BME - Guide

Master 2004-2005

BME-Guide

Study guide Master programme Biomedical Engineering

Colophon

Text	Education Support Staff WbMT
Word processing	Student assistant Michiel Warmerdam
Styling	Corrie van der Lelie and Hans van Schuppen
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Preface

We are very proud that per 1 september 2004 the new MSc programme Biomedical Engineering will start at the Delft University of Technology. Is it new? Is it a surprise? Well, the programme results from an ongoing collaboration between a number of departments in the field of Biomedical Engineering, i.e. the Depts of Applied Sciences, Electrical Engineering and Mechanical Engineering. Each of these departments already had the opportunity to direct the education programme to biomedical topics. These initiatives have been clustered into the new MSc programme.
What is new? New is that six specialisations have been defined, which combine the existing experience and knowledge in the fields of Surgical Instruments, Biomechatronics, Tissue Biomechanics and Implants, Medical Imaging, Clinical Physics and Biomedical Instrumentation. The courses offered by the named departments are easily found in this study guide, and the programme is well coordinated within the specializations.
Is it different? There are more programmes in Biomedical Engineering in the Netherlands. The programme at Delft University of Technology is different, because it focuses on the education of good engineers within the traditional engineering disciplines, but who can apply their skills within a multi-disciplinary team of researchers, in which also medical scientist will be represented. During the MSc education there is a focus on multi-disciplinary collaboration, and the MSc thesis will be guided by technical as well as clinical tutors. We are very glad with the collaboration with the Leiden University Medical Center and Erasmus Medical Center (Rotterdam), who have offered many opportunities for MSc projects.

In the field of Biomedical Engineering there are still many things to discover and there is a continuous quest for better devices. It is a hi-tech field in which research programmes in universities still can compete (and collaborate!) with industrial programmes. The importance for society is evident. It is very rewarding for students to see that their efforts may affect the clinical practice directly or indirectly.

We are looking forward to a new start and many new opportunities for students, researchers and clinicians!

Prof.dr. Frans C.T. van der Helm

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MSc programme

1 MSc Biomedical Engineering

1.1 Goal

The goal of the MSc education in Biomedical Engineering is to turn out technically high-skilled engineers, who have additional medical and biological knowledge, experience with applications in the medical field and with the multi-disciplinary collaboration with physicians and other researchers in the medical field. The concept 'clinically driven research' is a central theme in the education. The engineering should be able in consultation with a physician to translate ideas and theories into a research question, or into the design of a medical device or measurement instrument. The engineer should be able to go deeply into medical literature, and use the data to develop conceptual models from a technical perspective.

The following exit qualifications serve to realise this goal:

The graduated Master of Science Biomedical Engineering meets the following qualifications:

- Broad and profound knowledge of the basic engineering sciences (mathematics and applied physics) and the capability to apply these at an advanced level on one biomedical engineering specialisation.
- Broad and profound technical scientific knowledge of one biomedical engineering discipline and the skills to use this knowledge effectively. The knowledge should be mastered at a level of the technological borders of the discipline.
- Thorough knowledge of methods, paradigms and tools to analyse, interpret, model, simulate design and perform experiments and research. The knowledge has been actively applied in one biomedical engineering specialisation.
- Capability to contribute to the solution of technological problems by a systematic approach involving analysis, formulating sub problems, providing innovative solutions, evaluating the feasibility and the final elaboration.
- Capability of working both independently and in (multidisciplinary) teams, taking initiatives where necessary, identifying and acquiring lacking expertise. Have an appreciation of the uncertainty, ambiguity and limitations of knowledge.
- Capability to effectively communicate (including presenting and reporting) about his/her work to both professionals and a non specialised public both in English and his/her native language.
- Capability to evaluate and assess the technological, societal and ethical impact of his/her work, taking responsibility with regard to sustainability, economy and social welfare.
- Maintain his/her professional competence through life-long learning.

1.2 Educational Concept and Assessment

The study programme involves two years of study, each with a study load of 60 EC (European credits). The total programme involves 120 EC.

The MSc Biomedical Engineering programme offers six specialisations:

- Medical Instruments & Medical Safety (MIMS), directed to the medical specialisations internal medicine, cardio-vascular diseases, pneumology, surgery and anaesthesiology
- Biomechatronics (BM), directed to the medical specializations orthopaedics, rehabilitation and neurology
- Tissue Biomechanics and Implants (TBI), directed to orthopaedics
- Medical Imaging (MI), acquisition and data processing of medical images, directed to the radiology.
- Clinical Physics (CP), applications of physics in medicine, in particular diagnostics and interventional radiology, nuclear medicine and radiation therapy.
- Biomedical Instrumentation (BI), directed to the application of electrical devices and sensors for measuring and monitoring of patients.

Lecture courses

(60 EC)
Students are expected to take about 30 EC in Biomedical Courses, and about 30 EC in non-Biomedical courses. There is a compulsory part for the Biomedical courses and non-Biomedical courses, specified for each specialization. There is an elective part to be chosen in agreement with the MSc-Thesis supervisor. For this part, there is a list with recommended courses and other courses.

Assignments

(60 EC)
The assignments take place in the second year of the MSc programme. In general the assignments are carried out individually.

The assignments involve:

- A traineeship in a hospital, industry or other research institute of 10 EC. During the internship a project task defined in consultation with the host institute should be done. It is recommended to do the internship abroad. The faculty of the MSc Biomedical Engineering programme will support initiatives hereto, or will actively help to find host institutes. The internship should be finished with a report.
- Literature survey (10 EC), which might be performed in combination with the MSc research project. The literature survey should be finished with a report, and a colloquium.
- MSc research project (40 EC), to be finished with the MSc thesis.

The MSc research project will be done in collaboration with a clinical partner from Leiden University Medical Center (LUMC) or Erasmus Medical Center (EMC Rotterdam). The MSc student will have a clinical tutor and a technical tutor.

About six weeks after the start of the MSc research project, the student will give a colloquium in which the goals of the research project and the research plan will be presented. The student prepares the MSc thesis as a report of his/her research project. The thesis work is evaluated through an oral presentation (colloquium) by the candidate and an oral examination before a MSc examination committee composed of at least three scientific staff members, including the thesis supervisor. The examination committee may also include external examiners from research institutes or from industrial partners. In paragraph 1.5 the requirements for assignments are specified.

In total each student has three oral presentations (colloquia), for which he/she receives a grade: One for his literature survey, one six weeks after the start of his MSc assignment and one at the end of his/her MSc thesis assignment. The colloquia will be organized centrally for all Biomedical Engineering students. For all Biomedical Engineering students in their final year it is compulsory to attend these central meetings.

1.3 Study programme and general structure

Biomedical 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 in which tests can be scheduled.
Most examinations will be held orally. For those subjects where written examinations are taking place, the student will get at least one opportunity per 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 are scheduled in the second half of August.

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

1.4 Admission to the programme

There are five academic BSc degrees which give direct admission to the MSc-program Biomedical Engineering: Applied Physics, Electrical Engineering, Aerospace Engineering, Marine Technology and Mechanical Engineering. However, due to the variety in specializations, each specialization can still require some additional BSc courses for admission to the specialization. There is a special enroll program for students with a BSc degree in Industrial design or civil engineering.

The master's phase can also be entered after completing a BSc-program at a polytechnic high school, e.g. in Physics, Electrical Engineering, Mechanical Engineering, Aerospace Engineering and Human Motion Technology (Bewegingstechnologie). There is a special enroll program for these students.

1.4.1 Academic bachelor degree

Academic BSc-degree Applied Physics, Mechanical Engineering, Electrical Engineering, Aerospace Engineering, Marine Technology, Civil Engineering (DUT, TUE, UT and IDEA-league)

Students holding an academic MSc-degree Applied Physics, Mechanical Engineering, Electrical Engineering or Aerospace Engineering of a Dutch University of Technology (Delft, Eindhoven or Twente) or a University which belongs to the IDEA-league (ETH Zürich, Imperial College London or Technische Universität Aachen) can enter the MSc program without selection.

A student in the BSc-program is permitted to do examinations of the MSc-program, if the examination committee approves. When the student has passed the propaedeutic examination and has a study result of the second and third year of at least 100 EC, including the BSc-thesis, the student can be conditionally admitted to the MSc-program, to take part in examinations of a few MSc-courses. Final admittance is granted after completing the BSc-program.

BSc Applied Physics

For admission to the BME specializations MIMS and BM

Course code	Course name	EC
sc4140ap	Control engineering	5
wb1216	Dynamics 2	3
wbtp209	Mechatronica	10

For admission to the BME specialization TBI

Course code	Course name	EC
sc4140ap	Control engineering	5
wb1308	Dynamica 3	3
wb1309	Stijfheid en sterkte 3	3
wb1212	Eindige Elementen Methode I	3
wb1213	Elasticiteitsleer	1.5
wb1214	Eindige Elementen Methode II	1.5

For admission to the BME specializations MI and CP

No additional requirements

For admission to the BME specialization BI

13 - 27 ECTS Electrical Engineering courses are required in the Bsc curriculum.

BSc Mechanical Engineering

For admission to the BME specializations MIMS, BM and TBI

No additional requirements

For admission to the BME specialization MI

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization CP

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization BI

Not recommended

BSc Electrical Engineering

For admission to the BME specializations MIMS and BM

Course code	Course name	EC
wb1216	Dynamics 2	3
wbtp209	Mechatronica	10

For admission to the BME specialization TBI

Course code	Course name	EC
wb1216	Dynamics 2	3
wb1309	Stijfheid en sterkte 3	3
wb1212	Eindige Elementen Methode I	3
wb1213	Elasticiteitsleer	1.5
wb1214	Eindige Elementen Methode II	1.5

For admission to the BME specialization MI

Course code	Course name	EC
tn2512	Computer science	
tn2344	Golven	6

For admission to the BME specialization CP

Course code	Course name	EC
tn2512	Computer science	
tn2344	Golven	6

For admission to the BME specialization BI

No additional requirements

BSc Aerospace Engineering

For admission to the BME specializations MIMS, BM and TBI

Course code	Course name	EC
wb2207	Systems & Control Engineering 2	3

For admission to the BME specialization MI

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization CP

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization BI

Not recommended

BSc Industrial engineering

For admission to the BME specializations MIMS and BM

Course code	Course name	EC
wi2051wb	Differentiaalvergelijkingen	3
wi2252wb	Analyse 3	3
wb2207	Systems & Control Engineering 2	3
wb1216	Dynamics 2	3
wbtp209	Mechatronica	10

For admission to the BME specialization TBI

Course code	Course name	EC
wi2051wb	Differentiaalvergelijkingen	3
wi2252wb	Analyse 3	3
wb2207	Systems & Control Engineering 2	3
wb1216	Dynamics 2	3
wb1309	Stijfheid en sterkte 3	3
wb1212	Eindige Elementen Methode I	3
wb1213	Elasticiteitsleer	1.5
wb1214	Eindige Elementen Methode II	1.5

For admission to the BME specialization MI

Not recommended

For admission to the BME specialization CP

Not recommended

For admission to the BME specialization BI

Not recommended

BSc Marine Technology

For admission to the BME specializations MIMS, BM and TBI

Course code	Course name	EC
wb1216	Dynamics 2	3
wb2207	Systems & Control Engineering 2	3

For admission to the BME specialization MI

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization CP

Course code	Course name	EC
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specialization BI

Not recommended

BSc Civil Engineering

For admission to the BME specializations MIMS, BM and TBI

Course code	Course name	EC
wb1126wb	Thermodynamics 1	3
wb1216	Dynamics 2	3
wb1224	Thermodynamics 2	3
wb2104	Systems & Control Engineering 1	3
wb2207	Systems & Control Engineering 2	3

For admission to the BME specialization MI

Course code	Course name	EC
tn1662	Natuurkunde 2	3
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

For admission to the BME specializations CP and BI

Not recommended

BSc Mathematics & BSc Computer Science

For admission to the BME specialisation MI

Course code	Course name	EC
tn1662	Natuurkunde 2	3
tn2512	Computer science	
tn2545	Systemen en signalen	6
tn2344	Golven	6
tn2052	EM1	5

The student can be conditionally admitted to the MSc-program, when the propaedeutic examination is passed and at least 100 EC of the second and third year of the BSc-program have been obtained. Final admittance is granted after completing the additional courses.

