
Total in credit points	**84**	**84**	**84**	**84**	**84**	**84**	

1) PT, MP and ED: sometimes to be combinated with the MSc- thesis.
2) IO-ME en IO-LR: the traineeship(wbo403-3) is exercised in the 4th dimester.
3) A research assignment or literature thesis may also be planned and performed on a topic in one of the cooperating PTO specialisatons. Into the research assignments a number of aspects of different courses are being integrated
4) Students entering the master course 2002/2003 are expected to deliver their reports and presentations in the English language.

Obligatory and elective courses per specialization (o = obligatory; e = elective)

Course code	Course name	Lect.h.	CP	PT	MP	ED	IO-ME 1)	IO-LRr 1)	ME	cat (8
ide343	Development operational safety	0/2/2/0	2,5	-	-	-	-	-	o	d
In2041TU	Introduction databases	3/0/0/0	3	e	e	e	-	e	o	d **7)**
In2025	Introduction database systems	0/4/0/0	4	e	e	o	e	e	e	f
wm0324LR	Ethics of engineering	0/4/0/0	2	e	e	e	e	o	e	m
Ae4-711	Durable development	4/0/0/0	2	e	e	e	e	o	e	m
wb1310	Multibody dynamics A	0/0/0/4	2	-	o	e	e	-	-	f
wb5201	Power drives	0/0/2/2	2	-	o	o	-	-	e	f
wb3303	Mechanisms	0/0/2/2	2	-	o	e	-	-	-	d
wb5303	Tribology	4/0/0/0	2	e	o	e	e	-	e	f
wb5415	Maintenance technology	2/2/0/0	1,5	-	e	e	e	e	o	d
wb5428	Applied systems theory	2/0/0/0	1	-	-	-	o	o	-	f **2)**
wb5421	Modelling of manufacturing	0/0/0/2	1	o	-	-	-	-	-	d
wb5422	Industrial assembly	0/0/2/0	1	o	-	-	-	-	-	d
wb5425	Fundamentals of machine tools	0/0/0/2	1	o	-	-	-	-	-	d
wb5426	Capita selecta PTO	0/3/0/0	1	o	o	o	o	e	e	m
wbo403-1	Organisation design & final testc.	2/0/0/0	1	-	-	-	o	o	-	d **3)**
wbo403-2	Final preparation & oral exam	2/0/0/0	1	-	-	-	o	o	-	d **4)**
wi4051TU	Introduction to operation research	2/2/0/0	3	-	e	e	e	e	o	f **5)**
wi4052	Risc analysis	0/4/0/0	2	-			-	-	o	d
wi4059	Reliability theory	0/4/0/0	2	-	-	-	-	-	o	f
w4070TU	Digital simulation A	4/0/4/0	2,5	-	e	e	-	e	o	d
wm0404tu	Business sociology	2/2/0/0	2	-	-	-	o	o	e	m
wm0104tu	Organization psychology	4/0/0/0	2	-	-	-	o	o	e	m **6)**
wm0505tu	Industrial organization B	0/0/4/0	2	-	-	-	o	o	-	m
wm0610tu	Elementary business economics	2/0/0/0	1	e	e	e	e	e	o	m **7)**
wm0611tu	Calculation information	0/2/0/0	1	-	-	-	-	-	o	m **7)**
Subtotal obligatory subjects for specialization				**4**	**9**	**7**	**9**	**12**	**17**	

1) In 2002/2003 the former course wb5413C will be part of wbo403-3 (Practicum in Industry – IO).
2) Obligatory if not earlier studied in the B.Sc-programme. If this course is part of the specialization subjects the minimum number of elective courses may be reduced with 1 CP.
3) wb0403-1 after having completed wb5417, wbo402-1 (PTO lab exercise) and the Practicum in Industry (wbo403-3).
4) wbo403-2 after having completed wbo403-1
5) for OM: 2 CP.
6) To this course wm0104TU belongs a corresponding conference.
7) wm0610TU and wm0611TU are both part of wm0605TU " Business Economy for engineers" (2/2/0/0 – 3 CP); to a maximum of 2 CP may be spended on these subjects.
8) Category of subjects/courses:
   f = science oriented
   d = design oriented
   m = society oriented

Elective courses per specialization

Course code	Course name	Lect.h.	CP	PT	MP	ED	IO-ME	IO-LR	ME	cat
ct5720	Environmentology and safety	0/0/4/0	3	e	e	e	-	-	-	m
et3021wb	Electrical power drives	0/0/3/0	2,5	-	-	-	-	-	e	f
ide532	Display ergonomics	0/0/0/2	1	-	e	e	e	-	-	d
in1011tu	Software design	0/2/2/0	4	e	e	e	-	-	-	f
in4028tu	Business systems engineering	0/0/0/4	3	-	e	e	e	-	-	d **3)**
in4029tu	Information systems engineering	2/2/0/0	3	-	e	e	e	-	-	d **3)**
ae2-082	Technology aircraft building	0/4/0/0	2	e	e	e	-	-	-	d
ae4-485	Manufacturing Engineering	0/0/2/2	2	-	e	e	e	e	e	d
ae4-496	Maintenance technology	0/0/2/2	2	-	-	-	-	-	e	d
mk5171	Welding technology	0/2/2/0	2	-	-	-	-	-	e	d
mk6231	Design techniques		2	e	e	e	-	-	-	d
mk2302	Material science 2		8	e	e	e	-	-	-	f
mk6261tu	Breukleer	4/0/0/0	2	-	-	-	-	-	e	f
mk5291	Non-destructive research	0/0/2/2	2	-	-	-	-	-	e	d
mk3421	Corrosion	-/-/-/-	2	-	-	-	-	-	e	f
mk4401	Fysics en technology thin layers		3	e	e	e	-	-	-	f
mk5631	Damage analysis	-/-/-/-	2	-	-	-	-	-	e	d
mk5641	Breaking mechanics	-/-/-/-	2	-	-	-	-	-	e	f
St4881	Durable technology 2		2	e	e	e	-	-	-	d
wb2306	Cybernetical ergonomics	0/0/0/4	2	-	e	e	e	e	-	f
wb3407A	Logistics: introduction	0/0/2/2	2	-	e	e	e	e	e	d
wb4300B	Introd. pumps and compressors	0/0/2/0	1	-	-	-	-	-	e	d
wb4402	Project engineering	2/2/0/0	4	-	-	-	e	-	e	d
wb5305	Manager and information	0/2/0/0	1	-	e	e	e	e	-	m
wb5400	Tribology in machine design	0/2/2/2	3	-	-	-	-	-	e	f
wi1003wb	Research meth.& data processing	0/0/4/4	4	e	e	e	-	-	-	f
wi2064	Decision analysis	0/4/0/0	2	-	e	e	e	e	-	d
wm0311tu	Human engineer		2	e	e	e	-	-	-	m
wm0401tu	History of engineering		2	e	e	e	-	-	-	m
wm0509tu	Business aspects research	0/2/2/0	2	-	e	e	e	e	e	m **4)**
wm0621tu	Innovation management		2	e	e	e	-	-	e	m **4)**
wm0702tu	Principles of law (comprehensive)	0/4/0/0	2	-	-	-	-	e	-	m
wm0781tu	Patent law and – policy		2	e	e	e	e	-	e	m
wm0801tu	Introduction safety engineering	0/4/0/0	2	-	-	-	-	-	e	m
wm0908tu	Engineering and future		2	e	e	e	-	-	-	m
wm1102tu	Written english for technologists	-/-/-/-	2	e	e	e	e	e	e	- **5)**
wm1109tu	Scientific writing	0/2/2/0	2	e	e	e	e	e	e	- **5)**
	and oral presentations	0/0/2/2								
	Minimum cp of elective subjects			**10**	**11**	**13**	**11**	**9**	**10**	

1) Each specialization has to deal with a minimum of 4 cp to society oriented courses (m) and 6 cp to fundamental oriented courses (f)
2) Students are not supposed to make their choice for elective subjects exclusively out of this and the previous tables! Elective subjects are meant for broadening the student's view; students are encouraged to consciously choose the elective subjects they want to include in their programme, in agreement with the student's mentor. This table is only meant to help the search process.
3) To choose one of the two; in4028 is preferable, but only if enough prior knowledge is obtained.
4) To choose one of the two.
5) To choose one of the two; wm1109tu is preferable.

TH-programme (see also 1.4.2)

Curriculum subdivision in credit points	PT	MP	ED	IO-ME	ME
Additional courses for TH (see 1.4.2)	22	22	22	22	22
P/D1 – subjects	-	-	-	2 **1)**	-
PTO – core obligatory subjects	14	14	14	7 **2)**	7 **2)**
PTO – lab exercises (wbo402-1)	8	8	8	8	8
Obligatory subjects in specialization **3)**	4	9	7	9	17
Elective subjects **4)**	10	11	13	9	10
Traineeship (wbo403-3) **5)**	-	-	-	7	-
Design/research assignment, literature thesis or combination of both **6)**	12	6	6	6	6
MSc- thesis	26	26	26	26	26
Total in credit points	**96**	**96**	**96**	**96**	**96**

1) wm0501TU
2) wb5420, wb3417 en wm0504TU
3) see the regular programme
4) see the electives of the regular programmePTO
5) based upon 3 CP preparation, 3 CP in industry and 1 CP report
6) May also be executed in one of the co-operating PTO-specializations.

1.5.5 Variant Solid and Fluid Mechanics

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 and excellent basis for those aiming at a research carrier in industry or academia. However, also for those planning a carrier in advanced engineering the programme yields a solid basis for further specialization.

The programme is organized on the basis of a joint curriculum and four specializations. For each of these specializations the joint curriculum is compulsory and differentiation takes place on the basis of an individual selection of courses. A short description of the four specializations is given below.

Obligatory courses variant Solid and Fluid Mechanics

Course code	Course name	Lecture hours	cp
ct5142	Computational Methods in Nonlinear Mechanics		2
wb1409	Theory of Elasticity	2/2/0/0	3
wb1410	Continuum Mechanics	0/0/4/0	3
wb1419	Engineering dynamics and mechanisms	2/3/0/0	3
wb1427	Advanced Fluid Mechanics A	2/2/0/0	3
wb1428	Computational Fluid Dynamics	0/0/2/2	2
		Total	**15**

Specialization Mechanics of Materials

The continuous improvement of mechanical products and processes requires a flexible design method. In the past few years virtual (=simulation-based) prototyping is beginning to draw attention from both industries and the academic world. Virtual prototyping involves a variety of aspects such as mechanical modeling of the material behavior, numerical simulation, design of appropriate optimization tools and adequate experimental verification techniques. Education and research in Mechanics of Materials is directed to these aspects, with special focus on experimental characterization and modelling of (process dependent) material behaviour, simulation of production steps and related mechanical properties of products and experimental verification of simulation results.

Some of the most challenging fields of application are found in the (production related) reliability of microelectronics and of (micro-) composite materials. Because of the continuing miniaturization in this area some new concepts in mechanics as well as in experimental methods should be developed and applied. MSc-theses will often be related to these challenges and will offer opportunities to co-operate with the industrial research partners, such as Philips, Fraunhofer IZM, IMEC, TNO, LMS Int., Thales, Siemens, Kriton, Motorolla and DSM.

Mechanics of Materials	prof.dr.ir. L.J. Ernst
Secretary	mrs.C.du Burck

Specialization Engineering Dynamics

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).

Engineering Dynamics	prof.dr.ir. D.J. Rixen
Secretary	mrs.C.du Burck

Specialization Engineering Optimization

Recent developments in computer technology have opened possibilities for automated design and optimization. This requires a solid understanding and knowledge of both (computational) mechanics and optimization. However, nearly always also other disciplines are involved, for example, production, electrical, material sciences, etc. The educational 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.