Other Academic BSc-degree from Technical University

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

- admission without additional requirements
- admission with additional requirements of no more than 14 EC. The additional requirements will be part of the elective courses of the chosen variant.
- admission with additional requirements between 14 and 43 EC. In this case 14 EC are part of the 120 EC of the normal MSc-program and 30 EC at most are additionally required above the standard MSc-program.
- no admission. The candidate has to obtain a relevant BSc-degree first. Within the BSc-program, exemption for some courses is possible, depending on earlier education.

1.4.2 Bachelor degree of Dutch polytechnic high school (TH)

Candidates having a BSc degree from a Dutch TH-program in Electrical Engineering, Mechanical Engineering, Applied Mathematics, Applied Physics, Aerospace Engineering or Human Motion Technology (Bewegingstechnologie) can be admitted. A requirement is that the candidate has completed the TH-Bachelors program within 4 years, with good results. The intake-coordinator of the Examination Committee is responsible for the selection of candidates.

An additional program of 30 EC needs to be completed before the candidate is formally admitted to the MSc-program. An additional number of courses, of the second year of the BSc-programme has to be followed. These additional requirements will ensure that the student has at least an entrance level comparable to the second-course year of the Mechanical Engineering BSc-programme. The lecturer of the chosen variant and specialization may require that also a number of third year courses of the BSc-programme, in the field of the specialization is followed. Candidates are admitted to the pre-MSc-programme. This means that both the pre-MSc-programme and MSc courses can be followed. Final admission to the MSc-programme is given after completing the pre-MSc-programme. Courses are given in Dutch. A summary of additional courses and requirement is in Dutch.

It is recommended that TH students with a background in Electrical Engineering or Applied Mathematics choose the BME specialisation Biomedical Instrumentation. TH students with a background in Applied Physics are recommended to choose the BME specialisations Medical Imaging or Clinical Physics. TH students with a background in Mechanical Engineering, Aerospace Engineering or Human Motion Technology (Bewegingstechnologie) are recommended to choose the BME specialisations Medical Instruments and Medical Safety, Biomechatronics or Tissue Biomechanics and Implants.

These above subjects will be chosen in agreement with the MSc Coordinator according to the individual profile of the student and the schedule of the courses. The proposed upgrade program has to be approved by the Examination Committee.

1.5 MSc-programme Biomedical Engineering

In September 2004 Delft University of Technology starts the new two-year MSc program in Biomedical Engineering. This program is directed towards the education of technically high-skilled engineers, who have additional medical and biological knowledge, experience with applications in the medical field and with the multi-disciplinary collaboration with physicians and other medical researchers. The program is focused on 'clinically driven' research. The Biomedical Engineer should be able in collaboration with a physician to transform concepts into research questions, or into the design of a assistive devices or measurement instruments. Research-oriented as well as design-oriented MSc students will be educated. The Biomedical Engineer should be able to read medical literature, and conceptualize the theories and data into technical models. The education to Biomedical Engineer will emphasize the multidisciplinary character of the field.

The MSc program is based on the support of three disciplinary organized departments: Applied Physics, Electrical Engineering and Mechanical Engineering. In these departments much of the research and design in the biomedical engineering field at Delft University of Technology is organized. In the MSc program BME variant there is a close collaboration with clinical partners at Leiden University Medical Center (LUMC) and Erasmus Medical Center Rotterdam (EMC). The clinical partners participate in the teaching in the 1st MSc year, and in the tutoring of the MSc final year projects.

The MSc-program has six specialisations:

- Medical Instruments & Medical Safety (MIMS), directed to the medical specialisations internal medicine, cardio-vascular diseases, pneumology, surgery and anaesthesiology
- Biomechatronics (BM), directed to the medical specializations orthopaedics, rehabilitation and neurology
- Tissue Biomechanics and Implants (TBI), directed to orthopaedics
- Medical Imaging (MI)
- Clinical Physics (CP), as a preparation to the post-doctoral education to Clinical Physicist.
- Biomedical Instrumentation (BI), directed to the application of electrical devices and sensors for measuring and monitoring of patients.

The program is oriented towards students from a variety of backgrounds in engineering. The program will be interesting and challenging, and it will provide top-quality expertise and skills for a successful professional career in either research, technology development, or any other professional environment.

Through the combination of the above mentioned disciplines the presentation of an integrating approach to biomedical engineering is enabled.

Professional perspectives
Regarding the social and economical impact there is a great demand for engineers specialised in BioMedical Engineering (BME). Nationwide, there are large investments in medical devices and medical research. In the design of the medical devices and in the medical research, engineers with a biomedical specialisation have an important role.

Most engineers receive a mono-disciplinary education, e.g. in electrical, civil or mechanical engineering. In contrast, the largest scientific progress is made in the fields where the traditional disciplines meet or even overlap. Biomedical engineering is a multi-disciplinary specialisation with great challenges, in which well-educated engineers can make a large progress. In addition to the technical challenges, BME also appeals to the social responsibility of the engineer. A more direct relation to the improvement of the quality of life is hard to find.

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.

1.5.1 Affiliated research groups

Five research groups at Delft University of Technology are the major contributors to the MSc Biomedical Engineering program:

Pattern Recognition, Faculty of applied science
Prof.dr.ir. T.Young, Prof.dr.ir. L. van VLiet, prof.dr. A. Vossepoel
Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data. It encloses subdisciplines like discriminant analysis, feature extraction, error estimation, cluster analysis (together sometimes called statistical pattern recognition), grammatical inference and parsing (sometimes called syntactical pattern recognition). Important application areas are medical image acquisition, image analysis, character recognition, speech analysis, man and machine diagnostics, person identification and industrial inspection.

Electronic Instrumentation Laboratory, Faculty of Electrical Engineering, Mathematics and Computer Science

Prof.dr. P. French

The research mission of the Electronic Instrumentation Laboratory is to realize smart sensor systems for the acquisition of data from physical, chemical and biomedical signals. After mechanisation and informatisation, sensorisation has become the largest obstacle to total automation. Therefore, breakthroughs are required in technology, price, size, weight, power consumption and user-friendliness.
To accomplish this goal, the Laboratory has chosen to interweave two functions. Firstly to realize sensors in IC-compatible silicon technology suited for mass-production. Secondly, to combine these silicon sensors with smart interface electronics, preferable in one package. This allows easy communication with the sensors.

Man-Machine Systems & Control Group, Faculty of Mechanical Engineering and Marine Technology

Prof.dr.ir. P.A. Wieringa, Prof.dr. F.C.T. van der Helm, Prof.dr. J. Dankelman

The field of Human-Machine Systems (MMS) concerns research and design of systems where humans control their environment through a technical system. In the research program, system and control theory is used and developed to study the dynamics of the human as a controller, i.e. as part of the control loop. The cognitive and neuromuscular nature of the human as a controller have interesting implications for issues such as identification, perceptibility, responsiveness, open and closed loop behavior. In the design efforts a human-centered approach is applied, taking into account the capabilities and preferences of the human in order to design technical systems that match these dynamic characteristics optimally. In many cases unconventional technology is developed that is useful in our field of application as well as in general mechanical engineering. Projects in direct control can be subdivided in design of assistive technology for physically challenged people (prosthetics and orthotics for the upper extremity), (walking) robotic systems (control of system parameters, study of human gait, application as leg orthosis), and haptic interfaces (dynamic interaction with virtual environment or telemanipulator, force feedback, application in surgery).

Structural Optimization & Computational Mechanics, Faculty of Mechanical Engineering and Marine Technology

Prof.dr.ir. F. van Keulen

The objective of the research activities of the Structural Optimization and Computational Mechanics group is to improve possibilities for automated design and optimization.
As a consequence our research activities involve both (structural) optimization and computational mechanics. Applications are amongst others in the analysis of bone structures and implant-bone interface.

Interfaculty Radiation Technology IRI

Prof.dr.ir. C.E. van Eijk

The biomedically oriented research of IRI concentrates on dosimetry, i.e. useful and acceptable levels of radiation, and absorption of radiation by materials. Measurement methods have been developed, e.g. Thermo Luminescence and Optically Stimulated Luminescence (OSL)

In addition, a large number of clinical research groups at the Leiden University Medical Center, and Erasmus Medical Center (Rotterdam) are supporting the MSc research projects:

Clinical Partners collaborating in the MSc Biomedical Engineering

Leiden University Medical Center (LUMC)	
Prof.dr. P.M. Rozing	Orthopaedics
Prof.dr.ir. Reiber	Medical Imaging
Prof.dr. Roos	Neurology
Prof.dr. Thomeer	Neurosurgery
Prof.dr. Arendzen	Rehabilitation
Erasmus Medical Center Rotterdam (EMC)	
Prof.dr. T. van der Steen	Medical Technology
Prof.dr. J.A.N. Verhaar	Orthopaedics
Prof.dr. H. Stam	Rehabilitation
Prof.dr. Bonjer	Minimal Invasive Surgery

Other Biomedical Education progammes in the Netherlands.

Eindhoven

At Eindhoven University of Technology there is a Department of Biomedical Engineering, with a BSc and MSc programme. In the MSc programme the student can choose between 'Biomedical Engineering' and 'Medical Engineering'. The latter specialisation educates for work inside the hospitals, as support for medical specialists. The Biomedical Engineering specialisation results in researchers and designers of medical-technical products.There are 4 tracks:

1. Molecular Bio-engineering, directed to proteomics, genomics, new drugs, biomaterials, etc.
2. Biomechanics and tissue engineering
   a. Tissue biomechanics and engineering
   b. Cardiovascular biomechanics and fluid mechanics
   c. Bone and orthopaedic biomechanics
3. Biomedical imaging and informatics
4. Biosignals and regulation: Regulatory mechanisms in the human body.

There is also the opportunity to specialize in Clinical Physics at the Applied Physics Department.

Twente In september 2001 also a BSc programme in Biomedical Engineering started at the University of Twente. Next year the MSc programme will start. In the MSc programme the following tracks will be offered:

1. Cellular tissues and biology
2. Biology
3. Biomechatronics
4. Medical Imaging
5. Health care technology

In september 2003 also a BSc programme in Clinical Technology is offered which educates students for technical specialisations within the hospital.

Groningen At the University of Groningen a specialisation in Biomedical Engineering is offered at the Department of Applied Physics. In the MSc programme the following tracks are offered:

1. Medical Imaging
2. Medical Instrumentation
3. Biomaterials

1.5.2 Course program

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.

Specific Biomedical Engineering courses	30 EC
Other Mathematics and Engineering courses	30 EC
Traineeship	10 EC
Literature study	10 EC
MSc thesis	40 EC
Total	120 EC

Specific Biomedical Engineering courses

Course code	Course name	Lecture hours	EC	MI & MS	BM	TBI	MI	CP	BI
	Medical ethics		0,5	-	-	-	-	o	-
	Introduction clinical physics		0,5	-	-	-	-	o	o
ap3351	Radiation technology and radiation detection	2/2/0/0	6	-	-	-	-	o	-
ap3361	Medical physics and radiation technology 1	0/0/2/2	6	-	-	-	-	o	-
ap??	Medical physics and radiation technology 2	0/0/2/2	6	-	-	-	-	o	-
ap3371	Radiological health physics (+31 hours pract.)	3/3/0/0	6	e	e	e	e	o	r
ap3471p	Measurement in images		2	-	-	-	o	-	e
et4085	Image processing	0/4/0/0	4	-	-	-	o	r	e
et4126	Medical technology	3/0/0/0	4	o	o	o	o	o	o
et4127	Theme course biomedical technology	0/0/0/3	3	e	e	e	e	-	e
et4128	Health care systems	3/0/0/0	3	o	o	o	o	o	o
et4129	Physical measurement mehods & image techn.	0/3/0/0	3	e	e	e	e	r	e
et4130	Bio-electricity	0/3/0/0	3	e	e	e	r	r	o
ide530	Biomechanics		3	e	e	e	e	-	r
ide534	Ergonomical aspects data processing systems		2	e	e	e	e	-	e
ide5381	Design ergonomics for elderly & handicapped		3	e	e	e	e	-	e
in4085	Pattern recognition	2/2/0/0	3	e	e	r	o	-	e
ls1061	Cell biology 1		3	e	e	r	e	-	o
wb2308	Biomedical engineering design	2/0/0/0	4	o	o	e	e	r	e
wb2407	Human movement control	2/2/0/0	4	r	o	o	e	-	e
wb2408	Physiological systems	0/4/0/0	3	o	r	o	e	r	o
wb2431	Bone mechanics and implants	0/2/2/0	3	e	r	o	e	-	e
wb2432	Biomechatronics	0/0/2/2	4	r	o	o	e	-	e
wb2435-03	Surgical instruments and medical safety	2/0/0/0	2	o	r	r	?	r	?
			Total EC	30	30	30	30	32	30

(o: obligatory courses; r: recommended elective courses; e: elective courses)

Mathematics and Engineering courses

Course code	Course name	Lecture hours	EC	MI & MS	BM	TBI	MI	CP	BI
ap3531	Acoustal imaging		6	-	-	-	o	r	-
ap3121d	Imaging systems		6	-	-	-	o	r	-
ct5142	Comp. methods in non-linear mechanics	0/4/0/0	3	-	-	r	e	-	-
et4004	EM radiation, scattering and imaging		3	-	-	-	-	-	e
et4083	Statistic signal processing		3	-	-	-	-	-	e
et4092	Practical control systems		2	-	-	-	-	-	e
et4102	Mechatronic design		2	-	-	-	-	-	e
et4137	Fuzzy logic engineering applications		2	-	-	-	-	-	e
et4147	Signal processing for telecommunications		3	-	-	-	-	-	e
et4161	Information theory		3	-	-	-	-	-	e
et4235	Digital signal processing		2	-	-	-	-	-	e
et4248	Introduction to micro electronics	3/0/0/0	2	-	-	-	-	-	o
et4249	Semiconductor comp. and techn.		4	-	-	-	-	-	r
et4250	IC technology		3	-	-	-	-	-	r
et4251	HF silicon technology		3	-	-	-	-	-	e
et4252	Analogue IC design	0/3/0/0	3	-	-	-	-	-	o
et4253	Nanoelectronics & micropower design		3	-	-	-	-	-	e
et4256	Reliability engineering		3	-	-	-	-	-	e
et4257	Silicon sensors	0/3/0/0	3	-	-	-	-	-	o
et4258	Displays & actuators		3	-	-	-	-	-	r
et4260	Microsystems integration		3	-	-	-	-	-	e
et8016	Structured electronic design	4/0/0/0	3	-	-	-	-	-	o
et8017	Electronic instrumentation 1	4/0/0/0	3	-	-	-	-	-	o
ide521	Computer visualisation		3	e	e	e	e	-	-
in4006tu	3D computer graphics		4	e	e	e	e	-	-
in4008	Data visualization (+56 hours practical)	0/0/3/0	5	-	-	-	o	r	-
in4017	Multimodal interfaces and VR		2	-	-	-	o	r	-
mk26	Fracture mechanics		3	-	-	r	e	-	-
sc4020	Control theory	4/0/0/0	6	o	o	e	e	-	-
sc4110	System identification B	0/0/2/2	5	e	e	e	e	-	-
wb1310	Multibody dynamics A	0/0/0/2	3	e	e	e	e	-	-
wb1406	Experimental mechanics	0/0/2/2	3	e	e	e	e	-	-
wb1409	Theory of elasticity	2/2/0/0	4	e	e	o	e	-	-
wb1413	Multibody dynamics B	0/0/2/2	3	r	o	r	e	-	-
wb1416	Computational engineering mechanics	0/0/2/2	3	e	e	e	e	-	-

Course code	Course name	Lecture hours	EC	MI & MS	BM	TBI	MI	CP	BI
wb1427-03	Advanced fluid mechanics A	2/2/0/0	5	-	-	e	e	-	-
wb1428	Computational fluid dynamics	0/0/2/2	3	-	-	e	e	-	-
wb1429-03	Microfluidics	0/0/2/2	3	e	e	e	e	-	-
wb1440	Eng.optimization: concept and applications	2/2/0/0	3	e	e	o	e	-	-
wb1441	Engineering optimization 2	0/0/2/2	3	-	-	e	e	-	-
wb2301	System identification & parameter estimation	0/0/2/2	7	o	o	e	e	-	-
wb2303	Measurement techniques	0/0/2/2	3	o	e	e	e	-	-
wb2306	Cybernetical ergonomics	0/0/0/4	3	e	e	e	e	-	-
wb2309	Introduction specialisation MMS and BME	2/0/0/0	1	o	o	-	e	-	-
wb2402	Hydraulic servo systems	2/2/0/0	3	e	e	e	e	-	-
wb2404	Man-machine systems	2/2/0/0	4	o	o	e	e	-	-
wb2413	Instrumentation	0/0/2/2	3	o	e	r	e	-	-
wb2414	Mechatronical design	2/2/0/0	3	e	e	e	e	-	-
wb2421	Multivariable control systems	0/0/4/0	6	e	e	e	e	-	-
wb2422	Modelling 2	0/0/4/0	6	e	r	e	e	-	-
wbp202	Haptics system design		4	o	o	e	e	-	-
wi4008	Complex analysis		4	-	-	e	e	-	-
wi4011	Numerical fluid dynamics		6	-	-	e	e	-	-
wi4014tu	Numerical analysis C2		4	-	-	r	e	-	-
wi4017	Non-linear differential equations		6	e	e	e	e	-	-
wi4070tu	Digital simulation A (+ 25 hours practical)	0/0/4/0	4	-	-	-	-	r	-
wm0605tu	Business economics for engineers		4	e	e	e	e	-	-
wm0621tu	Innovation management		3	e	e	e	e	-	-
wm1101tu	Upper-Intermediate english (refresher)		3	e	e	e	e	-	-
wm1102tu	Written english for technologists		3	e	e	e	e	-	-
wm1109tu	Scientific writing and oral presentation		2	-	-	-	e	-	r
	Advanced dynamics (new)		4	-	-	r	e	-	-
		Total EC		30	30	30	30	26	30

(o: obligatory courses; r: recommended elective courses; e: elective courses)

EC = European Creditshttp://www.sfc.tudelft.nl.

1.5.3 Technical University Teacher Course (TULO)

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

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

1.6 Study and internship abroad

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

You can make use of one of many exchange agreements with European and non-European universities for your study at a foreign university. Within such an agreement you do not pay the foreign university any tuition fee. In addition to this, grants are available for financing the additional expenses for staying abroad. For your first information on studying abroad it is recommended to visit the *Back Office International Programmes* of the Student Facility Centre. Much documentation about study abroad is available at this Centre, like information on all universities with which an exchange agreement exists, possibilities of financing, and travel reports from students. Also information is available at the website: http://www.sfc.tudelft.nl.

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

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

Internship

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

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

1.7 Enrolling for courses and tests

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

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

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

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

1.8 Pass rules and criteria for 'cum laude'

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.

'cum laude'

At the discretion of the examinations board, 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, excluding the Master's Thesis 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 9;

d the examiner of the graduation assignment shall have submitted a proposal for the award of "cum laude".

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

1.9 Profile of the Biomedical Engineer

In the light of the social impact and economical interests, there is a great demand for engineers who are specialised in the field of Biomedical Engineering. Health care is one of the largest socio-economical areas in the society. In the Netherlands about 8 % of the Gross National Product is spent in this sector, e.g. in the direct patient care but also in investments in medical devices and medical research. In the design of medical devices and for medical research engineers with a biomedical specialisation have an important role.

The field of Biomedical Engineering appeals next to the large technical challenges also to the social responsibilities of the engineer. A closer relation with the improvement of the quality of life is hardly imagable.

The most progress in research is made in the areas where the traditional displicines touch each other. There is a need for engineers with a multi-disciplinary, technical education. The new Bachelors-Masters (BSc – MSc) structure offers the possibility to provide a thorough technical education in the three years of the BSc, and then let the MSc students specialise in a multi-disciplinary field. Biomedical Engineering is such a multi-disciplinary field, where there are still many challenges, and where well-educated engineers can make much progress.

In the MSc education Biomedical Engineering the students will become technically high-skilled engineers, who have additional biomedical knowledge, experience with medical applications and with the multi-disciplinary collaboration with medical doctors and other biomedical researchers. The concept 'clinically driven research' is a central theme in the education. The engineering should be qualified together with a medical doctor to translate ideas and theories into research questions, or into the design of a medical device or measurement instrument.

There is a difference in the acquisition of technical and biological knowledge. In a technical education the necessary depth can only be obtained by an accumulation of courses starting in the first year. For the biomedical application of this technical knowledge the specialised knowledge of a very small part of the medical field will often be sufficient. For each new application the engineer must acquire the necessary medical knowledge. The biomedical education will enable the engineer to acquire the knowledge adequately and fast.

In the first place good engineers will be educated in the MSc Biomedical Engineering at Delft University of Technology, which are able to specialise in specific areas of the biomedical research and design. In the BSc phase a thorough fundamental base in courses like mechanics, dynamics, control engineering and mathematics will be obtained. In the MSc phase on the one hand the fundamental base will be deepened, and on the other hand the students will learn to apply the fundamental knowledge in respect with the specific requirements of the medical field. During the MSc education, the students will be confronted with medical scientific knowledge and procedures in health care. Clinicians and biomedical scientists will teach part of the courses, in which the biophysical knowledge and technical applications of this knowledge are the central theme. In the MSc thesis project students have the opportunity to acquire the skills to be engaged in medical science.

1.10 Cheating, Citation and Plagiarism

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

Citation

Citation, literaly copying text is allowed, if:
- the text is limited in length and
- the citation is made between quotation marks and
- the source, even when this is an internet source, is mentioned in a correct and complete manner.

Parafrasing

Parafrasing means describing a text of a third party in your own words. This is allowed, if:
- it is mentioned what is being copied and of whom and
- the source, even when this is an internet source, is mentioned in a correct and complete manner and
- there is a clear seperation between the ideas of the third party and own ideas.

Plagiarism

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

Cheating

Passengers

Cheating is wider than plagiarism and also includes taking a look at other's work during exams or refusing to make a proportional amount of effort in a group assignment, which is assessed based on the effort of the group as a whole. People, who do this are called passengers.
Students suspected of copying, cheating, or being passengers, run the risk of being barred by the examination board from all tests and examinations held by TU Delft for up to one year. This can also have wide-ranging consequences for both the duration and the financial aspects of your course of study.