Engineering Optimization	prof.dr.ir. A. van Keulen
Secretary	mrs.C.du Burck

Specialization Fluid Mechanics

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

Fluid Mechanics	prof.dr.ir. F.T.M. Nieuwstadt
Secretary	mrs.R. v.d. Bruggen

Elective courses variant Solid and Fluid Mechanics

Course code	Course name	Lecture hours	cp
	Society oriented (≥ 4 credits)		
wm0605tu	Business Economics for Engineers		3
wm0621tu	Innovation Management		2
wm1101tu	Upper-Intermediate English (refresher)		2
wm1102tu	Written English for Technologists		2
	Optional courses (≥ 6 credits)		
tn3713	Advanced thermodynamics	0/0/3/0	4
wb1406	Experimental mechanics	0/0/2/2	2
wb1417	Fluid-structure interaction	0/0/0/2	1
wb1440	Engineering Optimization	2/2/0/0	2
wb1441	Optimization II	0/0/2/2	2
wb2414	Mechatronical Design	2/2/0/0	2
wi4014tu	Numerical Analysis C2		3
	Rheology of polymers		2
	Recommended courses (≥ 10 credits)		
Course code	**Course name**	**Lecture hours**	**cp**
ae4-140	Gasdynamics I	2/2/0/0	2
ae4-141	Gasdynamics II	0/0/2/2	2
Ctme5145	Random vibrations	4/0/0/0	2
ide521	Computer Visualisation	2/0/0/2	2
in006tu	3D Computer Graphics	0/3/0/0	3
lAe4-30	Aero-Elasticity	0/0/2/2	2
mk26	Fracture Mechanics	4/0/0/0	2
tn3713	Advanced thermodynamics	0/0/3/0	4
tn3733	Turbulent reacting flows	2/2/0/0	4

Recommended courses (≥ 10 credits) continued

Course code	Course name	Lecture hours	cp
tn3753	Transport phenomena II	0/0/3/0	4
tn3782	Multiphase Flow	0/0/2/2	4
wb1310	Multibody Dynamics A	0/0/0/4	2
wb1402a	Plates and Shells	2/4/0/0	3
wb1405a	Buckling Analysis	0/0/4/2	3
wb1406	Experimental Mechanics	0/0/2/2	2
wb1408	Mechanics of pressure vessels	2/2/0/0	2
wb1412	Non-linear vibrations	0/0/2/2	2
wb1413	Multibody Dynamics B	0/0/2/2	2
wb1416	Computational Engineering Mechanics	0/0/2/2	2
wb1424atu	Turbulence A	0/0/2/2	4
wb1424b	Advanced turbulence	0/0/2/2	2
wb1430a	Introduction to Fibre Reinforced Plastics	2/2/0/0	2
wb1430b	Fibre Reinforced Plastics - continued course	0/0/4/4	4
wb1432	Mechanics of Fibre Reinforced Plastics	2/2/0/0	3
wb1440	Engineering Optimization	2/2/0/0	2
wb1441	Optimization II		2
wb2303	Measurement Theory and Praxis	2/2/0/0	2
wb2414	Mechatronics	2/2/0/0	2
wb4300a	Heat and Mass Transfer Apparatus	4/0/0/0	2
wb5303	Tribology	2/2/0/0	2
wb5414	Design of Machines and Mechanisms	2/2/2/0	3
wi3001	Num.Meth.for Partial Differential Equations	2/2/0/0	4
wi3031	Nonlinear Optimization		4
wi4006	Special functions	2/2/0/0	4
wi4008	Complex analysis	2/2/2/2	3
wi4010	Advanced Course on Numerical Linear Algebra	4/0/0/0	4
wi4011	Numerical fluid Dynamics	2/2/2/2	4
wi4016	Parallel Algorithms special subjects		4
wi4017	Non-linear differential equations	2/2/2/2	4
wi4017	Parallel Computing	0/0/4/0	4
wi4054	Large-scale Models		4

1.5.6 Variant Biomedical Engineering

Regarding the social and economical impact there is a great demand for engineers specialised in BioMedical Engineering (BME). Nationwide, there are large investments in medical devices and medical research. In the design of the medical devices and in the medical research, engineers with a biomedical specialization have an important role.
Most engineers receive a mono-disciplinary education, e.g. in electrical, civil or mechanical engineering. In contrast, the largest scientific progress is made in the fields where the traditional disciplines meet or even overlap. Biomedical engineering is a multi-disciplinary specialization with great challenges, in which well-educated engineers can make a large progress. In addition to the technical challenges, BME also appeals to the social responsibility of the engineer. A more direct relation to the improvement of the quality of life is hard to find.
At Delft University of Technology two MSc educations offer a variant in BME, i.e. Electrical Engineering and Mechanical Engineering. In the BME variant there is a close collaboration with clinical partners at Leiden University Medical Center (LUMC), Erasmus University Rotterdam (EUR) and the Amsterdam Medical Center (AMC). The clinical partners participate in the teaching and in the tutoring of the MSc Theses.
The goal of the BME variant is to educate engineers with excellent technical skills and knowledge, who have additional medical and biological knowledge, experience in medical applications and experience in the multi-disciplinary collaboration with physicians and other researchers in the biomedical field. Research-oriented as well as design-oriented MSc students will be educated.
Within the BME variant in the MSc Mechanical Engineering programme, a choice can be made between four specializations.

Specialization Medical Instrumentation & Measurements

The development and improvement of surgical instruments and medical devices for the clinician.

Medical Instrument. & Measurements	prof.dr.ir. P.A. Wieringa	phone 015 27 85763
secretary	mrs. Maria Macherhi	phone 015 27 86400

Specialization Bio Mechatronics

The development of mechanical and electronical devices for aiding the motion control functions of the patient

Bio Mechatronics	prof.dr.ir. F.C.T. van der Helm	phone 015 27 85616
secretary	mrs. Maria Macherhi	phone 015 27 86400

Specialization Medical Safety

Analysis of clinical procedures and devices in order to reduce the risk for failures.

Medical Safety	prof.dr.ir. P.A. Wieringa	phone 015 27 85763
secretary	mrs. Maria Macherhi	phone 015 27 86400

Specialization Tissue Biomechanics & Implants

Analysis of the mechanical behaviour and interaction between implanted devices and body tissues.

Tissue Biomechanics & Implants	prof.dr.ir. A. van Keulen	phone 015 27 86515
secretary	mrs. Marianne Stolker	phone 015 27 86513

The specializations are closely related to the research in the Dept. of Mechanical Engineering, especially in the subdivision Medical Technology and Mechanics, consisting of the research groups Man-Machine Systems & Control and Structural Optimization.
In the 1st year the programme consists of roughly 50% Medical Technology and Biophysics classes and 50% fundamental technical classes. In the Medical Technology and Biophysics classes the clinical and technical partners will both participate. The physicians will explain the clinical problems and viewpoints, as well as the progress in clinically related research. From the engineering viewpoint, there will be an emphasis on the technical and biophysical aspects, i.e. what is the state of the art in design, modelling and simulation. Here, the relation will be made with the engineering background of the students. In the 2nd year there will be a stay in a biomedical research group or company, and a MSc thesis project in Biomedical Engineering. In order to assure the multi-disciplinary nature of the BME education, the MSc thesis project will be tutored by a technical as well as a clinical staff member.

Summary of the Variant Biomedical Engineering

1st course year

Specific Biomedical Engineering courses (total 20 credits)

-Common BME courses (4 credits)
- -Health care systems
- -Introduction Medical Engineering

-BME courses for specialization (16 cp; about 9 obligatory and 7 elective cp)
- -Medical Instruments
- -Biomechatronics
- -Medical Safety
- -Tissue Biomechanics & Implants

Other Mathematician and Engineering courses (total 22 cp; about 10 obligatory and 12 elective cp)

- -Specialization knowledge
- -Research methods
- -Design courses

2nd course year

-Traineeship (8 cp)
-Literature study (8 cp)
-MSc- Thesis(26 cp)

Course schedule Specializations Biomedical Engineering

Specific BME courses

in the programmes of the specializations Medical Instruments (MI), Biomechatronics (BM), Medical Safety (MS) and Tissue Biomechanics & Implants (TBI) are:
(o: obligatory courses; r: recommended elective courses; e: elective courses)

Course code	Course name	Lecture hours	cp	MI	BM	MS	TBI
et4-126	Medical technology		2	o	o	o	o
et4-127	Theme course biomedical technology		2	e	e	e	e
et4-128	Health care systems		2	o	o	o	o
et4-129	Fysical measurement meth. and image tech.		2	e	e	e	e
et4-130	Bio-electricity		2	e	e	e	e
ide530	Biomechanics		2	e	e	e	e
ide534	Ergonomical aspects data processing systems		1	e	e	e	e
ide5381	Design ergonomics for elderly and handicapped		2	e	e	e	e
ls1061	Cell biology 1		2	e	e	e	r
tn3433	Fysical image techniques		2	e	e	e	r
tn3435	Pattern recognition		2	e	e	e	r
tn399	Radiation dosimetrie (intensive course IRI)		4	e	e	o	e
wb2308	Biomedical engineering design	2/0/0/0	3	o	o	r	r
wb2407	Human movement control	2/2/0/0	3	r	o	e	o
wb2408	Fysiological systems	0/4/0/0	2	o	r	o	o
wb2431	Bone mechanics and implants	0/2/2/0	2	e	r	e	o
wb2432	Biomechatronics	0/0/2/2	3	r	o	e	o
	Total credits obligatory BME courses		**9**	**13**	**10**	**14**	

Non-specific BME courses

in the programmes of the specializations Medical Instruments (MI), Biomechatronics (BM), Medical Safety (MS) and Tissue Biomechanics & Implants (TBI) are:
(o: obigatory courses; r: recommended elective courses; e: elective courses)

Course code	Course name	Lecture hours	cp	MI	BM	MS	TBI
ctxxxx	Computational modelling of materials		2	-	-	-	o
wb1409	Theory of elasticity	2/2/0/0	3	e	e	e	o
wb1410	Continuum mechanics	0/0/4/0	3	e	e	e	o
wb1413	Multibody dynamics B	0/0/2/2	2	r	o	r	r
wb1440	Engineering optimization	2/2/0/0	2	e	e	e	o
wb2301	System identific. and parameter estimation	0/0/2/2	5	o	o	o	ek
wb2303	Measurement techniques	0/0/2/2	2	o	e	o	e
wb2309	Introduction specialization MMS	2/0/0/0	0.5	o	o	o	-
wb2404	Man-machine systems	2/2/0/0	3	o	o	o	e

Course code	Course name	Lecture hours	cp	MI	BM	MS	TBI
wb2413	Instrumentation	0/0/2/2	2	e	e	o	r
wb2420	Control theory	4/0/0/0	4	o	o	o	e
wbp202	Haptics system design		3	o	o	o	e
	Total credits obligatory courses			**17.5**	**17.5**	**19.5**	**10**
ct5142	Computational meth. in non-linear mechanics		2	-	-	-	r
ide521	Computer visualisation		2	e	e	e	e
in006tu	3D computer graphics		3	e	e	e-	e
mk26	Fracture mechanics		2	-	-	-	r
tn3111wb	System identification B	0/0/2/2	3	e	e	e	e
wb1310	Multibody dynamics A	0/0/0/4	2	e	e	e	e
wb1406	Experimental mechanics	0/0/2/2	2	e	e	e	e
wb1416	Computational engineering mechanics	0/0/2/2	2	e	e	e	e
wb1427	Advanced fluid mechanics A	2/2/0/0	3	-	-	-	e
wb1428	Computational fluid dynamics	0/0/2/2	2	-	-	-	e
wb1430a	Introduction to fibre reinforced plastics	2/2/0/0	2	-	-	-	e
wb1432	Mechanics of fibre reinforced plastics	2/2/0/0	3	-	-	-	e
wb1441	Optimization 2		2	-	-	-	e
wb2306	Cybernetical ergonomics	0/0/0/4	2	e	e	e	e
wb2402	Hydraulic servo systems	2/2/0/0	2	e	e	e	e
wb2414	Mechatronical design	2/2/0/0	2	r	e	e	e
wb2421	Multivariable control systems	0/0/4/0	4	e	e	e	e
wb2422	Modelling 2	0/4/0/0	4	e	r	e	e
wb5303	Tribology	4/0/0/0	2	-	-	-	e
wb5412	Micro techniques	0/0/2/2	2	r	e	e	e
wi4008	Complex analysis		3	-	-	-	e
wi4011	Numerical fluid dynamics		4	-	-	-	e
wi4014tu	Numerical analysis C2		3	-	-	-	r
wi4017	Non-linear differential equations		4	e	e	e	e
wm0605tu	Business economics for engineers		3	e	e	e	e
wm0621tu	Innovation management		2	e	e	e	e
wm1101tu	Upper-Intermediate english (refresher)		2	e	e	e	e
wm1102tu	Written english for technologists		2	e	e	e	e

1.5.7 Annotations

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

a Technical Marketing
b Offshore Technology
c Sustainable Development

The study programme, including an annotation, has to comply with the requirements of paragraph 1.2 (84 cp).

Annotation Technical Marketing

The Technical Marketing annotation offers students the possibility to get knowledge and skills in a more commercial direction. The study programme is meant for students, who want to prepare themselves for a technical commercial function (sales, marketing), in the area of their variant and specialisation.
The study programme will be determined in consultation between student, lecturer responsible for the chosen variant and specialisation and the responsible lecturer for Technical Marketing (prof. mr. dr. Sicco S. Santema). The marketing component in the study programme consists of at least 10 cp marketing courses and 16 cp of the MSc-thesis should be devoted to marketing aspects. This means that a major part of the elective courses has to be used for technical marketing. The marketing content of the MSc- thesis should be complementary to the chosen variant and specialisation. Normally this part involves a marketing research study, for products, which still have to be developed, or a market introduction study, for developed products, but not yet introduced into the market. At the end of the MSc- thesis integration between marketing and technology will take place. This will result in a synthesis report.
Both the lecturer of the chosen variant and specialisation and a technical marketing lecturer will guide the student.
The responsible lecturer for Technical Marketing is prof. mr. Dr. Sicco C.Santema (phone 015 27 83076; e-mail S.C.Santema@io.tudelft.nl). The Technical Marketing guidance of students will be co-ordinated by dr. H.M.J.J. Snelders (phone 015 27 83108; e-mail H.J.M.M.Snelders@io.tudelft.nl).