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

Organisation

2 Organisation

2.1 Faculty

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

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

2.2 Delft Center of Biomedical Engineering

In the Delft Center of Biomedical Engineering many research groups with applications in the biomedical engineering field collaborate. There is a yearly two-day symposium in which the PhD students present their work. The clinical partners are also invited to this symposium which is an excellent meeting place to start new and innovative research projects.

2.3 Education support staff

The education support staff is executing the education support of the study Biomedical Engineering. For all issues related to the Biomedical Engineering study the students can get information.

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

The Education Support Staff consists of the following persons:

prof.ir. Hans Klein Woud	Director of Education	j.kleinwoud@wbmt.tudelft.nl	Tel. 015 27 81556
ir. Nic-Jan van Bemmel	Manager Educational Programmes	n.j.vanbemmel@wbmt.tudelft.nl	Tel. 015 27 88791
Fatma Çinar	Education Administration office	f.s.cinar@wbmt.tudelft.nl	Tel. 015 27 86753
Teuni Eden	Student adviser	t.eden@wbmt.tudelft.nl	Tel. 015 27 82176
Lies Gesink	Education Administration office	e.g.gesink@wbmt.tudelft.nl	Tel. 015 27 86591
Louise Karreman	Study Administration office	l.m.karreman@wbmt.tudelft.nl	Tel. 015 27 83457
Ewoud van Luik	Manager Education Administration office & webmaster	e.p.vanluik@wbmt.tudelft.nl	Tel. 015 27 85734
dr. ir. Dick Nijveldt	Educational Adviser & Coordinator international exchange	d.nijveldt@wbmt.tudelft.nl	Tel. 015 27 85921
Carel Piguillet	Software Support	c.f.f.piguillet@wbmt.tudelft.nl	Tel. 015 27 86820
Mascha Toppenberg	International MSc-coordinator	m.p.i.toppenberg@wbmt.tudelft.nl	Tel. 015 27 86959
ir. Jaap v.d. Zanden	Student adviser	j.vanderzanden@wbmt.tudelft.nl	Tel. 015 27 82996

2.4 Education committee

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

Chairman prof.dr. F.C.T. van der Helm
tel.: (015) 278 5616
e-mail: F.C.T.vanderHelm@wbmt.tudelft.nl

Secretary mw. D. Heersma
Mekelweg 2, kamer 8C-1-18,
2628 CD Delft
tel.: (015) 278 6400
e-mail: D.Heersma@wbmt.tudelft.nl

2.5 Board of examiners

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

Chairman prof.dr. F.C.T. van der Helm
tel.: (015) 278 5616
e-mail: F.C.T.vanderHelm@wbmt.tudelft.nl

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

2.6 Students association

Since the MSc programma starts in 2004, at that time a new student association for all students in the Biomedical Engineering programme will be founded.

2.7 Student guidance

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

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

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

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

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

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

Ir. Jaap v.d. Zanden, student adviser for all students BSc-MSc WbMT.
Specialisms: Graduate students, polytechnic high school students, quality control, student mentors.
Mekelweg 2, 8B 2th floor, room 28A
Email: j.vanderzanden@wbmt.tudelft.nl
Phone: 015 27 82996

Dyslexia
Students having dyslexia usually have problems with reading and understanding of long texts. This can be an obstacle to 'normal' study progress. Therefore these students are advised to contact one of the student advisers and to set up a remedial plan. Important issues are:
- A planned study delay often helps
- When necessary, longer time for tests is possible
- Studying with a fellow student often results in more study progress
- IBG has extra student grants

2.8 Working conditions, RSI and harassment

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

Causes

There are two mechanisms that cause RSI:

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

Symptoms

There are various symptoms, which indicate RSI: pain, stiffness, tingling and a loss of strength can occur in neck shoulders, arms, wrists, hands and sometimes even in legs. Without 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 recommended to do no more than six hours of computer work a day.
- Make sure that the working position of the body is correct. A good installed workplace is important for a correct working position. Sit straight in front of your monitor and keyboard. The height and distance of the monitor and desk should be sufficient. A chair with a convex back at waist height is favourable.
- Try not to work under stress caused by deadlines or private problems.

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

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

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

Counsellor

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

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

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

2.9 Quality Control

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

Internal Quality Control:

SENSOR

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

Complaints

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

External quality control:

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

2.10 Information services

Study guide

This study guide is the main information source of the study programme and is available to all students at the education support desk (8B, 2th).

Blackboard

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.

Grades

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. Grades can also be found on blackboard.

Information that is not related directly to the study e.g. information by students association 'Leeghwater', will be published on publication boards. Members of 'Leeghwater' will be kept informed by e-mail.

2.11 Rules and Regulations

Student Statute (Studentenstatuut)

The Education Specific Part of the Student Statute (OSDS) applies to the education and the examinations of the study Biomedical Engineering.

The OSDS defines which educational services are given by the faculty and what is demanded from the students. The OSDS intends to offer the students an easy way to accomplish improvements in the educational situation, with help of the education director.

The OSDS consists of:

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

Faculty regulations

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

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

- Bikes should be placed in the bike stands provided.
- There is an opportunity to store personal belongings in lockers which are provided in the main hall. In the corridor situated next to lecture rooms A to F, bigger lockers can be used to store helmets. At the end of the study year, before the 15th of July, the lockers should be empty and the keys should be returned. Lockers, still in use after the 15th of July, will be provided with a new lock at the 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 of in bins.
- For the use of computers, network connections, printers and plotters there are rules and regulations, which should be taken in consideration.
- Disobeying of rules and regulations can result in a suspension or a denial of certain facilities. Theft or destruction on purpose of properties of DUT and also serious misbehaviour will be mentioned to the proper authorities.

Internet facilities

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

It is allowed to:

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

It is not allowed to:

- Damage or disable facilities.
- Use available facilities in any other way than they were supposed to be used:
  - Download, upload and fileshare of copyright protected items, such as texts, audio and video files, in any format.
  - Download and install any applications on the faculty computers.
  - Play computer games using network facilities.
- Make excessive use of the facilities.
- Let a third party use available facilities (including fellow students).
- Do damage or obstruct other users or equipment linked to the world wide web.
- Disrespect other peoples privacy, for example by sending information under a false name.
- Become a member of a mailing list outside the faculty without permission of the "dutwmail director". This rule only applies to the students.
- Distribute or show material that can be regarded as offending, for example insulting phrases or pornographic images or movies.

Sanctions:

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

Facilities

3 Facilities

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

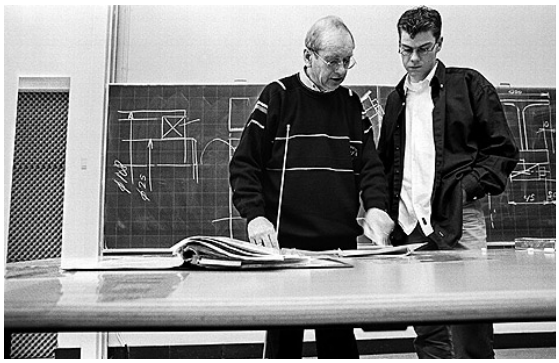
3.1 Lecture Rooms / Meeting Rooms

Lecture rooms are used for lectures, (graduation) presentations and instructions. The next table shows all the lecture rooms, their capacity and their location of the Building for Mechanical Engineering and Marine Technology.
Meeting rooms are available for meetings, discussions etc. of small groups of students. Reservations can be made as the desk of the education support staff.

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

3.2 Individual study facilities

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



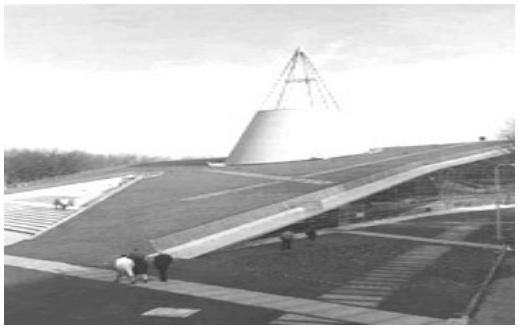
3.3 Computer rooms

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

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

3.4 Research facilities

The colloborating research groups in Biomedical Engineering (see Section 1.5.2) have many research laboratories to offer. Students may perform a part of their study, e.g. the MSc Thesis or a laboratory exercise in these laboratories. The laboratories are used for research activities of PhD students and staff.



3.5 Library

Central library

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

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

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

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

Faculty Library

The faculty library is a part of the TU Delft library. It has a collection, focussed on Mechanical Engineering and Marine Technology. Part of the books on Mechanical Engineering and Marine Technology, however can be found in the central library. In the faculty library the lecture-notes and books, used in the study, are available. These books and lecture-notes are not lent out in general. The faculty library also offers places to study. Print and scan equipment is available and there are several recent technical magazines. The library is located at the ground floor in section 8D.

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

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

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

3.6 Mailbox and access to the internet

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

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

The services mentioned above are taken care of by:

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

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

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

3.7 Available software

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

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

3.8 Catering

The faculty offers a variety of catering facilities.

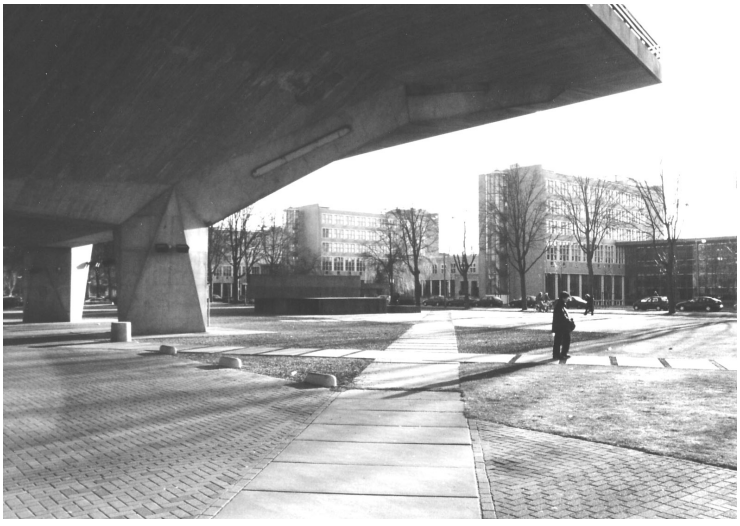
Canteen The faculty canteen serves a comprehensive lunch. The canteen can be found at location 10, BG.