Obligatory courses annotation Technical Marketing

Course code	Course name	Lecture hours	cp
ID4141	Consumer research	0/0/3/3	4
ID5131	Business marketing for engineers	0/0/2/0	2
IDE511	Integral aspect of business marketing	0/0/0/4	2
	Total		**8**

Recommended elective courses annotation Technical Marketing (at least 2 cp)

Course code	Course name	Lecture hours	cp
wm0720	Bedrijfsrecht A / ondernemingsrecht	0/0/4/0	2
wm0115	Conflicthantering en onderhandelen	0/3/0/0	1
	Other courses relevant for TM		

Annotation Offshore Technology

The Offshore Technology annotation offers students the possibility to get knowledge and skills with regard to the complete field of offshore engineering. It is an interfaculty study programme, which is offered via the Delft Interfaculty Centre for Offshore Technology (DICOT). The annotation can be obtained in combination with a number of variants and specialisations. The Participant's guide to the interfaculty Offshore Technology MSc curriculum can be obtained from DICOT (W.W. Massie MSc, P.E.; phone 015 27 84614; e-mail w.w.massie@offshore.tudelft.nl)
The study programme will be determined in consultation between student, lecturer responsible for the chosen variant and specialisation and the responsible lecturer for Offshore Engineering (prof. dr.ir.J. Meek or W.W. Massie). The offshore component in the study programme consists of at least 25 cp offshore courses and the MSc-thesis should be devoted to an offshore technology subject. This means that the elective courses have to be used for offshore engineering; some of the obligatory courses for the chosen variant and specialisation may be left out in consultation with the lecturers. The offshore content of the MSc-thesis should be complementary to the chosen variant and specialisation.
Both the lecturer of the chosen variant and specialisation and an offshore lecturer will guide the student.

Obligatory courses annotation Offshore Technology

Course code	Course name	Lecture hours	cp
ot4600	Survey of offshore technology		5
ot4615	Oceanography and waves		4
ct4130	Probabilistic design		3
ot4620	Offshore hydromechanics		5
	total		**17**

Elective courses annotation Offshore Technology (at least 8 cp)

Course code	Course name	Lecture hours	cp
ot4620	Offshore soil mechanics		2
ot4651	Bottom founded structure design		4
ot4652	Design of floating structures		3
ot4653	Subsea engineering and marine pipelines		3
ot4661	Offshore moorings		3
ot5662	Subsea engineering design		3
ot5663	Offshore windfarm design		3

Annotation Sustainable Development

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

The curriculum should include:

- colloquium in sustainable development of 2 cp
- 4 courses, each not less than 2 cp; to be chosen from the following clusters:
  - Design, Analysis and Tools (General)
  - Design, Analysis and Tools (Marine Technology)
  - Organisation
  - Policy and society
- MSc-thesis, which shall be devoted also to sustainable development. The coordinator shall approve the problem formulation of the thesis and the extent to which sustainable development is integrated into the thesis. The coordinator shall further determine whether the theme of sustainable development has been sufficiently integrated into the problem formulation, the execution of the project and the project report.

Further information on the available courses can be obtained at the website http://www.odo.tudelft.nl and from dr.ir. C.A. Infante Ferreira (phone: 015 27 84894, email: c.a.infanteferreira@wbmt.tudelft.nl), who is the coordinating lecturer for Mechanical Engineering, with regard to sustainable development.

1.5.8 Technical University Teacher course (TULO)

Graduated Masters of Science Mechanical Engineering or Maritime Technology have the opportunity to participate in a special course to become a high school teacher in science or mathematics.
There is a standard course, which includes 42 cp. A maximum of 21 of these points can be integrated in the MSc study programme, the other, at least, 21 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.
- 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, 3th).

1.7 Pass rules and criteria for 'honours-degree'

Pass rules

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

Examination

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

'honours- degree'

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

- grade average is at least 7,5
- no grades lower than 6
- grade for MSc- thesis is at least 8
- not more than 2,5 years to complete the MSc-programme

This is a summary from part of the "Regulations and guidelines for the board of examiners", appendix 6.4 of this studyguide.

1.8 Profile of the Mechanical Engineer

Mechanical engineers 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 extensive choice of specializations within the MSc-programme, gives the mechanical engineer from Delft a versatile employability. This versatility is illustrated by the variety of professions, among which there are: designer, scientific researcher, organisation 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 a scientific education from Delft are excellent: 93% of the 1998/1999 graduates had a paid job within 3 months, 72% with a permanent appointment. On average they spent 1 month to get their first job. The average monthly salary for a starting Mechanical Engineer was € 2350 (the average for Mechanical Engineers from all universities: € 2275). 1% of the graduates received further education.

2 Bachelor/Master system: a brief explanation

In the year 2000 29 European ministers of education have signed the "Bologna Declaration on the European Space for Higher Education": the first step towards implementation of the Bachelor/Master system in the Netherlands. The main targets of this system are:

- to stimulate international mobility of students
- development of international study paths
- an increase of the transparency and harmonization of the educational system
- better international recognition of the Dutch educational programmes

The system has been implemented in the Netherlands per september 2002. TUD is the first university in the Netherlands, which implements the system within all its study programmes. The result is 15 BSc- and 23 Msc-programmes.

The traditional programme of 5 study years is divided in a BSc-programme of 3 years and a MSc-programme of 2 years. The BSc-programme ends with a BSc-thesis. Only after completing the MSc-programme the education is complete.

Features of BSc:

- selecting and orientating propedeutic exam
- collective courses in clusters
- BSc-thesis as an integral test of the study programme
- official language is Dutch

Features of MSc:

- several variants and specializations based on research
- better admittance of foreign students
- official language is English, but in the course year 2002/2003 still much courses will be taught in Dutch
- degree with the title 'Ingenieur' or 'Master of Science'

The TU Delft emphasizes that the implementation of this system should in no way interfere with the progress of students, which started their study before 2002. If, however, this occurs it is recommended to consult one of the student advisers.

3 Organisation

3.1 Faculty

The faculty Mechanical Engineering and Marine Technology offers the study programmes Mechanical Engineering (ME) and Marine Technology (MT).
The organisation of the faculty and the structure of the educational and board of examiners of the faculty are described in the faculty regulations.
The dean has the final responsibility for the faculty. He is assisted by the education director. Together with the department heads they form the management team. The dean is supported by the Faculty Staff and is advised by a number of advisory boards.

Dean prof. ir. W. L. Dalmijn
phone: 015 27 85401
e-mail: w.l.dalmijn@wbmt.tudelft.nl

3.2 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:

Joke Ammerlaan	Secretary	j.m.a.ammerlaan@ocp.tudelft.nl	Tel. 015 27 86959
ir. Nic-Jan van Bemmel	Education Manager	n.j.vanbemmel@wbmt.tudelft.nl	Tel. 015 27 88791
Fatma Çelik	Study Administration	f.s.celik-cinar@wbmt.tudelft.nl	Tel. 015 27 86753
Teuni Eden	Study Adviser	t.eden@wbmt.tudelft.nl	Tel.015 278 2176
Lies Gesink	Study Administration	e.g.gesink@wbmt.tudelft.nl	Tel. 015 27 86591
Aad Gutteling	Study Administration	a.gutteling@wbmt.tudelft.nl	Tel. 015 27 86753
Louise Karreman	Study Administration	l.m.karreman@wbmt.tudelft.nl	Tel. 015 27 83457
prof.ir. Hans Klein Woud	Education Director	j.kleinwoud@wbmt.tudelft.nl	Tel. 015 27 81556
Ewoud van Luik	Manager Study Administration and webmaster	e.p.vanluik@wbmt.tudelft.nl	Tel. 015 27 85734
dr. ir. Dick Nijveldt	Education Adviser	d.nijveldt@wbmt.tudelft.nl	Tel. 015 27 85921
Carel Piguillet	Software Support	c.f.f.piguillet@wbmt.tudelft.nl	Tel. 015 27 86820
ir. Jaap v.d. Zanden	Study Adviser	j.vanderzanden@wbmt.tudelft.nl	Tel. 015 27 82996

Education Support Staff
Mekelweg 2,
Location 8B, 3th floor
2628 CD Delft
Phone: 015 27 86959 / 015 27 83457
Fax: 015 27 88340

3.3 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 study 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-3-05
Mekelweg 2
2628 CD Delft
phone: 015 27 83457
e-mail: l.m.karreman@wbmt.tudelft.nl

3.4 Board of examiners

The board of examiners consists of all lecturers, involved in the study programme, as mentioned in paragraph 1.3.
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-3-06
Mekelweg 2
2628 CD Delft
phone: 015 27 85734
e-mail: e.p.vanluik@wbmt.tudelft.nl

3.5 Students association

'Gezelschap Leeghwater' is the students association of students Mechanical Engineering at the TU Delft. It aims to give its members support to their study and to look after the interests of the students Mechanical Engineering.
The first aim, to support to the study, is taken care of by organising excursions, case studies and by taking a seat in the organisation of the "Delftse Bedrijvendagen". Gezelschap Leeghwater also publishes a year book and five times per year magazine 'de Slurf'.
The second aim, to look after the interests of the students, is taken care by organizing "lecture response groups" in order to give feedback to teachers. Gezelschap Leeghwater manages the Lecture Response Computer ("College Respons Computer") in front of lecture room C. Every year one member of the board of Gezelschap Leeghwater is responsible to represent the students in discissions with the faculty and education staff about education. He or she is the person, who canalizes complaints and wishes about the education programme, organization and lecturers. This person can be contacted at onderwijs@leeghwater.nl

Every weekday between 12.00 hrs and 14.00 hrs Gezelschap Leeghwater sells books at its office. Here you can buy books at cost price, last-years examinations and various office articles. On the blackboard last years examinations are available for members of Gezelschap Leeghwater to download and print.

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

3.6 Student guidance

For assistance and advise to students the faculty has two study advisers. The study adviser is the person for questions or problems related to the study or about issues, which may influence the ability to study. The study adviser functions as oracle (vraagbaak) and as confidential consultant to students.
The study 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 study advisers and personal advisers at the TU Delft and outside the University; so he knows what is going on elsewhere.

During a talk with a study adviser, often intimate information comes up. The student can be sure that this information will be dealt with confidentially. This kind of information will only be used after consultation with the student, to plead to apply TU- or faculty regulations. A study 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 study adviser becomes an intermediary between TU Delft personal advisers: student, deans, psychologists and physicians.

The amount, in which the study adviser pays attention to a student, is up to the student. The study 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 study adviser yourself when a question or problem comes up. Waiting often results in an increase of the problem.

The two study advisers at the faculty are available for all questions. They also have their own specialisms.

mrs. Teuni Eden
Specialisms: International contacts, guidance of foreigners and female students
Mekelweg 2, 8B 3th floor, room 20
Email: t.eden@wbmt.tudelft.nl
Phone: 015 27 82176
Consulting hours on weekdays from 12.30 till 13.30 hrs.

ir. Jaap v.d. Zanden
Specialisms: MSc students, polytechnic high school students, quality control, student mentors
Mekelweg 2, 8B 3th floor, room 19
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 study 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

3.7 Quality Control

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

Internal Quality Control:

- 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.
- Regular **Evaluations** with students and lecturers.
- Lodging of and dealing with **complaints**. These complaints can be lodged at the students association or at the education director.
- The faculty evaluates itself in a, so-called, self-assessment.
- The student association establishes "Lecture Response Groups". These groups publish, together with lecturers, in the 'Meer dan Konsumentengids' their comments on the courses. They also give a direct feedback to lecturers.

External quality control:

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

3.8 Information services

This study guide is the main information source of the faculty and is available to all students at the study administration.
The website, however always contains the most recent information. Announcements, which are of importance for the study, like changes in the schedules, are made timely on the homepage of the faculty and at Black Board.
Schedules about the lectures, assignments and examinations are available at the desk of the study administration. At the homepage of the faculty and Black Board the changes in these schedules are given.
Information that is not related directly to the study e.g. information by students association 'Gezelschap Leeghwater', will be published on publication boards. Members of 'Gezelschap Leeghwater' will be kept informed by e-mail.

3.9 Rules and Regulations

Faculty regulations

- Students have to follow the instructions given by staff members. Staff members are those who support or give lectures and those who are responsible for buildings and the surrounding areas.
- On the first demand of a staff member the student should identify him- or herself by showing the campus card.
- The student should be present in time, before the start of a lecture, assignment, instruction or meeting. The lecturer or assistant may reject students who are late.
- Regular times for lectures to start are:

	start	end		start	end
1st lecture	8.45	9.30	5th lecture	13.45	14.30
2nd lecture	9.45	10.30	6th lecture	14.45	15.30
3rd lecture	10.45	11.30	7th lecture	15.45	16.30
4th lecture	11.45	12.30	8th lecture	16.45	17.30

- Bikes should be placed in the bike stands provided
- There is an opportunity to store personal belongings in lockers which are provided in the main hall. In the corridor situated next to lecture rooms A till F, bigger lockers can be used to store helmets. At the end of the study year, before the 15th of July, the lockers should be empty and the keys should be returned. Lockers, still in use after the 15th of July, will get a new lock on cost of the student.

- Eating and drinking is only allowed in the canteen, the coffee corner and in the immediate surroundings of a soda, candy, coffee or soup dispensers.
- Writing on, drawing on, sticking things on or scratching in furniture, walls, doors or windows is prohibited.
- Garbage and paper should be disposed in bins.
- For the use of computers, network connections, printers and plotters there are rules and regulations, which should be taken in consideration.
- Disobeying of rules and regulations can result in a suspension or a denial of certain facilities. Theft or destruction on purpose of properties of TU Delft and also serious misdemeanours (misdragingen) will be mentioned to the proper authorities.

Student Statute (Studentenstatuut)

The Education Specific Part Student Statute (OSDS) applies to the education and the exams of the study Mechanical Engineering. The OSDS comes into force on 1 September 2002.
The OSDS defines which educational services are given by the faculty and what is demanded from the students. The OSDS intends to offer the students an easy way to accomplish improvements in the educational situation, with help of the education director.

The OSDS consists of:

- This Study Guide
- The Course and Examination Regulations for the study Mechanical Engineering (CER, see appendix 6.3)
- Regulations and guidelines for the board of examiners (appendix 6.4)

Internet facilities

Using the internet facilities at the faculty is bound to some regulations:

<u>It is allowed to:</u>
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.

<u>It is not allowed to:</u>
Use available facilities in any other way as they were supposed to be used.
Make excessive use of the facilities
Let a third party use available facilities
Do damage or obstruct other users or equipment linked to the world wide web.
Become member of a mailing list outside the faculty without permission of the "dutwmail director". This rule only counts for the students.

4 Facilities

The locations of facilities, as mentioned in this chapter, can be found at the faculty map in appendix 6.8. In this study guide is being referred to this map, with a number and a letter, which corresponds to a certain part of the building. The floor is also indicated (BG= ground floor, 1st = first floor, etc.).

4.1 Lecture Rooms

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

Lecture Room	Capacity	Location
A	300	6, BG
B	200	6, BG
C	150	6, BG
D	150	6, BG
E	70	6, BG
F	70	6, BG
J	50	8D, 1st
K	30	8G, 1st
L	30	8G, 1st
M	20	8B, 4th

4.2 Student work facilities

Study places

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

Study places in the library

Besides the study places as mentioned above, there are also places to study in the library. Individual students can use these places. In the library students have to be silent. The same rules apply as for the study places.

4.3 Computer rooms

Besides computers at the different study places, there are computers available in the computer rooms. Each computer room is provided with a network printer. All computers give access to the internet. The computer rooms are sometimes in use for instructions or assignments. When they are, the computer rooms are not accessible for everybody. A schedule, on the door of each computer room tells when these instructions or assignments take place. If computer rooms are not in use for instructions or assignments, individual students can use them.
The next table shows all the computer rooms and their location.

Computer room	Location
Athena room	4, 1st
Parthemus room	4, 1st
Pallas room	4, 1st
IOP room	8G, BG

4.4 Research facilities

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

Laboratory of Dredging Technology and Bulk Transport

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

Mechanics of Materials Laboratory

Facilities Zwick 1474 en 1484 trekbanken
Metravib Dynamic Mechanical
Analyzer; DSC 2920 (thermische analyse)
Data acquisitie systemen (300 Hz en 100 kHz)
Isel XYZ tafel
online dichtheidsmeting
video+foto apparatuur
microscopen
ovens
autoclaaf
benodigdheden voor composietfabricage
smelt impregnatie opstelling
programmeerbare wikkelbank
Contact Laboratoriummanager mr. R. v.d. Boogaard
Phone: 015 27 89394 / 89424
Location: 5, BG, room 07

Tribolab

Facilities diverse tribologische meetopstellingen
Contact Laboratoriummanager mr. B. Hoevenaar
Phone: 015 27 86805
Location: 5, BG, room 16

Delft Bio-robotics Laboratory

Facilities Diverse typen bi-pedale robots voor de bestudering van lopen:
- Museon Walker: passief-dynamische ballistische loper

- BAPS: Pneumatisch bekrachtigde 3-D loper met 'vestibulary' feedback control, zonder knieen
- BOB: Pneumatisch bekrachtigde 3-D loper met reflexieve feedback, met knieen
- MIKE: Pneumatisch bekrachtigde 2-D loper met reflexieve feedback, met knieen
- Haptische feedback interfaces

Contact Laboratoriummanager: ir. M. Wisse
Phone: 015 27 86585
Location: 5, 1st, room 03-L

Engineering Dynamics Laboratory

Facilities A data aquisition system: PC and siglab 2042 aquisition box with 4 inputs, 2 outputs with a maximim measuring frequency of 20 KHz.
Accelerometers (charge and ICPs) for measuring signals from 0.002 to 2000 g, in the range of 2 to 10 KHz: 4 PCB 338M12, 1 PCB 353B33, 2 BK 4369
Impulse force hammer with ICP force transducer: PCB 086C03
Impedance head for acceleration and force measurement: PCB 288M25
ICP supply source and amplifier (4 channels), PCB 442B104
3 electrodynamical shakers
Software: Matlab, Siglab, Star modal analysis, Ansys
A droptest machine
A Dynamical Mechanical Analyzer (Metravib) for measuring viscoelastic properties of soft sample materials (belonging to the engineering mechanics group)

Contact Laboratoriummanager: ing R. v.d. Boogaard
Phone laboratory: 015 27 89394
Phone manager: 015 27 86739
Location: 5, BG, room 07

Laboratory for process equipment

Facilities Pilot scale research equipment and utilities
Analytical equipment
Computational Tools

Contact Laboratoriummanager: mr. J. v. Os
Phone: 015 27 86921
Location: API building, Leeghwaterstraat 44

AH laboratory

Contact Laboratoriummanager: mr. B v.d. Velden
Phone: 015 27 82892
Location: Leeghwaterstraat 21

EV/KK laboratory

Contact Laboratoriummanager: mr. M. de Groot
Phone: 015 27 81821
Location: Leeghwaterstraat 37b

4.5 Library

Central library

The library of the TU Delft consists of a main building and smaller libraries in each faculty. The main building has a large collection of books, reference books and magazines. The main part of the collection can be lent from the library, a smaller part is only available within the library. The main part of the collection has to be requested and will be available at the desk within half an hour after requesting. The other part, like study books and lecture notes, is available in the bookcases in the back of the building. The main building has more than 1000 study places (at the ground floor, on the different floors of 'the cone' and in a couple of group rooms), a computer room and coffee and candy dispensers.
To lend a book, a student should posses a library card. This pass can be acquired at the desk in the main building or at the library of the student's faculty.

Opening hours
Monday to Thursday 9:00 - 0:00
Friday 9:00 - 18:00
Saturday and Sunday 10:00 - 18:00

Book desk
Monday to Thursday 9:00 - 18:45
Friday 9:00 - 16:45
Saturday 10:00 - 12:45

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.

The central library is behind the auditorium (aula) at the Prometheusplein, see appendix 6.7.

Faculty Library

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

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

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

4.6 Selling point for lecture notes

Most lecture notes, which are used for lectures at the faculty, are for sale at the selling point for lecture notes.
Opening hours: Monday to Friday 12:00 - 15:00
Phone: 015 27 86766
The location is 10, 1st.

4.7 Mailbox and access to the internet

E-mail account

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

Printing

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

The services mentioned above are taken care of by:

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

ir.J. de Wilde:
Manager e-mail accounts
Phone: 015 27 83757
E-mail: j.dewilde@wbmt.tudelft.nl
Room: 7 – 1 – 120.

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

4.8 Available software

Software on the working places

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

	PC Rooms	Project tables		PC Rooms	Project tables
Data Analysis & Simulation Software			**Practical Software**		
Adams 10.1	x		Autocad 14	x	
Ansys 5.6	x		Autocad Lite 2002	x	x
GSP 9.101	x		BFP FlowSelect		x
Maple 7	x	x	Blok Coëfficiënt		
Matlab 6.1	x	x	Brooks		x
Pro Engineer 2000 i2	x		Card	x	
Grafic Software			Carene		
Coreldraw 9	x	x	CMS	x	x
Internet Software			Costcomp		x
Eudora 5.01	x	x	DelftShip		
Internet Explorer 6.0	x	x	Eagle 11.6		
WS_FTP LE	x	x	E Balans		
Program Languages			Evaluatie Design		
Borland Pascal 7.0	x		Freeboard		
Microsoft Visual Basic 6.0	x	x	Holtrop & Mennen	x	x
Tools			Massa Calculation		
Acrobat Reader 5.0	x	x	Mathcad 5.0	x	x
Flash	x	x	Microsoft Project		x
Mathtype 4	x	x	Pias		
Powerarchiver 6.1	x	x	REBISlite		x
Qres	x	x	SKF	x	x
Realplayer 8.0	x	x	Wtadsoc		x
Shockwave	x	x	**SKA**		
TAS	x	x			
TNT Lite	x	x	Microsoft Frontpage 2000	x	x
Wbalance	x	x	Microsoft Office 2000	x	x
Workpace	x	x	Sophos Antivirus	x	x

4.9 Catering

The faculty offers a variety of catering facilities.

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

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

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

Lagerhuysch The Lagerhuysch is situated in the cellar beneath section 8B. There is an access on the square in front of the faculty. The Lagerhuysch offers the possibility for giving graduation drinks (afstudeerborrels), but also for organising symposia and meetings. The students associations Gezelschap Leeghwater and William Froude regularly organise a reception.
On the site http://www.lagerhuysch.tudelft.nl a route description and a reservation form for the Lagerhuysch can be found.

Auditorium Within the TU Delft auditorium a variety of catering facilities is available. Lunch time is from 11.30 till 13.30, diner time from 16.30 till 19.30. See appendix 6.8 for the location of the auditorium.

5 TU - Services for students

The TU Delft provides several service centres for students:
- Student Service Centre (SSC)
- Sports Centre
- Cultural Centre TU Delft 'Mekelweg 10'
- Library TU Delft

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

Student Service Centre

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

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

Student Service Centre
Julianalaan 134
2628 BL Delft
Postbus 5
2600 AA Delft
Phone: 015 27 86311
Fax: 015 27 86498
http://www.ssc.tudelft.nl

Sports Centre

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

Also it is possible to use the facilities on an individual basis.

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

Cultural Centre TU Delft 'Mekelweg 10'

Anyone who likes to express oneself in an artistic manner can do this is at the Cultural Centre. There are numerous possibilities, differing between darkrooms to rehearsal and Dee Jay-studio.

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

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

ICT Infrastructure

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

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

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

6.1 Course descriptions

ae4-711	Sustainable development				
Lecturer	Mulder, K.F.				
Course material	Reader:Lucht- & Ruimtevaart in Duurzame Ontwikkeling, (in Dutch). Available at Aerospace Engineering. English course material is available on request. Non-dutch speaking persons can ask for a personal approach of this course.				
Description	This course covers the background of Sustainable Development in general engineering and the specific applications in aerospace engineering. The lectures give information about global problems like climate change, technology dynamics (e.g. How does technology develop? When will there be a new paradigm in aviation?), social dynamics (e.g. what drives man? Can behaviour be changed? Why is Schiphol Airport argued and not the Travel Agency?), economics equilling sustainability (e.g. Short Term versus Long Term profits), the justice system and sustainability (e.g. What is the use of International treaties and protocols concerning for instance climate or aviation?) and Worldwide Development of Countries (e.g. Can there be worldwide Sustainable Development without the developments of third world countries to the level of the Western World?).				
Education			**Credits**	**TU**	
Assesment				**ECTS**	

et3021wb	Electrical drives				
Lecturer	Bauer, dr. ir. P.				
Course material	Deleroi, W., "Electrical Drives"				
Description	Characteristics of machines, control possibilities of DC- and AC-machines, power electronic converters for use in drives with DC- and AC- motors, princips and conbinations as well as control of drives in combination with power converters, choise of drives				
Education	Lecture 0/0/3/0		**Credits**	**TU**	2.5
Assesment	Oral			**ECTS**	4

et4245wb	Electromechanical Systems				
Lecturer	Polinder, dr.ir. H.				
Course material	J.C. Compter, 'Mechatronics, Introduction to Electromechanics', dictaat Waarschijnlijk ook: Ned Mohan, 'Electric drives, an integrative approach', Minneapolis, Mnpere, 2001				
Description	Elektromechanica, magnetische circuits, permanente magneten, gelijkstroommotoren, borstelloze gelijkstroommotoren, aandrijvingen, lineaire motoren, uitvoeringsvormen, basisprincipes en begrenzingen				
Education	Lecture 0/0/0/3		**Credits**	**TU**	3
Assesment	Written / assignment			**ECTS**	4,5

mt212	Marine engineering B				
Lecturer	Klein Woud, prof. ir. J.				
Course material	J.Klein Woud, "Maritieme Werktuigkunde B", 2002.				
Description	Shafting dynamics, torsional and axial vibrations in (diesel engine) drive systems. Whirling vibrations. Shaft alignment. Flexible mounting of equipment. Vibration and noise isolation. Balancing of piston engines.				
Education	Lecture 2/0/0/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

mt213	Marine engineering C				
Lecturer	Grimmelius, ir.ing.H.				
Course material	Lecture notes				
Description	Maintenance concepts. Relation with Life Cycle Costs. Reliability, Availability. Fault tree analysis. Condition monitoring.				
Education	Lecture 0/2/0/0		**Credits**	**TU**	1
Assesment	Written			**ECTS**	1,5

mt215	Marine engineering A				
Lecturer	Klein Woud, prof. ir. J				
Course material	Klein Woud, J., Marine Engineering, Design of Propulsion and Electric Power Supply Systems				
Description	Propulsion Systems, diesel engines, gas turbines, transmission systems, controllable pitch opellers, matching machinery plant with propulsor, electric power generation.				
Education	Lecture 0/3/0/0	Test 0/2/0/0	**Credits**	**TU**	1.5
Assesment	Written			**ECTS**	2.25