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

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

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

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



Service for Students

4 DUT - Services for students

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

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

SFC

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

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

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

Sports Centre

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

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

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

Cultural Centre 'Mekelweg 10'

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

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

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

ICT Infrastructure

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

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

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

Course descriptions

ap3121d	Imaging systems
Lecturer	J.J.M. Braat
Course Material	Course notes "Imaging Systems"
Description	Basic properties of imaging systems, impulse response, frequency domain analysis. Source and illumination system; effects of coherence. Scanning systems. Distributed systems (apertue synthesis). Noise sources. Inverse problem in imaging. Examples of imaging systems from optics, acoustics and particle optics.
Education	Lecture **EC** 6
Assessment	Written exam

ap3351	Radiation technology and radiation detection
Lecturer	A.J.J. Bos, C.W.E. van Eijk
Course Material	G.F.Knoll, Radiation Detection and Measurement, John Wiley & Sons, 1989; W.R.Leo, Techniques for Nuclear and Particle Physics Experiments, Springer Verlag, 1987
Description	This course provides students an introduction to the application of radiation in medical, industrial and physics information technology. Radiation types, each with their specific properties, are introduced. Radiation sources like simple radioactive sources, particle accelerators, synchrotrons and X-ray machines are discussed. The interaction of radiation with matter is treated from the imaging point of view (transmission) as well as from the detection point of view (absorption). Radiation detection is an important subject in the course. Instrumentation for radiation detection is the main issue of this course.
Education	Lecture **EC** 6
Assessment	Written exam

ap3361	Medical physics and radiation technology
Lecturer	C.W.E. van Eijk, J. Zoetelief, A.J.J. Bos
Course Material	G.F.Knoll, Radiation Detection and Measurement, John Wiley & Sons, 1989
Description	The course is about selected topics concerning the detection of ionizing radiation, for instance i) the interaction of ionizing radiation with matter, ii) operation principles of several radiation detectors, iii) spectroscopic measuring techniques and data handling.
Education	Lecture **EC** 6
Assessment	Oral

ap3371	Radiological health physics (+31 hours pract.)	
Lecturer	A.J.J. Bos	
Course Material		
Description	Interaction between radiation and matter. Dosemetry. Biological working. Internal contamination. Measurement-methods. Masking. Safetymeasures. Rules and legislation	
Education	Lecture, exercises, pract.	**EC** 6
Assessment		

ap3471p	Measurement in images	
Lecturer	C.L. Luengo Hendriks	
Course Material	Hoeksma, Instruction Image Processing, Internal document of the Pattern Recognition Group. Gonzalez and Wintz, Digital Image Processing, Addison-Wesley,Reading MA	
Description	Introduction to measurement in images (image analysis). Exercises in different image processing operations. Solving simple problems.	
Education	Practical work 40 hours	**EC** 1.5
Assessment		

ap3531	Acoustical imaging	
Lecturer	C.P.A. Wapenaar, D.J. Verschuur	
Course Material	A.J. Berkhout, Seismic Migration, Elsevier, 1982;C.P.A. Wapenaar and A.J. Berkhout, Elastic Wavefield Extrapolation, Elsevier, 1989	
Description	Wave field decomposition (acoustic and elastic). Inverse wave field extrapolation (acoustic and elastic). Imaging principle. Acoustic and elastic Kirchhoff integrals. Applications in seismic exploration, medical imaging and non-destructive testing of construction materials	
Education	Lecture	**EC** 6
Assessment	Oral	

ct5142	Comp. methods in non-linear mechanics
Lecturer	Dr.ir. L.J. Sluys
Course Material	
Description	Recapitulatie van wiskundige gereedschappen die nodig zijn voor modelbeschrijving notatie; recapitulatie spannings- en rektensor en virtuele arbeid geometrische niet-lineariteit; staakwerkmodellen, stabiliteit, lineaire knikberekeningen oplossingstechnieken voor niet-lineaire statische problemen; verplaatsings- en krachtgestuurde methoden; Newton-Raphsonmethode; booglengtesturing; toepassing op eenvoudige systemen fysische niet-lineariteit; plasticiteit voor staal, beton en grond; scheurvorming in beton; lokalisatie en insnoeringsverschijnselen in staal en beton
Education	Lecture + exercise **EC** 3
Assessment	Oral exam

et4004	EM radiation, scattering and imaging
Lecturer	Dr. N.V. Budko
Course Material	
Description	Three basic electromagnetic processes are considered, namely: radiation from arbitrary current-distributions; scattering of given incident fields by arbitrary inhomogeneous objects; objects image formation from the measured scattered field. Fundamental three-dimensional equations in frequency and time domains are derived. Examples and computer simulations include: radiation from electric and magnetic dipoles, Born scattering from weak inhomogeneities, and linearized imaging by backpropagation.
Education	Lecture **EC** 3
Assessment	

et4083	Statistic signal processing
Lecturer	Prof.dr.ir. J. Biemond, Prof.dr.ir. R.L. Lagendijk
Course Material	R.L. Lagendijk and J. Biemond. Statistische Signaalverwerking. DUM, 1999. Reader (in English)
Description	After studying the course, the student has easy entrance to the vast amount of literature on this topic; he/she is able to develop algorithms for signal detection and estimation; he/she will gain a thorough understanding of the role of statistics/probability theory in signal processing.
Education	Lecture **EC** 3
Assessment	

et4085	Image processing
Lecturer	Dr. E.A. Hendriks / Prof.dr.ir. L.J. van Vliet
Course Material	
Description	image restoration (inverse filtering, Wiener filtering, geometric transformation), advanced morphological image processing and extension to grey-scale images, image segmentation (boundary detection, region-based segmentation, watersheds), representation and description of image objects, image features (structure tensor, local shape, Hough transform), camera calibration (intrinsic and extrinsic parameters, projection matrix), stereopsis (correspondence, epipolar geometry, essential and fundamental matrix), motion estimation (optical flow, feature-based techniques).
Education	**EC** 4
Assessment	

et4102	Mechatronic design
Lecturer	Dr.ir. J.B. Klaassens
Course Material	
Description	Mechatronic Design; An introduction Elementary principles of mechanics. Physical Modeling. Actuators: DC motor, Permanent magnet motor, stepper motor. Piezo actuator. Force control. Sensors for mechatronic applications. Hydraulic amplifier. X-by-wire.http://www.dcsc.tudelft.nl/~sc4100
Education	Lecture **EC** 2
Assessment	Written exam

et4126	Medical technology
Lecturer	Dr.ir. J.J. Gerbrands / Dr.ir. Th.J.C. Faes
Course Material	
Description	The use of medical technology in clinical practice (cycle of diagnosis and therapy). Physicla theory and engineering principles as basis for medical technology. Modelling and simulation of physiological processes in the human body. Measurement errors, quality and effectiveness of instruments. Safety and disinfection of instruments. These topics will be discussed for examples of diagnostic and therapeutic instruments.
Education	**EC** 4
Assessment	

et4127	Theme course biomedical technology
Lecturer	Dr.ir. J.J. Gerbrands / Dr.ir. Th.J.C. Faes / Dr.ir. W.A. van Duijl
Course Material	
Description	Every year another theme in biomedical engineering is presented. The subject and details of the course will be timely announced on Black Board of the university and on the website of Biomedical Engineering: (http://bmt.ewi.tudelft.nl). Each theme will be teached as an integration of physiological, clinical and technical disciplines.
Education	**EC** 4
Assessment	

et4128	Health care systems
Lecturer	Dr.ir. J.J. Gerbrands / Dr.ir. Th.J.C. Faes / dr.ir. W.T. van Beekum / Dr. D.W. Meijer
Course Material	
Description	Organization of the healthcare system in the Netherlands. State of health and its determinants. The role of technology in healthcare systems (level of aggregation, interaction, dynamics). Need of medical technology by patients, medical doctors and hospitals in daily practice. Requirements on safety, quality and desinfection.
Education	**EC** 3
Assessment	

et4129	Physical measurement methods & image techn.
Lecturer	Dr.ir. J.J. Gerbrands / Dr.ir. Th.J.C. Faes / prof.dr. R.M. Heethaar
Course Material	
Description	Imaging techniques in medicine (Microscopy, X-ray, CT, Echography, Scintigraphy, PET, MRI, Impedance tomography, MEG).
Education	**EC** 3
Assessment	

et4130	Bio-electricity
Lecturer	Dr.ir. J.J. Gerbrands / Dr.ir. Th.J.C. Faes / Dr.ir. W.A. van Duijl
Course Material	
Description	Ion processes in cell membranes. Creation and propagation of action potentials and neuromagnetic activity. Modelling. Clinical measurement and interpretation of bioelectric and biomagnetic signals.
Education	**EC** 3
Assessment	

et4137	Fuzzy logic engineering applications
Lecturer	Prof.dr.ir. J. Hellendoorn, Prof.dr. R. Babuska MSc
Course Material	
Description	Fuzzy logic techniques can be applied in various engineering domains, mainly in fields where reasoning under uncertainty plays an important role. This course provides background in fuzzy set theory, fuzzy logic and related soft-computing techniques with applications in control, information and data processing, artificial intelligence and decision making. See also: http:/www.dcsc.tudelft.nl/~sc4150.
Education	Lecture **EC** 2
Assessment	Written exam

et4147	Signal processing for telecommunications
Lecturer	Prof.dr.ir. A.J. van der Veen / Dr.ir. G. Leus
Course Material	
Description	Signal processing model of the wireless channel, elementary beamforming concepts (spatial filtering), tools from linear algebra: QR, SVD, eigenvalue decompositions, projections. Elementary beamformers/receivers: the matched filter, the Wiener filter. Estimation of angles and delays using ESPRIT, adaptive space-time filters and the LMS algorithm, the Constant-Modulus algorithm. Application to CDMA systems.
Education	**EC** 4
Assessment	

et4161	Information theory
Lecturer	Dr. A. Hanjalic
Course Material	
Description	This couse explains the basic ideas of information theory and the correspondances between the elements of this theory and certain natural concepts of importance in a wide number of fields, such as transmission, storage, authoring and protection of data. On the basis of simple concepts from probabiliby calculus, models are developed for a discrete information source and a discrete communication channel. Further, the theoretical basics for developing source coding algorithms is provided, as well as the basics of optimal data transmission through a discrete communication channel.
Education	**EC** 4
Assessment	

et4235	Digital signal processing
Lecturer	Prof.dr.ir. P.M. Dewilde, Prof.dr. A.J. van der Veen, A.J.vanderVeen@ewi.tudelft.nl
Course Material	
Description	Techniques in Signal Processing are treated as they really occur in major applications, most notably in telecommunications and multimedia. The course provides for a link between algorithm in Signal Processing and their implementation. We follow a modern approach: we start out from well-chosen main applications and develop the theory needed to fulfill the demands. Our starting points in this course will be (1) coding and modulation techniques for digital subscriber lines, in particular OFDM, (2) estimation and coding of speech as used in GSM and (3) selective filtering as is done in most radio receivers.
Education	Lecture **EC** 2
Assessment	Oral

et4248	Introduction to micro electronics
Lecturer	Prof.dr. C.I.M. Beenakker / Prof.dr. P.J. French
Course Material	
Description	This introduction to microelectronics provides an over-view of the different challenges in het field of Micro-electronics, as reflected by the research areas of the groups that comprise the department of microelec-tronics. The course includes visits to the various labora-tories, a visit to the DIMES facility and an excursion to a chip foundry. ET4, 14 hours lectures, 14 hours exercises.
Education	**EC** 3
Assessment	

et4249	Semiconductor comp. and techn.
Lecturer	Swaaij, dr. R.A.C.M.M. van
Course Material	
Description	Some basic semiconductor components are discussed, like the p-n junction, the p-n diode, the bipolar transistor and the field-effect transistor. The characteristics of these devices are explained on the basis of physical properties of meterials and interfaces between these materials.
Education	**EC** 5
Assessment	

et4250	IC technology
Lecturer	Ir. A.J.G. Spiekerman/ Prof.dr.ir. P.M. Sarro
Course Material	
Description	After an introduction on fabrication of pure monocrystalline silicon and meterial properties the major process steps in the fabrication of integrated circuits are discussed. Including photolithography. The basic concepts of silicon micromachining are introduced to illustrate the potential of 3D microstructuring in the development of microsystems. Finally process yield, component reliability, assembly and testing are considered. ET4, course.
Education	**EC** 4
Assessment	

et4251	HF silicon technology
Lecturer	Prof.dr.ir. J.W. Slotboom, Prof.dr. J.N. Burghartz
Course Material	
Description	This course will deal with integration principles to provide an idea of possibilities and limitations of inte-grated transistors, passive components, and intercon-nects at very high frequencies. First, typical process modules will be illustrated; those modules are the buid-ling blocks of integrated devices. Then, complete inte-grated divice structures, composed of such building blocks, will be explained. The high-frequency figures-of-merit will next be revisited while including parasitics from device integration.
Education	Lecture **EC** 3
Assessment	