mt216	Internal combustion engines				
Lecturer	Klein Woud, prof. ir. J.				
Course material	J. Klein Woud, Marine Engineering, Design of Propulsion and Electric Power Generation Systems				
Description	Piston Engines (Diesel and Otto) and gas turbines. Working principles. Indicator Diagram. Ignition and Combustion. Performance. Pressure charging. Introduction to thermodynamic analysis. Construction. Operating envelope. Fuels.				
Education	Lecture 0/0/0/4		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

mt518	Resistance and propulsion 1				
Lecturer	Terwisga, prof. dr. ir. T. van				
Course material					
Description					
Education	0/0/x/0		**Credits**	**TU**	1.5
Assesment				**ECTS**	2.25

mt518p	Tests resistance and propulsion 1				
Lecturer	Bom, ing. C.J.				
Course material	Handleiding practicum Weerstand en Voortstuwing zie Blackboard				
Description	Uitvoeren van de openwater schroef-, weerstands- en voortstuwingsproef in de kleine sleeptank van het laboratorium voor Scheepshydromechanica en cavitatie-inceptie proef in de cavitatietunnel achter de sleeptank.				
Education	0/0/x/0		**Credits**	**TU**	0.5
Assesment	Written report			**ECTS**	0.75

mt205	Project 2-4 Project Design Propulsion Plant				
Lecturer	Grimmelius, ing.ir. H.T, Frouws,ir. J.W., Dijkstra, dr. S. , Niet, ing. H. de				
Course material	Handleiding 'Project mtp204' Klein Woud, J., Stapersma, D., 'Marine Engineering, part I: 'Design of Propulsion and Electric power Generation Systems'				
Description	Voortstuwingssystemen, elektriciteitsopwekking, energiebalans, modelvorming, voortstuwingsregeling, simulatie, dynamisch gedrag, MarPol regelgeving, risicoanalyse, milieumaatregelen.				
Education	Lecture 0/0/0/x		**Credits**	**TU**	4
Assesment	Rapport			**ECTS**	6

st310	Thermodynamics of mixtures				
Lecturer	Kooi, dr.ir. H.J. van der				
Course material	J.M.Smith, Introduction to Chemical Engineering Thermodynamics, 4th edition				
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 0/0/2/2		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

tn3111wb	System Identification				
Lecturer	Hof, dr. ir. P.M.J. van den				
Course material	Lecture Notes: P.M.J. Van den Hof, "System Identification", 1998				
Description	Experimental modelling of dynamical systems; methodology. Discrete-time signals and system analysis. Identification of transfer functions. Representations of linear models; black-box models; parametrised model sets. Identification by prediction error minimization; least squares methods. Approximate modelling; algorithms. Experiment design and data analysis; identification from closed loop data; model validation. MATLAB toolbox.				
Education	Lecture 0/0/2/2		**Credits**	**TU**	5
Assesment	Oral			**ECTS**	7,5

wb1310	Multibody dynamics A				
Lecturer	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 0/0/0/2	Other: 4	**Credits**	**TU**	2
Assesment	Written	Lab report		**ECTS**	3

wb1406	Experimental mechanics				
Lecturer	Booij, J. MSc., Woerkom, dr.ir. P.Th.L.M. van				
Course material	Directly via lecturer				
Description	Measurement of strains and changes of shape that result from static loading, role of experimental mechanics, underlying principles. Strain gages, photoelastic coatings, thermoelastic method, pattern methods with light, laser light methods, comparison of methods. Measurement of response to dynamic loading: modal analysis, registration of the response, signal conditioning, determination of parameters, and applications.				
Education	Lecture 0/0/2/2	Other: 15 hours	**Credits**	**TU**	2
Assesment	Oral			**ECTS**	3

wb1409	Theory of elasticity				
Lecturer	Keulen, prof. dr. ir. A. van				
Course material	Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall, New York, 1965 M.E. Gurtin, An Introduction to Continuum Mechanics, Mathematics in Science and Engineering, vol. 158, Academic Press, New York, 1982 I.S. Sokolnikoff, Mathematical Theory of Elasticity, McGrawHill, 2nd edition, New York, 1956 R.W. Ogden, Nonlinear elastic deformations, Ellis Horwood Ltd., 1984				
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	Other: 2	**Credits**	**TU**	2
Assesment	Oral	Excersises		**ECTS**	3

wb1410	Continuum mechanics				
Lecturer	vacancy				
Course material	Lecture notes				
Description	This course is concerned with modelling of matter in terms of a continuum. This type of modelling is central to basically all types of models/"theories" for the behaviour of solids and fluids which are presently in use in mechanical engineering. This course demonstrates the unification implied by continuum theory. At the same time, the physical assumptions that underly continuum modelling are emphasized, as well as the corresponding ranges of applicability. The fully general features concerning the behaviour of a continuous medium are emphasized: deformations, stresses, balance equations. But, the course also addresses the way in which the variety of behaviour of materials is accounted for through so-called constitutive models. The similarities and differences between solids and fluids are discussed.				
Education			**Credits**	**TU**	3
Assesment	Oral	Excersises		**ECTS**	5

wb1413	Multibody 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	Other: 2	**Credits**	**TU**	2
Assesment	Essay			**ECTS**	3

wb1427	Advanced Fluid Dynamics				
Lecturer	Delfos, dr. R., Nieuwstadt, prof.dr.ir. F.T.M.				
Course material	Dictaat Stromingsleer Voortgezette Cursus A (wbmt 1422A), in PDF-formaat downloadbaar. G.K. Batchelor, Introduction to Fluid Dynamics, Cambridge University Press.				
Description	Stromingsleer, Kinematica, Dynamica, Bewegingsvergelijkingen, Continuïteitswet, Spanning-Vervormingssnelheidsrelatie, Navier-Stokes vergelijkingen, Potentiaaltheorie, Grenslaagtheorie, Stokes stroming				
Education	Lecture 2/2/0/0	Other: 3	**Credits**	**TU**	3
Assesment	Schriftelijk			**ECTS**	4.5

wb1440	Engineering optimization				
Lecturer	Keulen, prof.dr.ir. A. van				
Course material	P.Y. Papalambros et al. Principles of Optimal Design: Modelling and Computation				
Description	Formulering van het optimalisatieprobleem: ontwerpvariabelen, doelfunctie en constraints Minimalisatie zonder nevenvoorwaarden, Lineair programmeren: simplex methode, interieur methoden, gevoeligheidsanalyse, dualiteit, Minimalisatie met nevenvoorwaarden: noodzakelijke en voldoende voorwaarden, gevoelig- heidsanalyse, SQP, penalty functie methode, Nulde orde methoden: Nelder Mead, simulated annealing, genetische algoritmes, Geheeltallige en discrete programmering: branch and bound methoden, Inleiding FE-optimalisering				
Education	Lecture 2/2/0/0	Test: 2 hrs	**Credits**	**TU**	2
Assesment				**ECTS**	3

wb2301	System identification and parameter estimation				
Lecturer	Helm, Prof.dr. F.C.T. van der				
Course material	Dictaat Signaalanalyse, Van Lunteren / Dankelman (in Dutch) Dictaat Systeemidentification A Overheads Demonstration programs in Matlab				
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		**Credits**	**TU**	
Assesment	Report	Oral		**ECTS**	

wb2303	Measurement theory and praxis				
Lecturer	Teerhuis, ir. P.C., Grimbergen, prof.dr.ir. C.				
Course material					
Description	Statical and dynamical performance of mechanical measurement systems. Motion and dimensional measurement devices. Force, torque, pressure and temperature measurement devices. Conditioning, transmission and manipulation of measurement data.				
Education	Lecture 2/2/0/0		**Credits**	**TU**	2
Assesment	Oral			**ECTS**	3

wb2305	Digital control				
Lecturer	Dijkstra, dr. S.				
Course material	K.J. Åström, B.Wittenmark 'Computer-controlled Systems, Prentice Hall ,1990, 2nd edition				
Description	Computer control. Sampling of continuous-time signals. The sampling theorem. Aliasing. Discrete-time systems. State-space systems in discrete-time. The z-transform. Selection of sampling-rate. Analysis of discrete-time systems. Stability. Controllability, reachability and observability. Disturbance models. Reduction of effects of disturbances. Stochastic models.Design methods. Approximations of continuous design. Digital PID-controller. Stata-space design methods. Obvservers. Pole-placement.Optimal design methods. Linear Quadratic control. Prediction.Minimum-variance control. LQG-control.Implementational aspects of digital controllers.				
Education	Lecture 0/4/0/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb2308	Biomedical engineering design				
Lecturer	Plettenburg, dr.ir. D.H.				
Course material	Just L. Herder, Dick H. Plettenburg, reader: "Ontwerpen in de medische techniek"				
Description	Medical systems design, Diagnosis; Treatments, Orthopaedics, Rehabilitation				
Education	Lecture 2/0/0/0		**Credits**	**TU**	3
Assesment	Project			**ECTS**	5

wb2309	Introduction specialization MMS				
Lecturer	Wieringa, Prof.dr.ir. P.A.				
Course material	G.L.M. Passier, Graduation guide section Man Machine Systems (until 96/97), 1999 Handouts				
Description	Introductie sectie en vakgebied MMS, toelichting verplichte en keuzevakken hoofdvak MMS, toelichting afstudeerverplichtingen presentatie onderzoeksprojecten				
Education	Lecture x/x/0/0	Excursions	**Credits**	**TU**	0.5
Assesment				**ECTS**	1

wb2311	Introduction Modelling				
Lecturer	Bosgra, prof. ir. O.H., Vergouwen, ir. F.J., Kramer, dr. ir. H.J.M.				
Course material	O.H. Bosgra, Modelling of Dynamic Process systems Course notes for wb2405 Preliminary version, 120 pages, 1994 Revised version January 1996				
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		Credits	TU	2
Assesment	Oral			ECTS	3

wb2400	Proces Control				
Lecturer	Dijkstra, dr.S.				
Course material	-Copies of the powerpoint slides are available. -The examples for the simulations with explanation are available as hard copy and 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		Credits	TU	2
Assesment				ECTS	3

wb2402	Hydraulic servo systems				
Lecturer	Teerhuis, ir. P. C.				
Course material	T.J.Viersma. Analysis synthesis and design of hydraulic servo systems and pipeline Blackburn, Reethof and Shearer, Fluid power control, Wiley and Sons				
Description	Dynamic behaviour of hydraulic servo systems Design of (low function) servo systems Hydraustatic bearings, hydraulic line dynamics				
Education	Lecture 0/0/2/2		Credits	TU	2
Assesment				ECTS	3

wb2404	Man-machine systems				
Lecturer	Wieringa. Prof. dr. ir. P.A.				
Course material	Syllabus Handouts				
Description	Menselijke supervisie, fouten en betrouwbaarheid, human operator model, beslissingsondersteunend systemen				
Education	Lecture 2/2/0/0		**Credits**	**TU**	3
Assesment	Oral			**ECTS**	4,5

wb2407	Human movement control				
Lecturer	Helm, prof.dr. F.C.T. van der				
Course material	Reader: Human movement control Hand outs				
Description	1. Introduction, joints, ligaments, muscles. 2. Three-dimensional motion description, Euler angles, helical axis. 3. 3-D motion recording. 4. Muscle properties, muscle models. 5. Musculo skeletal models, parameters, EM6-recordings. 6. Inverse dynamics, forward dynamics, optimization. 7. Motion control, stabilization. 8.'Equilibrium point' hypothesis. 9. Internal representation, adaptive model reference control. 10. Proprioceptive, muscle spindles, Golgi tendon organs. 11. A-reflexive muscles, reflexive muscles, neural transmission delays. 12. Muscle stiffness, joint stiffness, stabilization. 13. Applications tot the human arm, shoulder and elbow. 14. Artificial neural networks as a model of the central nervous system. 15. Comparison with robotics.				
Education	Lecture 0/4/0/0/0		**Credits**	**TU**	3
Assesment	Oral			**ECTS**	4,5

wb2408	Fysiological systems				
Lecturer	Dankelman, prof. dr. J., Grimbergen, prof. dr. ir. C.A.				
Course material	J. Dankelman, C.A. Grimbergen, Fysiologische Systemen (Physiological Systems) lecture notes				
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 2/2/0/0/0		**Credits**	**TU**	2
Assesment	Oral			**ECTS**	3

wb2413	Instrumentation in the process industry				
Lecturer Course material	Weiden, dr. ir. A.J.J. van der				
Description	The course is divided in several blocks. First a industrial example will be given to show the different procedures necessarily to start a design cycle and disciplines which might be involved. Planning will be a subject to be focussed on. The main topics in the second block of lectures are Process Control and Instrumentation. Special attention will be given to e.g. split range and selective control and the principles of measuring, valves types and their application. In the third block further details for instrument engineering shall be provided such as the level of automatisation and the systems which might be used. Other subjects in this block are e.g. instrumentation and supply systems, fire and gas detection and explosion danger. In the fourth block different distributed process control and information management systems are treated.				
Education Assesment	Lecture 0/0/2/2		Credits	TU ECTS	2

wb2414	Mechatronical design				
Lecturer Course material	Teerhuis, ir. P.C.				
Description	Modellen van mechanische systemen. Dynamisch gedrag, eigenfrequenties, demping. Overdrachtsfuncties. Actuatoren: hydraulische, pneumatische en (vooral) elektrische. Sensoren: positie, kracht, snelheid en versnelling. Regeling				
Education Assesment	Lecture 2/2/0/0		Credits	TU ECTS	2 3

wb2420	Control theory				
Lecturer Course material	Bosgra, prof.ir. O.H., Vergouwen, ir. F.J. 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 Assesment	Lecture 4/0/0/0		Credits	TU ECTS	4 6

wb2421	Multivariable control systems				
Lecturer	Weiiden, dr.ir. A.J.J. van der				
Course material	Multivariable Feedback Control Analysis and Design. S.Skogestad, I.Postlethwaite. John Wiley & Sons, ISBN 0-471-94330-4 , and Lecture notes				
Description	Review of single loop feedback design using frequency domain methods. Poles, zeros and stability of multivariable feedback systems. Decoupling by state-feedback for linear as well as nonlinear systems. The robust servomechanism problem for multivariable systems: asymptotic tracking of reference signals in the presence of disturbances. Nyquist-like multivariable design techniques: the characteristic-locus method and Nyquist-array methods. Performance and robustness of multivariable systems. The use of singular values for assessing performance; generalization of the classical control theory. Representations of model uncertainties. The use of the H-infinity norm and the structured singular value to analyse robust stability and robust performance. The choice of suitable weighting functions to specify performance for obtaining an H-infinity controller.				
Education	Lecture 0/0/4/0		**Credits**	**TU**	4
Assesment	Oral and exercises			**ECTS**	6

wb2422	Modeling 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	Assignment: 10x 4	**Credits**	**TU**	4
Assesment				**ECTS**	6

wb2423	Introduction Project SC				
Lecturer	Teerhuis, ir.P.C., Weiden, dr.ir.A.J.J. van der				
Course material	Lecture notes				
Description	To achieve good controller designs it is necessary to connect theory with problems of practical interest. 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.				
Education	Project x/0/x/0		**Credits**	**TU**	
Assesment				**ECTS**	3

wb2425	Integration Project				
Lecturer	Huesman, 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	Project x/x/x/x		**Credits**	**TU**	4
Assesment				**ECTS**	6

wb2427	Predictive Modelling				
Lecturer	Eijk, prof. dr. ir. J. van				
Course material	Lecture notes				
Description	Mechatronisch ontwerpen, gedrag voorspellend ontwerpen, systeem ontwerp, modelleren, simuleren, dynamisch gedrag, modaal analyse, servo systemen, machine dynamica				
Education	Lecture 0/0/4/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb2428	Mechanical construction principles				
Lecturer	Soemers, dr.ir. J.				
Course material	Lecture notes				
Description	Mechatronisch ontwerpen, mechanisch, constructies, stijfheid, kinematica, mechanismen, ontwerpen, systeem ontwerp, finite element modelling, dynamisch gedrag				
Education	Lecture 4/0/0/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb2430	Mechatronic Project				
Lecturer Course material	Teerhuis ir.P.C., Spronck ir.J.W.				
Description	Aandacht wordt besteed aan het leren mechatronisch te denken, te werken en te communiceren. De stof zoals behandeld in de hoofdvakcolleges van Systeem en Regeltechniek en van Advanced Mechatronics wordt getoetst en toegepast op verschillende opstellingen uit het lopende onderzoek. De studenten krijgen een opdracht en zullen zelf actief zijn op uiteenlopende werkgebieden zoals: predictive modelling, analyseren, modelleren, simuleren, ontwerpen, construeren, experimenten, meten, regelen, communiceren en verslaglegging				
Education Assesment	Project in all semesters Report		Credits	TU ECTS	6 9

wb2431	Bone mechanics and implants				
Lecturer Course material	Linden, mw. Dr. J. van der, Valstar, dr.ir. E.R. S.C. Cowin, Bone Mechanics Handbook, CRC Press, Boca Raton, Fl, 2001. R.B.Martin, D.B Burr, Skeletal Tissue Mechanics, Springer, New York Bucchorn and Willert, Technical Principles, Design and Safety of Joint Implants,				
Description	In this course you will learn about the biomechanical behaviour of bone as the main load-bearing constituent of the skeleton, and how bone is replaced by implants such as joint replacement prostheses. Topics covered are: Bone microstructure and bone cell biology, Anisotropic elasticity and strength, composite models, damage mechanics, bone remodelling theories, tissue differentiation theories, mechanobiology of bone cells, bone prostheses and tissue-engineered bone				
Education Assesment	Lecture 0/2/2/0 Oral		Credits	TU ECTS	2 3

wb2432	Biomechatronics				
Lecturer Course material	Helm, prof.dr.ir. F.C.T. van der, Plettenburg, dr. ir. D.H., Herder, dr. ir. J.L. Lecture notes				
Description	Biomechatronica is een samentrekking van biomechanica en mechatronica. In dit vak staat het functioneren en coördinatie van het bewegingsapparaat centraal, en het ontwerpen van hulpmiddelen ter ondersteuning van de functies van het bewegingsapparaat. Voorbeelden zijn hulpmiddelen zoals een orthese, prothese of spierstimulatie die gebruikt kunnen worden om patiënten waarbij onderdelen van het bewegingsapparaat niet meer optimaal werken, weer een functie terug te geven.				
Education Assesment	Lecture 0/0/2/2		Credits	TU ECTS	3 4.5

wb3303	Mechanisms				
Lecturer	Klein Breteler, dr.ir. A.J.				
Course material	Lecture notes Part 1: theory Lecture notes Part 2: user manual of computer program				
Description	Kinematics, kinetostatics and dynamics of (co-planar) mechanisms, kinematic optimization, numerical method (FEM), system drive and mechanism and process.				
Education	Lecture 0/0/2/2		**Credits**	**TU**	2
Assesment	Excersise			**ECTS**	3

wb3406A	Introduction transportation engineering				
Lecturer	Drenth, ir. K.F., Klein Breteler, dr. ir. A.J., Rijsenbrij, prof. ir. J.C.				
Course material	C. Spaans, Bandtransporteurs. P. Aberkrom, Discontinu transport. C. Pajer e.a.; Grundlagen der Fördertechniek.				
Description	Description of transportation. The importance of transport for the Dutch economy and employment. Manifestation of goods. Containers and bulk materials. The increase of container streams. Container terminals and equipment for container handling. A selection of dynamic problems in equipment. Bulk terminals and equipment for the handlingof bulk materials. Continuous and discontinuous transhipment. Interaction between bulk material and equipment. Spill, dust, wear and noise. Belt conveyors: basics, design and construction. Same for screw conveyors. Planetary gears, design and application in equipment. Environment, energy consumption and transportation.				
Education	Lecture 2/2/0/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb3406B	Transport engineering and crane design				
Lecturer	Gerstel, dr.ir. A.W.				
Course material	Gerstel, A.W.: "Transport Engineering and Crane Design. Drawings and annotations", 3rd edition				
Description	Containerterminals, container- and crab loading and unloading gantrycranes, trolley-cable systems, lay-out front-reach support, luffing cranes, design of crane details, engineering standards, dynamics, windforces, crack and folding of bars and plates, rail-wheel concept, hoisting and travelling cables, box girders				
Education	Lecture 0/0/2/2	Other 0/0/2/2	**Credits**	**TU**	2.5
Assesment	Oral			**ECTS**	4

wb3407A	Introduction logistics				
Lecturer	Lodewijks, prof.dr. G., Mensch, ir. T.C.A., Ottjes, dr.ir. J.A.				
Course material	H.M. Visser and A.R. van Goor, 'The practice of logistic engineering' J.J. Coyle, E.J. Bardi en C.J. Langley Jr, The management of business logistics Handouts				
Description	Basic concepts of logistics; Production, distribution and transport from a logistical point of view. Product model. Inventories; production planning; forecasting; inventory management. Logistic chains. Allocation of capacity.				
Education	Lecture 0/0/2/2		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb3408	Dredging design				
Lecturer	Vlasblom, Prof.ir. W.J.				
Course material	Syllabus				
Description	Het ontwerpen van baggerwerktuigen op basis van de kennis van baggerprocessen. Toepassingsgebied en technische afbouw van de bekende baggerwerktuigen. Produktieramingen en werktuiggerelateerde baggerprocessen. Instrumentatie en automatisering.				
Education	Lecture 0/0/2/2		**Credits**	**TU**	2.5
Assesment	Written or Oral			**ECTS**	3.75

wb3410	Large scale transport systems				
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 0/0/2/0		**Credits**	**TU**	1
Assesment	Written			**ECTS**	2

wb3413	Dredging processes 1				
Lecturer	Vlasblom, prof.ir. W.J., Miedema, dr.ir. S.A., Matousek, dr.ir. V.				
Course material	Syllabus Vlasblom, collegebook wb3408B Miedema, dissertation				
Description	Soil mechanical properties of sand, clay and rock Description of the cutting process Cutting theories of sand, clay and rock Breaching and erosion of sand Loading process of hopperdredgers Sedimentation process Modelling of overflow losses Case studies				
Education	Lecture 2/2/0/0		**Credits**	**TU**	2.5
Assesment	Written			**ECTS**	4

wb3414	Dredging processes 2				
Lecturer	Vlasblom, prof.ir. W.J., Miedema, dr.ir. S.A., Matousek, dr.ir. V.				
Course material	Vlasblom, Matousek, collegebook				
Description	1 Pumps and engines - Centrifugal dredge pump, Pump characteristics and cavitation, Influence of particles on the pump characteristics 2 Hydraulic transport by pipeline - 2-flow through pipelines, Newtonian fluids, Non Newtonian fluids, Inclined pipelines and long pipelines, Measurements and wear 3 Pump pipeline systems - Operation point and area's, Production factors 4 Case studies				
Education	Lecture 0/0/2/2		**Credits**	**TU**	2.5
Assesment	Written			**ECTS**	4

wb3415	Simulation of transport systems with Adams				
Lecturer	Verheul, ir. C.H.				
Course material	ADAMS Starters Course Manual				
Description	Mechanica, kinematica, dynamica, multibody systemen, multibody dynamics software, transportsystemen, overslagkranen, bandtransporteurs, ontwerpproces				
Education	Lecture 0/0/2/0		**Credits**	**TU**	1
Assesment				**ECTS**	2

wb3416	Design with Finite Element Method				
Lecturer	Bos, ir. W.v.d., Gerstel, dr.ir. A.W.				
Course material	Bos, W. van den, Collegedictaat "Ontwerpen met eindige elementen", 2000				
Description	Eindige elementen methode, ontwerpen, transporttechniek, kranen, mechanica, modelleren				
Education	Lecture 0/0/2/0		Credits	TU	1
Assesment	Assignment			ECTS	1

wb3417	Discrete systems: modelling, prototyping, simulation & control				
Lecturer	Ottjes, dr. ir. J.A., Veeke, ir. H.P.M., Sopers, ir. F.P.M., Duinkerken, ir. M.B.				
Course material	hand outs				
Description	This is a course on the modeling of discrete systems for transport and production. It deals with a method to quickly design flexible prototype models and to implement them in a simulation environment. The method is based on the systems approach in combination with process-orientated modeling. Special attention is paid to the modeling of controls and the use of these models for real-time control. A number of practical examples, including a production process, a transport system and a port will be considered. The first part of the course ends with a written test. Those who have attained a satisfactory result will be admitted to second part of the course. This takes the form of a practical. The students, working in project groups, develop models of realistic cases. Following on from this, a model or part thereof is implemented in a distributed simulation environment (Tomas: see www.tomasweb.com).				
Education	Lecture 2/2/0/0		Credits	TU	2
Assesment	Written	Assignment		ECTS	3

wb3419	Characterization & handling bulk solid materials				
Lecturer					
Course material					
Description					
Education			Credits	TU	
Assesment				ECTS	

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; Chapters 7, 12 Scheidingsprocessen; chapters 1, 2, 4, 6, and "bijlagen " I, III, IV.				
Description	diffusion, convective mass transfer, absorbers, strippers, extractors, convective heattransfer, condensation, boiling, tube heatexchangers, plate heatexchangers, condensors, evaporators, materials of construction.				
Education	Lecture 2/0/0/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb4300B	Introduction to pumps and compressors				
Lecturer	Infante Ferreira, dr. ir. C. A.				
Course material	Touber, S., "Pompen en compressoren", collegedictaat, Faculteit WbMT, TUD, 1996.				
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 0/0/0/2/0		**Credits**	**TU**	1
Assesment	Written			**ECTS**	2

wb4302	Thermodynamics of energy conversion				
Lecturer	Woudstra, ir. N.				
Course material	Lier, Prof.ir. J.J.C. van, Energietransformaties, deel I: de grondslagen van de thermodynamica Lier, Prof.ir. J.J.C. van, Thermodynamische processen in de centrale en mogelijkheden tot het verbeteren van deze processen Thermodynamische aspecten bij energie-omzettingen. Deel 2: Koelmachines en warmtepompen				
Description	Thermodynamics, energy conversion, exergy, exergy analysis, value diagram, exergy of fuel, power cycles, steam turbine systems, gas turbine systems, combined cycles, combined heat and power production, fuel cell systems, refrigeration cycles, heat pumps, gas expansion cycles, liquefaction of gasses, absorption cycles				
Education	Lecture 4/0/0/0		**Credits**	**TU**	3
Assesment	Written			**ECTS**	5