et4252	Analogue IC design
Lecturer	Prof.dr. J.R. Long
Course Material	
Description	Topics include: Review of analog design basics. Linear and non-linear analog building blocks: electronics switches, switched-capacitor circuits, oscillators, comparators, AGC and limiting circuits, wideband amplifier design. Circuits for modulation, demodulation and frequency conversion. Physical layout (e.g., device matching) for robust analog circuits and analog simulation issues. Design of voltage sources ranging from simple voltage dividers to high-performance bandgaps, and current source implementations from a single resistor to high-quality references based on negative-feedback structures. Quality aspects, such as accuracy, output noise and output impedance are treated within the context of power consumption requirements.
Education	Lecture **EC** 3
Assessment	Oral and design project

et4253	Nanoelectronics & micropower design
Lecturer	Dr. J. Hoekstra
Course Material	
Description	This course offers an introduction to nanoelectronics, a new and advanced topic in electronics. Nanotechnology promises new small electronic devices that might provide faster, more highly integrated circuits with extremely low power consumption. The quantum behavior of the metallic single-electron tunnel (SET) junction device in electronics, we shall after a brief introduction to the devices and the physics of the nanodevices concentrate on the modelling of the devices both by analytical techniques and by SPICE simulation.
Education	**EC** 4
Assessment	

et4256	Reliability engineering
Lecturer	Bossche, dr.ir. A.
Course Material	
Description	This course aims to provide the students with a thorough understanding of the reliability of systems and components. After the course the students should see reliability and safety as basic requirements that should receive attention throughout a product's complete lifecycle: specification, design, production, exploitation and disposal. The following subjects will be treated: Failure mechanisms in Electronics (overview), Life-Time Distributions, Data Analysis, Reliability Models, Reliability Prediction, Reliable Design Concepts, FMECA, Fault Tree Analysis.
Education	**EC** 4
Assessment	

et4257	Sensors
Lecturer	French, prof.dr. P.J.
Course Material	
Description	The course silicon sensors gives an overview of the most important principles related to sensors fabricated in integrated silicon technology. The sensors are divided into those for optical, mechanical, thermal, magnetic and chemical signals. A special topic in this course is that of CMOS image sensors. This part of the course will deal with the most important principles, possibilities and limitations of image sensors which are fabricated in a standard CMOS process. All different imaging aspect of the solid-state image sensors ranging from "photons in" till "digital numbers out" will be studied. Special attention will go to the combination of the imaging function with the analogue and digital circuitry on-chip.
Education	**EC** 4
Assessment	

et4258	Displays & actuators
Lecturer	Vdovin, dr. G. / French, prof.dr. P.J.
Course Material	
Description	This course gives an overview of the most important principles which are applied to modern displays and actuators. In addition, external computer memory and printers are considered. We all work with displays, whether they be for clocks, pc or information boards. The mechanisms to create the display make use of a wide range of principles including electrical, magnetic, chemical and mechanical. These will be considered and a large number of applications given. The actuators lectures give the range from large machines down to silicon micromachined device in the micron range.
Education	**EC** 4
Assessment	

et4260	Microsystems integration
Lecturer	Huijsing, prof.dr.ir. J.H.
Course Material	
Description	The course is intended to be a hands-on activity in which the student is confronted with typical aspects of measurement and instrumentation, especially as they relate to the realization of single chip systems. The course consists of four parts of which only three will be taught in a given year. In the first part the basic instrumentation issues associated with continuous and sampled-data signal processing will be discussed. The second part covers measurement techniques widely used in integrated circuit testing, such as the measurement of layer thickness and sheet resistivity. The third and fourth parts discuss components widely used in measurements systems viz. operational amplifiers and analog-to-digital converters respectively. The course consists of only 12 lecture hours.
Education	**EC** 4
Assessment	

et8016	Structured electronic design
Lecturer	Verhoeven, dr.ir. C.J.M. / Staveren, dr.ir. A. van
Course Material	
Description	This course focuses on a systematic approach to the design of analog electronic circuits. The methodology presented in the course is based on the concepts of hierarchy, otholonality and simple models applied to the design of negative-feedback amplifiers. It is shown that aspects such as ideal transfer; noise performance, distortion and bandwidth can be designed independently. Also, methods to preserve this independence even when it is not naturally present in the design are described. A systematic approach to biasing completes the discussion. Lectures are interactive and combined with hand-on exercises.
Education	**EC** 4
Assessment	

et8016	Electronic instrumentation 1
Lecturer	Dr.ir. R.F. Wolffenbuttel
Course Material	
Description	1. Designing measurement systems for electrical and non-electrical quantities. 2. Estimation of the detection limit in electrical and non-electrical measurements. 3. Applying circuit and system techniques for measuring in the presence of high-level interference signals.
Education	Lecture **EC** 3
Assessment	Homework, Projects, exam

ide521	Computer visualisation
Lecturer	Ir. D.P. Saakes
Course Material	
Description	In short, the idea of this course is to learn to use the computer to assist you in material studies and presenting your designs. You will select an existing product, preferably one of a previous design course. Next you will build a computer graphics model of this product and use this model to do a material study. At the end of the course you will render the material study in a presentation and create a presentation of the product in a context (product placement).
Education	Assignment + Lectures **EC** 3
Assessment	Presentation + Portfolio

ide534	Ergonomical aspects data processing systems
Lecturer	Ir. A.P.O.S. Vermeeren
Course Material	
Description	Products now increasingly feature chips, buttons and displays and complex functionality. This can present users of these products with problems unless the interface between product and user is ergonomically well designed. For the industrial designer this means acquiring new design techniques alongside the traditional ones. This subject introduces students to a range of techniques for designing interfaces for such products and deQuarterining functionality from the user's point of view.
Education	Lectures + exercises **EC** 2
Assessment	Based on exercises

in4008/4009	Data visualization
Lecturer	Ir. F.H. Post
Course Material	
Description	Theory and general principles of data visualization are discussed, and illustrated by practical examples from many application areas. Thopics covered: models of the visualisation process; basic 3D computer graphics; 2D graphs and charts; generation, representation and processing of data; colour and the use of colour; volume visualization and medical applications; visualization of vector fields and flows; feature extraction, and virtual reality. Guest lectures will be given on various topics. IN4, lectures 0/0/4/0 + lab 56 hours.
Education	**EC** 5
Assessment	

in4085	Pattern recognition
Lecturer	Dr.ir. R.P.W. Duin, Dr.ir. M.J.T. Reinders, Dr.ir. D. de Ridder, Dr. D.M.J. Tax, Dr. L.F.A. Wessels
Course Material	
Description	Recapitulation of Multi-dimensional statistics, data visualisation, density esimation, cluster analysis. Representation of real world objects by features, prototypes and dissimilarities. Training pattern classifiers by examples. Feature extraction. Bayes' rule. Classification by statistical discriminants, neural networks, decision trees or support vector machines. Statistical learning theory. One-class classifiers. Combined appraoches. EM algorithm. Partially supervised learning. Evaluation procedures, cross validation. Overtraining, regularisation.
Education	Lecture **EC** 6
Assessment	

ls1061	Cell biology 1
Lecturer	prof. dr. J.W. Kijne
Course Material	W.H. Lodish et al., Molecular Cell Biology 4th ed., Freeman and Co, New York A selection of overhead sheets
Description	The goal of this coarse is to give insight into the structure and funtion of the different parts of
Education	**EC** 3
Assessment	

sc4020	Control theory
Lecturer	Bosgra, prof.ir. O.H
Course Material	K. Ogata, Boek: Modern Control Engineering, Prentice Hall Int. Upper Saddle River, NJ, USA 1997. paperback edition ISBN: [0-13-261389-1] Hoofdstukken: 3, 9, 11, 12, 13
Description	Control engineering: basic theory. State space description of linear dynamic systems. Stability theory, frequency domain analysis. Controllability, observability. Loop shaping for dynamic response. Pole assignment, state feedback. Linear observers, Kalman filter. Design and separation principle. LQ regulator and LQG theory. LQ control system design, dynamic compensation. Tracking control, servomechanism design.
Education	Lecture **EC** 6
Assessment	Exersise + written exam

sc4110	System identification B
Lecturer	prof. dr. ir. P.M.J. Van den Hof and dr. ir. X.J.A. Bombois
Course Material	Lecture Notes: P.M.J. Van den Hof, "System Identification" (1998). (in English).
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; model validation. MATLAB toolbox.
Education	Lecture **EC** 5
Assessment	Oral exam

wb1310	Multibody dynamics A
Lecturer	Dr.Ir. Arend L. Schwab
Course Material	Lecture Notes and M.Wisse, Introduction to ADAMS, Delft, 1999.
Description	Multibody Dynamics id about the analysis of the motion of complex mechanical systems as in a robot arm, a railway bogie or a gantry crane. In this course you will learn about the fundamentals of Multibody Dynamics: the description of the orientation of a rigid body in space, the Newton-Euler equations of motion for a 3D rigid body, how to add constraints to the equations of motion, and how to solve such a system of coupled equations. Next you will spend most of the time (80%) in doing the assignments with the ADAMS Software.
Education	Lecture **EC** 3
Assessment	Written+Lab Report

wb1406	Experimental mechanics
Lecturer	Booij, J., M.Sc. and Woerkom, dr.ir. P.Th.L.M. van
Course Material	Course notes for Part A Course notes for Part B
Description	Measurement of static strains and shape changes in structures using strain gages, photo-elastic method, thermo-elasticity, raster techniques, Moiré, holography, and laser-speckle techniques. Measurement of structural dynamics: properties of materials, viscous damping and structural damping, visco-elastic materials, modal analysis, frequency response, modal parameter identification, identification of frequency transfer functions.
Education	Lecture **EC** 3
Assessment	Written report

wb1409	Theory of elasticity
Lecturer	Keulen, prof.dr.ir. A.
Course Material	Y.C. Fung, Foundations of Solid Mechanics,
Description	Stress and strain tensors, elastic constitutive equations, linear theory of elasticity, energy principles, energy theorems, stress functions, composite theory, homogenization
Education	Lecture **EC** 3
Assessment	Exercises + oral exam

wb1413	Multibody dynamics B
Lecturer	Dr.Ir. Arend L. Schwab
Course Material	Arend L. Schwab, `Applied Multibody Dynamics', Delft, 2003
Description	Dynamics of Mechanical Systems, Multibody System Dynamics, Kinematics, Spatial Systems.
Education	Lecture **EC** 3
Assessment	Oral exam

wb1416	Computational engineering mechanics
Lecturer	Daniel J. Rixen
Course Material	Lecture notes (available through blackboard)
Description	
Education	Lecture **EC** 3
Assessment	Oral exam

wb1427-03	Advanced fluid mechanics A
Lecturer	Delfos, dr. R. / (Nieuwstadt, prof.dr.ir. F.T.M.)
Course Material	Lecture Notes "Stromingsleer Voortgezette Cursus A (wbmt 1422A)", (in Dutch) in downloadable PDF-format. Introduction to Fluid Dynamics by G.K. Batchelor.
Description	Fluid mechanics, Kinematics, Dynamics, Equations of motion, Continuity equation, Stress-Deformation rate relationship, Navier-Stokes equations, Potential theory, Boundary-layer theory, Stokes flow
Education	Lecture **EC** 5
Assessment	Written