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 0/0/4/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb4422	Thermal Power Plants				
Lecturer	Spliethoff, prof.dr. H.				
Course material	Copies of the sheets 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	Other: '	**Credits**	**TU**	3
Assesment	Written			**ECTS**	4.5

wb4423	Modelling and Simulation of Energy Conversion Systems				
Lecturer	Colonna, dr. P.				
Course material	Course notes for wb4423, PowerPoint presentation, Home page section Thermal Power Engineering				
Description	Physical modeling of dynamic systems, Law of Conservation, Extensive and Intensive Equations, Lumped versus CFD modeling, Energy Conversion Systems, Two-faze equations, Heat Transfer, Numerical Integration of Stiff Systems, Module compatibility, Property Databases, Higher Level Simulation Languages, Real Time Simulation, Software Packages, Reliability Results, Simulators, Examples: Energy Conversion Systems.				
Education	Lecture 0/0/4/0		**Credits**	**TU**	2
Assesment	Oral			**ECTS**	3

wb5428	Applied systems theory				
Lecturer	Dekkers, ir.R.				
Course material	- Prof. ir. J. in't Veld, Analyse van Organisatie Problemen, Stenfert Kroese, 1998, ISBN 90-11-045947 -Syllabus Wb5100				
Description	- What is systems engineering? What does systems engineering apply to? - Systems engineering notions : system, element, characterization, relationships, environment, sub and aspect systems, system state, contents and structure, process, behavior, goal/objective, function, task, system, environment, system boundary, system objective, importance of and methods for target specification. Black box approximation. Principle of indetermination of a structure, levels of aggregation, zooming in and out.				
Education	Lectures: four hours in the first two weeks of the semester, further 2/0/0/0		**Credits**	**TU**	1
Assesment	Written, Report, Presentation			**ECTS**	1,5

wb5201	Power Drives				
Lecturer	Werff, Prof. Dr. Ir. K. van der				
Course material	K. van der Werff, Aandrijfsystemen				
Description	Characteristics of driven systems: Production machines, transport equipment, hoist and lifting machines, robots, pumps, etc. Characteristics of driving machines: Wind- en water mills, internal combustion engines, turbines, electric motors and hydraulic drives. Transmissions: Function and use of transmissions. Clutches and brakes. Gear transmissions. Variable transmissions. Examples of complete systems: Hand drilling machine incl. Thermal behavior. Centrifugal pump + asynchronous machine + piping. Boiler feed pump installation. Treatment including: Modeling and simulation. Dynamic behavior: Simple Torsion vibration calculations for multiple degrees of freedom systems. Transformation of Torque and Inertia. Dynamic motor models. Examples: Dynamics stone crusher, dynamics asynchronous machine.				
Education	0/0/2/2		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb5303	Tribology				
Lecturer	Beek, dr.ir. A. van				
Course material	Beek, dr. ir. A. van, Book "Tribology / Lifetime and Performance", 278 pp.				
Description	The machine runs, but for how long and what amount of maintenance is required, what machine temperatures will occur? In this coarse the fundamental aspects of lifespan and performance of machines and mechanisms are treated, that is tribology. Subjects included are friction, frictional heating, loadability, stick-slip, accuracy, wear, reliability, maintenance, lubrication and material selection				
Education	Lecture 2/0/0/0	E-learning 2/0/0/0	**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb5412	Micro Engineering				
Lecturer	Pistecky, ir.P.V.				
Course material	P.V. Pistecky, Micro-techniek, Constructie-elementen, part I en II, course book TU Delft, Faculty WbMT				
Description	Introduction in the field of micro engineering. Description of typical products. Actuators and sensors in micro engineering. Magnetic circuits. Optical components. Bearings in micro engineering, micro manipulators. Analysis of friction, precision and reliability. Spring elements. Finite element method as a design tool. Micro engineering in medical instrumentation.				
Education	Lecture 2/2/2/0/0		**Credits**	**TU**	2
Assesment	Written	Excersise		**ECTS**	3

wb5414	Design of machines and mechanisms				
Lecturer	Crone, prof.ir. H.A., Werff, prof.dr.ir.K. van der				
Course material	lecture notes wb5414				
Description	mechanization of production, diagram of motion, diagram of goalfunctions for the mechanisms in a machine, synthesis and analysis of linkages and cam-mechanisms, PLC, Grafcet diagram, electrical drives				
Education	Lecture 2/2/2/0		**Credits**	**TU**	3
Assesment	Written	Excersise		**ECTS**	5

wb5415	Maintenance technology				
Lecturer	Smit, prof.ir. K.				
Course material	Smit, K; Maintenance Management, Faculty of Mechanical Engineering, 1989.				
Description	maintenance characteristics and maintenance concepts of technical systems, design for maintenance, workflow control, shutdown scheduling, control of spareparts and technical purchasing, organization structures for the engineering maintenance function, evaluation of maintenance processes, information for maintenance control.				
Education	Lecture 2/2/0/0		**Credits**	**TU**	1.5
Assesment	Written			**ECTS**	3

wb5417	Innovation of manufacturing				
Lecturer	Steinhoff, K.				
Course material	Lecture notes: wb5417 Innovations in manufacturing				
Description	Introduction, aims of course, procedures, aims andprinciples of technological innovation, attention points in implementation of technological innovations, consulting hours, oral presentations by student groups				
Education	Lecture 0/2/2/0		**Credits**	**TU**	2
Assesment	Written			**ECTS**	3

wb5420	Design of production systems				
Lecturer	Meijer, ir B.R., Neve, ir. J., Tichem, dr.ir. M.				
Course material	Rembold U., Nnaji B.O., Storr A., "Computer Integrated Manufacturing and Engineering", 1994				
Description	Organization of the manufacturing processes, automation possibilities and integration of activities with the aim of maximizing the effectiveness of these processes. The change and effect of customer orders on product variety and product life cycle imposes new demands on the manufacturing processes, e.g. quality improvement, shorter design lead-times, shorter manufacturing lead-times and reduction of costs. This can be done with the aid of new technology, computer integrated manufacturing which combines the three primary processes (design and process planning, production control and scheduling and the manufacturing process) and integrates them on two area's, the material flow and the information flow. The requirements of each primary process will be treated, the way to integration (by structuring, automation and integration) and how to implement CIM with the aid of system- and reference models.				
Education	Lecture 4/0/0/0	Other: 2.0	**Credits**	**TU**	3
Assesment	Written	Laboratory Projects		**ECTS**	4.5

wb5421	Modelling of manufacturing				
Lecturer	Luttervelt, ir. C.A. van, Steinhoff, dr.ir. K., Hoogstrate, dr.ir. A.M.				
Course material	Lecture notes				
Description	afstemming van bewerkingen en behandelingen binnen een fabricagemethode, modellen van bewerkingen, begrenzingen van bewerkingen, begrenzingen van de maakbaarheid, milieuvriendelijk fabriceren				
Education	Lecture 0/0/0/2		**Credits**	**TU**	1
Assesment	Written			**ECTS**	1.5

wb5422	Industrial assembly				
Lecturer	Tichem, dr.ir. M.				
Course material	Reader				
Description	Characteristics of assembly in different segments (capital goods, consumer products, electronic assembly, micro assembly), The assembly process, Industrial assembly technology, programming and control (follow-up of wb5420), Laboratory exercise: programming of a robot cell with sensor feedback, Concepts for assembly systems, internal logistics, Design For Assembly (DFA), including case study, Micro-assembly				
Education	Lecture 0/0/2/0	Laboratory Project	**Credits**	**TU**	1
Assesment	Written	Case Study		**ECTS**	1.5

wb5425	Fundamentals of machine tools				
Lecturer	Karpuschewski, prof. dr. ing. habil. B.				
Course material	reader				
Description	Introduction to machine tool industry economic relevance structure guideways drives control dynamic behaviour				
Education	Lecture 0/0/0/2		**Credits**	**TU**	1
Assesment	Written			**ECTS**	1.5

wb5426	Capita selecta PTO				
Lecturer	Tichem, dr. ir. M.				
Course material	Hand-outs				
Description	Sprekers vanuit de industrie presenteren verschillende actuele onderwerpen vanuit het vakgebied van de productietechniek en de productieorganisatie. Hierdoor komen onderwerpen aan bod die niet tot het standaard curriculum van PTO behoren. Het feit dat de sprekers vanuit eigen ervaring praten geeft duidelijke meerwaarde. Per jaar worden de sprekers geselecteerd. Voorbeelden van onderwerpen dia aan bod komen zijn: organisatie van ontwerpprocessen, data management, technology management, kwaliteitsbeheersing, productielogistiek, opstarten van de productie, optimalisatie van complexe productiesystemen e.d.				
Education	Lecture 0/3 or 4/0/0		**Credits**	**TU**	1
Assesment	Presentation or report			**ECTS**	1.5

wm0504tu	Industrial organisation A				
Lecturer	Bikker, prof. ir. H., Haaf, ir. W. ten, Sopers, ir. F. Sopers				
Course material	Dictaat wm0504TU, Industriële organisatie A, versie 1997/1998 Veld, J. in 't (1992). Analyse van organisatieproblemen. 6th edition				
Description	Het college Industriële organisatie A vormt het vervolg op het college Inleiding in de bedrijfsleer (wm0501TU), dat een brede kennismaking biedt met de wijze waarop (productie-)organisaties binnen de maatschappelijke context functioneren, met de processen die zich binnen organisaties afspelen en met de rol die de techniek, bepaalde technieken en de ingenieur daarin kunnen spelen. Het college Industriële organisatie A gaat dieper in op de industriële voortbrenging zelf. Op welke verschillende manieren kunnen productieprocessen worden ingericht en georganiseerd? Wat kan worden gedaan om deze processen productief, effectief en efficiënt te laten verlopen? Welke rol speelt de mens daarin en hoe kan daarmee rekening worden gehouden?				
Education	Lecture 4/0/0/0		**Credits**	**TU**	2
Assesment				**ECTS**	3

wm0505tu	Industrial organization B				
Lecturer	Haaf, ir. W. ten				
Course material	Dictaat wm0505TU, Industriële organisatie B, versie 2001/2002 Senge, Peter M., De vijfde discipline, De kunst & praktijk van de Lerende Organisatie, 1992				
Description	Capita selecta van de bedrijfsleer. Elk jaar wordt door de docent een belangrijk boek op het gebied van de bedrijfsleer gekozen. Dat boek wordt intensief bestudeerd. Verder zijn er aan het vak 5 oefenmiddagen verbonden: 2 middagen over de benadering van het kostprijsvraagstuk vanuit de Delftse School voor Bedrijfskunde en 3 middagen over de Strategie Evaluatie Methode.				
Education	Lecture 0/0/7/0		**Credits**	**TU**	2
Assesment	Presentation			**ECTS**	3

wm0605tu	Elementary business economics				
Lecturer	Storm, dr. S.				
Course material	A.M.M. Blommaert en J.M.J. Blommaert (2000) Bedrijfseconomische analyses. Bedrijfseconomie vanuit managementperspectief, Houten: EPN. ISBN 90 11 056167.				
Description	Bedrijfseconomie is een tak van sport waar iedere afgestudeerd ingenieur mee te maken krijgt, of hij / zij nu wil of niet. Om te komen tot een goede afweging en een juiste beslissing te kunnen maken is het noodzakelijk dat bedrijven, maar ook overheidsinstellingen, de bedrijfseconomische aspecten van hun organisatie en processen juist in kaart brengen. Bedrijfseconomische informatie en criteria zijn daarom noodzakelijk. Na het succesvol volgen van dit vak zijn de bedrijfseconomische principes geen mysterie meer. Bedrijfseconomische beginselen worden actief toegepast en uitgediept in de practica die naast de hoorcolleges onderdeel van de cursus uitmaken.				
Education	2/2/0/0		**Credits**	**TU**	3
Assesment	written			**ECTS**	4,5

6.2 Study and traineeship 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 Information Centre of the Student Advisory Office. The Student Advisory Office is part of the Student Service Centre (paragraph 5.1). Much documentation about study abroad is available at this Centre, like information on all universities with which an exchange agreement exists, possibilities of financing, and travel reports from students. Also information is available at the website: http://www.stad.tudelft.nl.

If you got a clear idea about where you want to go to, you can ask the Coordinator for International Exchange Mechanical Engineering for advise about your programme at the foreign university and about the recognition of your results at the host university. Your graduation professor will judge your work afterwards according to the rules you agreed upon prior to departure.

The foreign programme should at least contribute 8 credit points 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.

Traineeship

Usually a traineeship 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 Advisory Office (see above). They offer a lot of information, not only on a large number of companies abroad, but also on financially related affairs, working permits, visa, etc. Additional information is available at the website: http://www.stad.tudelft.nl.

Coordinator for International Exchange Mechanical Engineering
dr.ir. D. Nijveldt
Room 8B – 3 - 08
Mekelweg 2
2628 CD Delft
Phone: 015 27 85921
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E-mail: d.nijveldt@wbmt.tudelft.nl

6.3 Course and Examination Regulations

(CER)

(art. 7.13 W.H.W.*)*

Master's degree programme Mechanical Engineering

Faculty of Mechanical Engineering and Marine Technology

Delft University of Technology

Section 1 GENERAL

Article 1 SCOPE AND APPLICABILITY OF THESE REGULATIONS

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

Article 2 DEFINITIONS

Any terms in these regulations also occurring in the Higher Education and Academic Research Act (WHW) will have the same meaning as that intended by that Act.

In these regulations, the following terms shall be understood as follows:

a. the Act: the Higher Education and Academic Research Act (abbreviated in Dutch to WHW), including its subsequent amendments;
b. programme: the Master's degree programme referred to in Article 7.3a, subsection 1 under b of the Act;
c. student: anyone enrolled at Delft University of Technology (as a student or "extraneus") for purposes of education and/or for taking the examinations and interim examinations that are part of the programme;
d. practical training: practical exercise as referred to in Article 7.13, subsection 2 under d of the Act, in one of the following forms:
   - writing a thesis;
   - writing a paper/completing an assignment, project or technological design;
   - completing a design or research assignment;
   - conducting literature study;
   - completing a work placement;
   - taking part in fieldwork or an excursion;
   - conducting tests and experiments;
   - or participating in another educational activity focused on the attainment of a particular skill.
e. interim examination: a test of a student's knowledge, insight and skills with regard to a particular unit of study, and the assessment of this examination by at least one examiner appointed for that task by the board of examiners.
h. examination: test used by the board of examiners to establish whether all interim examinations that are part of the *propedeuse* (i.e. first year), *kandidaats* or *doctoraal* phases have been successfully completed as specified in Article 7.10 of the Act.
i. board of examiners: the board of examiners as appointed according to Article 7.12 of the Act.
j. implementation procedures: the implementation procedures integral to the Course and Examination Regulations and applicable to a specific Master's programme.
k. working day: each day from Monday to Friday, with the exclusion of official national holidays.
l. course calendar: the publication containing all the specific information appropriate to a specific Master's course guide named in Article 1.

m. examiner: those appointed by the board of examiners for the purpose of taking interim examinations in accordance with Article 7.12 of the Act;
n. ECTS: 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.
2. Students who are not graduates of the course 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 the Bachelor's degree as specified in paragraph 1, the board of examiners may depart from paragraph 1 by allowing that student to attend parts of the Master's programme.

Article 5 EXIT QUALIFICATIONS OF THE MASTER'S PROGRAMME MECHANICAL ENGINEERING

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

Graduates will:

- have broad and deep knowledge of the basic engineering sciences
- have broad basic technical and scientific knowledge of the mechanical engineering disciplines: production, transport, process technology, energy conversion and mechatronics
- be specialized in at least one mechanical engineering discipline
- be able to innovate, to model and to design systems and equipment
- be able to contribute to solving multidisciplinary problems and to work both in multidisciplinary teams and independently in an international industrial context
- be able to communicate effectively with team members and environment
- be well aware of their responsibilities with regard to sustainability, economy, health, safety and social welfare
- be able to maintain professional competence through life-long learning

Article 6 FULL-TIME AND PART-TIME COURSE FORMAT

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

Article 7 LANGUAGE

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

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

Article 8

1. The composition of the educational programme is laid down in the implementation procedures. This educational programme starts once a year, in September.
2. Students can enter the programme at the beginning of each semester.
3. The examination for a Master's Degree is an integral part of the programme. The study load for this examination totals 84 credits (120 ECTS).

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.

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

2. In the event that a course component is not taught within the Faculty itself, and therefore there is no indication of the number of times it is possible to sit an interim examination as referred to in paragraph 1, the course and examination regulations of the relevant Faculty or degree programme will be applicable, provided no decision to the contrary has been taken by the board of examiners.
3. Notwithstanding the provisions of the first clause under 1a, at least one opportunity shall be given per year to take an interim examination in a course component that has not been taught in that year.
4. In certain cases the board of examiners may allow departures from the specified number of times that an interim examination can be sat.

Article 10 THE ORDER OF INTERIM EXAMINATIONS

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

Article 11 THE PERIOD OF VALIDITY OF INTERIM EXAMINATIONS

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

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

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

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

Article 13 ORAL INTERIM EXAMINATIONS

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

Article 14 THE ESTABLISHMENT AND NOTIFICATION OF RESULTS

1. Immediately after taking an oral interim examination, the examiner shall announce the result, and issue the student with the relevant written notification.
2. As soon as possible after a written interim examination, and always within a maximum of 15 working days, the examiner shall declbe 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 compbe 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 twice 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 2002.

IMPLEMENTATION PROCEDURES

for the course 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

The programme is concluded by fulfilling a final assignment and presenting a Master's thesis.

Article 7 VARIANTS AND ANNOTATIONS

1. The Mechanical Engineering MSc-programme is provided in 6 variants:
   - Transportation Engineering
   - Control Engineering and Mechatronics
   - Process and Engergy Technology
   - Production Technology and Organization
   - Solid and Fluid Mechanics
   - Biomedical Engineering

2. As an addition to the variant programme there are three annotations. After completing such an annotation, the student acquires a supplement to the MSc-degree, which declares a more than average knwoledge about that subject. These annotations are:
   - Technology in Sustainable Development
   - Technical Marketing
   - Offshore Technology

3. Further details and requirements are 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 six credits (9 ECTS), which should be allocated within the elective subjects.

Laid down by the Dean of the Faculty Mechanical Engineering and Marine Technology d.d. 26-6-2002, after the approval of the Faculty's Student Council d.d. 26-6-2002, and after considering the recommendations provided by the education committee on 10-6-2002.

6.4 Regulations and guidelines for the board of examiners

(art. 7.12 W.H.W.)

Delft University of Technology Faculty of Mechanical Engineering and Marine Technolgy

Master's programme in Mechanical Engineering

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 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 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 5 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 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.
12In the event that a certain examination requires students to use calculators, these calculators may at no time be able to exceed the maximum capabilities specified by the lecturer for that subject. In general, programmable calculating equipment is not allowed. (Generally examination assignments should be formulated such that they can be carried out with a simple calculator; at no times should candidates with more complex calculators have an advantage.)
13 Candidates may not write their answers in pencil, unless the lecturer has given prior permission for this.
14 During the interim examination, candidates may not consult books, readers, etc., unless the lecturer has given prior permission for this.
15 If an invigilator catches a candidate or candidates cheating, the procedure described in Article 6, paragraph 2 of these regulations will be applicable.
16 Before permanently leaving the examination room (i.e. no less than 30 minutes after the start of the interim examination), candidates must, at minimum, submit the front page of the answer sheet. This must bear their name and student number.
17 Before the interim examination begins, the invigilator shall instruct the candidates on the procedure they must follow if they leave the examination room without completing all the examination assignments.
18 Students who believe they may qualify for examination in a different form, should, as specified in Article 12 paragraphs 4 and 5 of the CER[1], submit a fully motivated request for this to the chair of the board of examiners.

Article 6 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.

[1] Course and Examination Regulations

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 7 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;
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 8 QUESTIONS AND ASSIGNMENTS

1 The scope of an interim examination, and the sources upon which it is based, shall be announced no less than a month before that examination takes place. No questions or assignments in the examination may go beyond the scope of these sources.
2 To the greatest possible extent, the questions and assignments of each interim examination shall be evenly distributed over the material being examined.
3 Both in content and form, each interim examination shall represent the learning objectives stated.
4 All questions and assignments shall be clear and explicit.
5 Well in advance of each interim examination, the board of examiners or the examiner shall announce the form of examination and method of testing as meant under Article 12 of the CER.

6 Well in advance of each written interim examination, the board of examiners or the examiner shall provide an opportunity whereby students intending to participate in it can examine a similar test on the same subject, together with sample answers and the norms that would be applied during its assessment.

Article 9 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 10 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 11 CUM LAUDE

1 At the discretion of the board of examiners, a candidate for the Master's degree can receive the designation "cum laude" if he or she meets the following conditions:
   a the mark awarded to the components specified in the Master's examination implementation procedures shall average no less than 8 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 two and a half years;
   c the mark awarded for the thesis project shall be no less than 8;
   d the examiner of the graduation assignment shall have submitted a proposal for the award of "cum laude".
2 When establishing the elapsed study time referred to in paragraph 1 subsection b of this Article, all due account should be taken of any delays caused by circumstances qualifying the candidate for support under the "Regeling Financiële Ondersteuning Studenten" (RFOS)
3 At all times, the board of examiners has the authority to decide on awarding the designation "cum laude" in cases that fall outside the provisions defined above.

[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.

Article 12 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 13 PROCEDURE FOR APPROVALS

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

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

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

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

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

Article 14 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 15 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 16 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 17 DATE OF COMMENCEMENT

These regulations will come into effect on 1 September 2002.

Approved by the board of examiners of the Master's programme in Mechanical Engineering on 10 April, 2002

6.5 Working conditions and RSI

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

Causes

There are two mechanisms that cause RSI:

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

Symptoms

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

Prevention

How to prevent RSI:

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

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

- Student adviser (paragraph 3.6)
- Student Health Care (SGZ), tel: 015 2121507, studentenartsen@sgz.nl
- Student Advisory Bureau (STA*D), tel: 015 27 88012
- VSSD support, tel: 015 27 82057, steunpunt@oli.tudelft.nl

6.6 Lecturers

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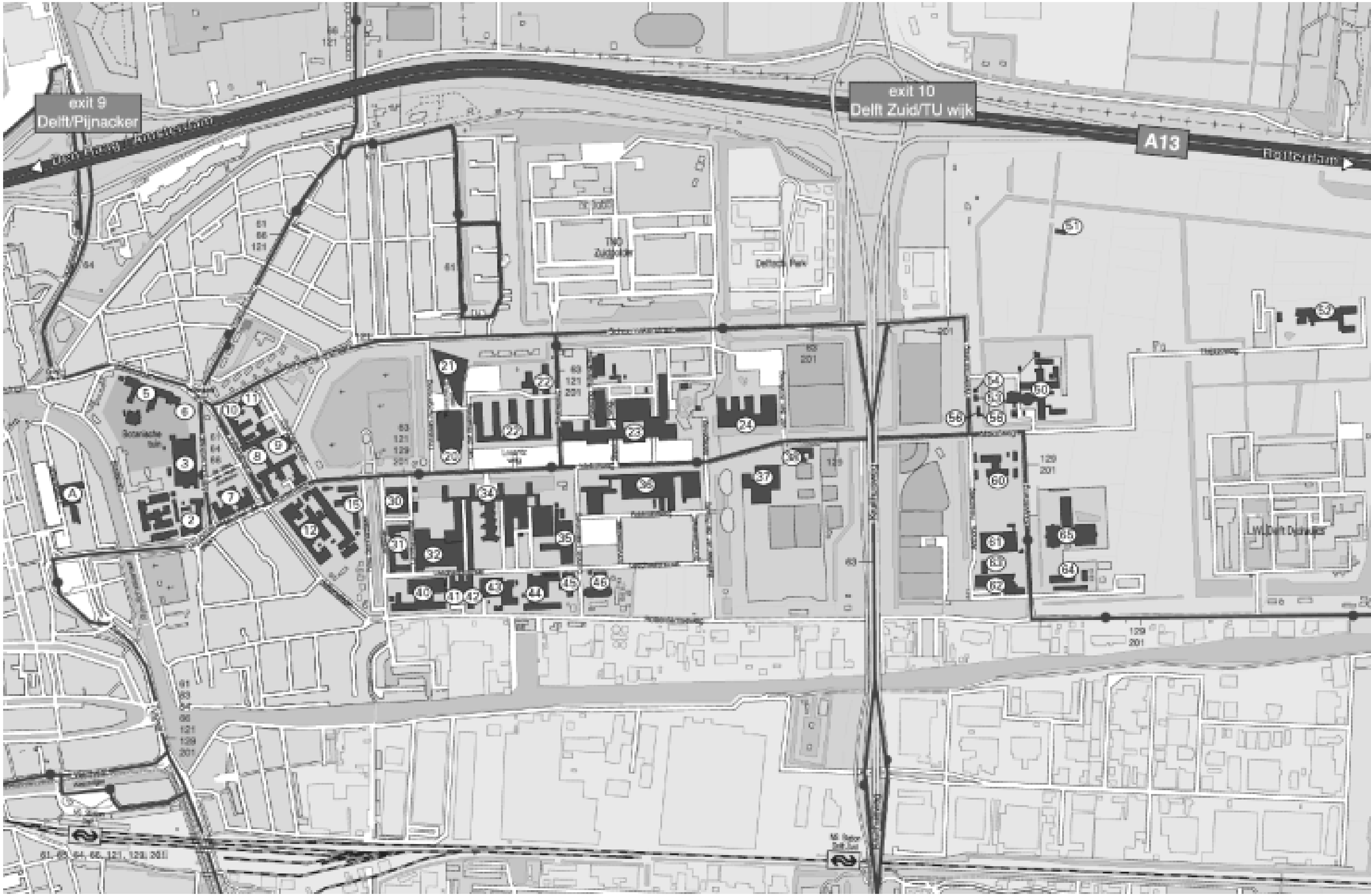
For other phone numbers the student can call the universal TU number (015 27 89111) or the reception of the faculty (015 27 86666)

1 Phone numbers in full are 015-27…..

2 API: Leeghwaterstraat 44, 2628 CA Delft
CTG: 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



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Botanische tuin