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

wb1429-03	Microfluidics
Lecturer	Lindken, R., Westerweel, prof.dr.ir. J.
Course Material	Fundamentals and Applications of Microfluidics, by Nguyen & Wereley (Artech House, 2002)
Description	This course is an introduction to microfluidics. We start with a review of fluid mechanics theory and electrokinetics. We study the typical geometries found in microfluidic devices and discuss different methods for experimental flow characterization, i.e. microPIV. This is followed by a discussion of microfluidic devices for external and internal flow control, i.e. microvalves, micropumps and microflow sensors, and microfluidic devices for life sciences and chemistry. The course will also introduce the student to numerical methods for solving microfluidic flows.
Education	Lecture + Lab. demonstrations **EC** 3
Assessment	Written exam

wb1440	Eng.optimization: concept and applications
Lecturer	Keulen, prof.dr.ir. A. van
Course Material	P.Y. Papalambros et al. Principles of Optimal Design: Modelling and Computation.
Description	Formulation of optimization problems, typical characteristics of optimization problems, minimization without constraints, constrained minimization, simple optimization algorithms, discrete design variables, approximation concepts, sensitivity analysis.
Education	Lecture + excercises **EC** 3
Assessment	

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

wb2301	System identification & parameter estimation	
Lecturer	Van der Helm, Prof.dr. F.C.T.	
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	**EC** 7
Assessment	Oral exam on final written assignment	

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

wb2306	Cybernetical ergonomics
Lecturer	Helm, prof.dr. F.C.T. van der
Course Material	Reader: Cybernetical ergonomics.
Description	Cybernetical ergonomics, sensory organs, motoric system, fysical load, mental load, human operator control, supervisory control, ergonomic design.
Education	Lecture **EC** 3
Assessment	Written

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

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

wb2402	Hydraulic servo systems
Lecturer	Teerhuis, ir. P.C.
Course Material	T.J.Viersma. Analysis synthesis and design of hydraulic servo systems and pipelines. 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 **EC** 3
Assessment	

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

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

wb2408	Physiological systems
Lecturer	Dankelman, prof. dr. J., Grimbergen, prof.dr.ir. C.A.
Course Material	J. Dankelman, C.A. Grimbergen, J.A.E. Spaan. Fysiologische Systemen (Physiological Systems) lecture notes in Dutch and in English (under preparation).
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 **EC** 3
Assessment	Oral

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

wb2421	Multivariable control systems
Lecturer	Weiden, dr.ir. A.J.J. van der
Course Material	Multivariable Feedback Control Analysis and Design. S.Skogestad, I.Postlethwaite. Lecture notes: The poles and zeros of multivariable systems, A.J.J. van der Weiden.
Description	The lectures are divided into blocks. At first a review of elementary single-loop feedback design is given. In the second block of lectures a system theoretical approach is used to explain the properties and the computation of the poles and zeros of multivariable feedback systems. Furthermore internal stability and the generalized Nyquist stability is discussed. The third block treats performance and robustness of multivariable feedback systems. The use of principal gains (singular values) for assessing performance is introduced.
Education	Lecture **EC** 6
Assessment	Oral examination and excercises based on MATLAB.

wb2431	Bone mechanics and implants
Lecturer	Linden, mw. J. van der, Valstar, dr.ir. E.R.
Course Material	Notes handed out during course
Description	This lecture series will give an overview of the functioning of the human skeleton, its evolution, growth and degeneration and artificial prostheses which are frequently used when parts of the skeleton fail.
Education	Lecture **EC** 3
Assessment	Oral examination after appointment

wb2432	Biomechatronics
Lecturer	Profdr. F.C.T. van der Helm, dr.ir. D.H. Plettenburg, dr.ir. J.L. Herder
Course Material	A reader is available through Blackboard
Description	Biomechatronics is a contraction of biomechanics and mechatronics. In this course the function and coordination of the human motion apparatus is the central focus, and the design of assistive devices for the support of the function of the motion apparatus. Examples are assistive devices like an orthosis, prosthesis or Functional Electrical Stimulation of muscles. The goal is to provide some function to patients with functional deficiencies.
Education	Lecture **EC** 4
Assessment	Oral

wb2435-03	Surgical instruments and medical safety
Lecturer	Mw. prof. dr. J. Dankelman
Course Material	Lecture notes (in preparation)
Description	Introduction to surgery, dissect and connect tissue. Surgical instruments and their specific requirements. Quality of surgical tools, quality control, sterilization. Advances and disadvantages of minimally invasive surgery (keyhole operations). Possibilities and problems of using robotic systems during surgery. Task analysis of the surgical process. Training of surgeons, Pelvi- and VR-trainers, on-site training.Operation rooms, equipment. Safety issues in the operation room.
Education	Lecture **EC** 2
Assessment	Oral exam

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

wi4008	Complex analysis	
Lecturer	Prof.dr. H.G. Meijer	
Course Material		
Description	Complex numbers. Analytic functions. Complex integration. Residue calculus. Zeros, poles, identify theorem, analytic continuation. Conformal mappings.	
Education		**EC** 4
Assessment		

wi4011	Numerical fluid dynamics	
Lecturer	Prof.dr.ir. P. Wesseling	
Course Material		
Description	Basic equations of fluid dynamics. Numerical methods for convection-diffusion equations: finite volume schemes; stability, consistency and convergence of numerical schemes; Fourier stability analysis, local grid refinement; singular perturbation theory; uniform accuracy and efficiency for vanishing viscosity. Numerical solution of the time-dependent and time-independent incompressible Navier-Stokes equations. Pressure-correction method. Direct and iterative solution methods for large sparse systems. Distributive iteration methods for the Navier-Stokes equations. Remarks on programming in MATLAB. Numerical methods discussed for the convection-diffusion and Navier-Stokes equations have been implemented in MATLAB programs that are made available.	
Education		**EC** 6
Assessment		

wi4014tu	Numerical analysis C2	
Lecturer	Ir. J. J. I. M. van Kan	
Course Material	J. van Kan en A. Segal, Numerieke methoden voor partiële differentiaalvergelijkingen. DUM, 1993	
Description	Numerieke methoden voor partiële differentiaalvergelijkingen. Klassifikatie van PDV's, eindige differentie, volume- en elementenmethode. Minimaliseringsproblemen. Methoden van Ritz en Galerkin. Lineaire en hogere orde basisfuncties. Conforme en niet conforme elementen. Foutschattingen. Oplossen van grote ijle stelsels lineaire vergelijkingen. Toepassingen op warmtegeleiding, trillingen en transportproblemen	
Education	Lecture	**EC** 4
Assessment	4 take-home excercises and practical exercise of 30 hours	

wi4070tu	Digital simulation A (+25 hours pract.)	
Lecturer	Dr. S.A. Borovkova	
Course Material		
Description	Digitale simulatie A versie. Modelbouw, Monte Carlo-methoden, simulatie en modelbouw met PROSIUM, satistische aspecten m.b.t. in- en uitvoer.	
Education		**EC** 4
Assessment		

wm0605tu	Business economics for engineers	
Lecturer	drs T. Poot	
Course Material		
Description	After having completed this course successfully the business-economical principles will no longer pose a mystery. Profit / loss queries, financing businesses and projects, and accounting of business processes will all be treated. Business-economical basic principles will be actively applied. Special attention will be given to the business-economical situation of innovative businesses.	
Education	Lecture	**EC** 4.5
Assessment	Written exam	

wm0621tu	Innovation management
Lecturer	Prof. dr. A.H. Kleinknecht
Course Material	J. Tidd, J. Bessant & K. Pavitt: Managing Innovation, Chichester: J. Wiley & Sons, second edition, 2001, ISBN: 0-471-49615-4 (paperback)
Description	
Education	lecture **EC** 3
Assessment	Written exam

wm1101tu	Upper-Intermediate english (refresher)
Lecturer	mr. A.K. Chatterjee
Course Material	Murphy, Raymond (1994, 2nd ed.). English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students, (with answers). Cambridge
Description	The course is based on a series of texts relating to various topics. Students are required to study the texts in detail and their knowledge will be tested each week. Listening skills will be developed while oral communication skills will be improved through discussion and conversation, and writing skills through the regular assignments. Each week there will also be the opportunity to discuss and revise vocabulary and grammar arising from the texts studied. In the second half of the course each student will be required to give a short presentation, which will be followed by detailed individual feedback.
Education	Lecture **EC** 3
Assessment	Written exam, written assignments, oral presentation

wm1102tu	Written english for technologists
Lecturer	drs. E. McDonagh
Course Material	Swales, John M. and Christine B. Feak (1994) Academic Writing for Graduate Students: A Course for Nonnative Speakers of English. Michigan: The University of Michigan Press
Description	This course is designed for students who are nearing the end of their studies in Delft and whose English is already of a reasonably high standard. As the name of the course suggests, the focus throughout will be on writing. Not only will your written English be corrected but you will also be taught how to structure essays, reports or theses. Attention will be paid to style and plenty of tips will be given on ways to improve and invigorate your writing. Your systematic mistakes will be pointed out so that you can become critical about your own writing while at the same time improving it.
Education	Lecture **EC** 3
Assessment	course attendance, assignments, report

wm1109tu	Scientific writing and oral presentation
Lecturer	drs. B.M.D. van der Laaken
Course Material	Robert A. Day, How to write and publish a scientific paper, 5th Edition, Cambridge University Press, 1998; Bob van der Laaken: Reader Presentation Skills WM0203.
Description	Reinforcing communicative skills in English. At the end of the course the student is able to write scientific texts (articles, Master's Thesis) and to give scientific oral presentations which meet the communicative and linguistic requirements of the scientific community.
Education	Lecture **EC** 3
Assessment	Article and Presentation

Appendices

6.1 Course and Examination Regulations

Section 1 GENERAL

Article 1 SCOPE AND APPLICABILITY OF THESE REGULATIONS

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

Article 3 OBJECTIVE OF THE MASTER'S PROGRAMME MECHANICAL ENGINEERING

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

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

Article 4 ADMISSION TO THE MASTER'S PROGRAMME

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

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

The graduated Master of Science Biomedical Engineering meets the following qualifications:

- Broad and profound knowledge of the basic engineering sciences (mathematics and applied physics) and the capability to apply these at an advanced level on one biomedical engineering specialisation.

- Broad and profound technical scientific knowledge of one biomedical engineering discipline and the skills to use this knowledge effectively. The knowledge should be mastered at a level of the technological borders of the discipline.
- Thorough knowledge of methods, paradigms and tools to analyse, interpret, model, simulate design and perform experiments and research. The knowledge has been actively applied in one biomedical engineering specialisation.
- Capability to contribute to the solution of technological problems by a systematic approach involving analysis, formulating sub problems, providing innovative solutions, evaluating the feasibility and the final elaboration.
- Capability of working both independently and in (multidisciplinary) teams, taking initiatives where necessary, identifying and acquiring lacking expertise. Have an appreciation of the uncertainty, ambiguity and limitations of knowledge.
- Capability to effectively communicate (including presenting and reporting) about his/her work to both professionals and a non specialised public both in English and his/her native language.
- Capability to evaluate and assess the technological, societal and ethical impact of his/her work, taking responsibility with regard to sustainability, economy and social welfare.
- Maintain his/her professional competence through life-long learning.

Article 6 FULL-TIME AND PART-TIME COURSE FORMAT

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

Article 7 LANGUAGE

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

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

Article 8

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

Section 3 INTERIM EXAMINATIONS

Article 9 THE NUMBER, PERIOD AND FREQUENCY OF INTERIM EXAMINATIONS

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

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

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

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

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

Article 10 THE ORDER OF INTERIM EXAMINATIONS

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

Article 11 THE PERIOD OF VALIDITY OF INTERIM EXAMINATIONS

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

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

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

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

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

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

Article 13 ORAL INTERIM EXAMINATIONS

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

Article 14 THE ESTABLISHMENT AND NOTIFICATION OF RESULTS

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

Article 15 CANDIDATES' RIGHT TO INSPECT THEIR EXAMINATION DOCUMENTS

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

Article 16 OPTIONS FOR DISCUSSING THE RESULTS OF AN INTERIM EXAMINATION

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

Section 4 EXEMPTION FROM INTERIM EXAMINATIONS

Article 17 EXEMPTION FROM INTERIM EXAMINATIONS OR PRACTICAL EXERCISE

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

Section 5 THE MASTER'S EXAMINATIONS

Article 18 PERIODS AND FREQUENCY OF EXAMINATIONS

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

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

Article 19 REPORTING ON STUDENTS' PROGRESS

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

Section 6 PROVISIONS FOR IMPLEMENTATION

Article 20 MODIFICATION OF THE REGULATIONS

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

Article 21 TRANSITIONAL RULING

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

Article 22 PUBLICATION OF THE TRANSITIONAL RULING

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

Article 23 DATE OF COMMENCEMENT

These regulations shall come into force on 1 September 2004.

6.2 Implementation Procedures

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

Article 1 COURSE CALENDAR

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

Article 2 COMPOSITION OF THE PROGRAMME

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

Article 3 COMPOSING FLEXIBLE STUDY PROGRAMMES

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

Article 4 PROCEDURE FOR APPROVING FLEXIBLE STUDY PROGRAMMME

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

Article 5 THE ORDER OF INTERIM EXAMINATIONS AND ASSIGNMENTS

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

Article 6 MASTER'S THESIS

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

Article 7 VARIANTS AND ANNOTATIONS

1. The Biomedical Engineering MSc-programme is provided in only one variant.
2. As an addition to the programme there is an 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. The annotation is:
   - Technical Marketing
3. Further details and requirements be laid down in the study guide.

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

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

Laid down by the Dean of the Faculty Mechanical Engineering and Marine Technology , after the approval of the Faculty's Student Council, and after considering the recommendations provided by the education committee on 1-7-2004.

6.3 Regulations and guidelines for the board of examiners

Article 1 SCOPE OF THE REGULATIONS

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

Article 2 DEFINITIONS

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

Article 3 DAY-TO-DAY ADMINISTRATION

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

Article 4 MASTER'S EXAMINING COMMITTEE

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

Article 5 ENTRY FOR INTERIM EXAMINATIONS

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

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

Article 6 ORDER DURING AN INTERIM EXAMINATION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Article 7 CHEATING

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

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

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

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

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

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

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

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

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

[1] Course and Examination Regulations

Article 8 CRITERIA

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

a that the criteria regarding quality and selection inherent to an interim examination are maintained;
b that the need for efficiency is met, particularly by limiting to a minimum any time loss that would hinder those students whose preparations for examinations and interim examinations are running to schedule;
c that students who wish to assume too great a study load should be protected from themselves;
d that clemency should be shown in all cases in which students' progress is slowed by circumstances beyond their control.

Article 9 QUESTIONS AND ASSIGNMENTS

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

Article 10 ASSESSMENT

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

Article 11 THE ESTABLISHMENT OF EXAMINATION RESULTS[2]

1 The votes of the board of examiners shall be established by a simple majority of votes.
2 If the votes are equally divided, the chair of the board of examiners shall have the casting vote, unless the vote takes place in writing.

[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.

3 If, in a written vote, the votes are equally divided, there shall be a second ballot. If this, too, leads to an equal division of votes, the proposal being balloted shall be rejected.

Article 12 CUM LAUDE

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

a the mark awarded to the components specified in the Master's examination implementation procedures, excluding the mark awarded for the Master's thesis project, shall average no less than 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 three years;

c the mark awarded for the thesis project shall be no less than 9;

d the examiner of the graduation assignment shall have submitted a proposal for the award of "cum laude".

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

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

Article 13 MASTER'S DEGREE CERTIFICATES AND STATEMENTS

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

2 a The degree certificate as intended under paragraph 1 shall list the specific components of the examination, and, where appropriate, the competencies associated with them.

b The degree certificate shall be accompanied by marks lists in both Dutch and English.

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

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

Article 14 PROCEDURE FOR APPROVALS

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

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

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

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

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

Article 15 TIME PERIODS

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

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

Article 16 RIGHT OF APPEAL

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

Article 17 MODIFICATION OF THESE REGULATIONS AND GUIDELINES

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

Article 18 DATE OF COMMENCEMENT

These regulations will come into effect on 1 September 2004.
Approved by the board of examiners of the Master's programme in Biomedical Engineering.

6.4 Lecturers

Naam	Tel[1]	E-Mail	Kamer	Gebouw[2]
Andriessen, prof. dr. J.H.T.H.	81742	j.h.t.h.andriessen@tbm.tudelft.nl	1.2.310	TBM
Bauer, dr. P	84654	p.bauer@its.tudelft.nl	LB 03.600	ITS-et
Beek, dr. ir. A. van	86984	a.vanbeek@wbmt.tudelft.nl	8C-2-19	WbMT
Bekke, dr. ir. J.H. ter	84402	j.h.terbekke@its.tudelft.nl	HB 10.110	ITS-et
Bikker, prof. ir. H.	82711	h.bikker@wbmt.tudelft.nl	8D-3-23	WbMT
Boersma, dr. ir. B.J.	87979	b.j.boersma@wbmt.tudelft.nl	5B-1-33	WbMT
Booij, MSc. J.	86504	j.booij@wbmt.tudelft.nl	8C-2-13	WbMT
Bos, ir. W. van den	82004	w.vdenbos@wbmt.tudelft.nl	8C-4-23	WbMT
Bosgra, prof. ir. O.H.	85610	o.h.bosgra@wbmt.tudelft.nl	8C-0-09	WbMT
Buijtenen, prof. ir. J.P. van	82179	j.pvanbuijtenen@wbmt.tudelft.nl	8D-2-10	WbMT
Buiting-Csikos, mw. ir. C.S.	83300	cs.buiting@wbmt.tudelft.nl	8D-4-19	WbMT
Colonna, dr. ir. P.	82172	p.colonna@wbmt.tudelft.nl	8D-2-09	WbMT
Dankelman, prof. dr. J.	85565	j.dankelman@wbmt.tudelft.nl	8C-1-20	WbMT
Dekkers, ir. R.	83153	r.dekker@wbmt.tudelft.nl	8D-3-20	WbMT
Delfos, dr. R.	82963	r.delfos@wbmt.tudelft.nl	5B-1-32	WbMT
Dhillon, prof.dr. J.S.	82147	j.s.dhillon@wbmt.tudelft.nl	1-09	API
Dietz, prof. ir. J.L.G.	87822	j.l.g.dietz@its.tudelft.nl	HB 09.060	ITS-et
Dijkstra, dr. S.	85606	s.dijkstra@wbmt.tudelft.nl	8C-0-01	WbMT
Drenth, ir. K.F.	86718	k.f.drenth@wbmt.tudelft.nl	8C-4-12	WbMT
Duinkerken, ir. M.B.	81790	m.b.duinkerken@wbmt.tudelft.nl	8C-4-13	WbMT
Eijk, prof. dr. ir. J. van	85396	j.vaneijk@wbmt.tudelft.nl	5A-0-28	WbMT
Ernst, prof. dr. ir. L.J.	86519	l.j.ernst@wbmt.tudelft.nl	8C-2-23	WbMT
Goosen, J.F.L.	86500	j.f.l.goosen@wbmt.tudelft.nl	8C-3-23	WbMT
Grimbergen, prof. dr. ir. C.A.	85419	c.a.grimbergen@wbmt.tudelft.nl	8C-1-24	WbMT
Haaf, ir. W. ten	86781	w.tenhaaf@wbmt.tudelft.nl	8D-3-25	WbMT
Hein, prof. dr. ing. K.R.G.	82186	k.r.g.hein@wbmt.tudelft.nl	8D-2-10	WbMT
Helm, prof. dr. ir. F.C.T. van der	85616	f.c.t.vanderhelm@wbmt.tudelft.nl	8C-1-19	WbMT
Herder, dr. ir. J.L.	84713	j.l.herder@wbmt.tudelft.nl	5A-2-06	WbMT
Hof, prof. dr. ir. P.M.J. van den	84509	p.m.j.vandenhof@tnw.tudelft.nl	F 218	TNW
Hooghiemstra, dr. G.	82589	g.hooghiemstra@its.tudelft.nl	HB 06.090	ITS-et
Hoogstrate, dr. ir. A.M.	86804	a.m.hoogstrate@wbmt.tudelft.nl	8D-4-08	WbMT
Huesman, ir. A.	88131	a.huesman@wbmt.tudelft.nl	8C-0-19	WbMT
Infante Ferreira, dr. ir C. A.	84894	c.a.infanteferreira@wbmt.tudelft.nl	8D-2-19	WbMT
Janssen, dr. ir. K.M.B.	86905	k.m.b.janssen@wbmt.tudelft.nl	8C-2-07	WbMT
Jong, dr. W. de	89476	w.dejong@wbmt.tudelft.nl	8D-2-14	WbMT
Karpuschewski, prof. dr. ing. B.	83204	karpu@wbmt.tudelft.nl	8D-3-08	WbMT
Keulen, prof. dr. ir. A. van	86515	a.vankeulen@wbmt.tudelft.nl	8C-3-23	WbMT
Klein Breteler, dr.ir. A.J.	83130	a.j.kleinbreteler@wbmt.tudelft.nl	8C-4-18	WbMT
Klein Woud, prof. ir. J.	81556	j.kleinwoud@wbmt.tudelft.nl	7-1-121	WbMT
Knoester, ing. J.	86569	j.knoester@wbmt.tudelft.nl	4-0-05	WbMT
Kramer, dr. ir. H.J.M.	85593	h.j.m.kramer@wbmt.tudelft.nl	1-18	API
Linden, mw. J.C. van der	82704	j.c.vanderlinden@wbmt.tudelft.nl	8C-3-21	WbMT

Naam	Tel[1]	E-Mail	Kamer	Gebouw[2]
Lodewijks, prof. dr. ir. G.	88793	g.lodewijks@wbmt.tudelft.nl	8C-4-11	WbMT
Makkee, dr. ir. M.	81391	m.makkee@tnw.tudelft.nl	0.467	TNW
Marissen, Prof. dr. ir. R.	83918	r.marissen@wbmt.tudelft.nl	8C-2-20	WbMT
Massie, W.W.	84614	w.w.massie@offshore.tudelft.nl	3.77.1	CiTG
Mast, C.A.P.G. van der	82549	c.a.p.g.vandermast@its.tudelft.nl	HB 10.120	ITS-et
Matousek, dr. ir. V.	83717	v.matousek@wbmt.tudelft.nl	3B-0-430	WbMT
Meijer, ir. B.R.	86876	b.r.meijer@wbmt.tudelft.nl	8D-4-06	WbMT
Miedema, dr. ir. S.A.	88359	s.a.miedema@wbmt.tudelft.nl	3B-0-410	WbMT
Moulijn, prof. dr. J.A.	85008	j.a.moulijn@tnw.tudelft.nl		TNW
Mulder, K.F.	81043	k.f.mulder@tbm.tudelft.nl	c1.170	TBM
Neve, ir. J.	86581	j.j.l.neve@wbmt.tudelft.nl	8D-4-07	WbMT
Nieuwstadt, prof. dr. ir. F.T.M.	81005	f.t.m.nieuwstadt@wbmt.tudelft.nl	5B-1-26	WbMT
Nijhof, ir. A.H.J.	86663	a.h.j.nijhof@wbmt.tudelft.nl	8C-2-20	WbMT
Olujic, dr. Z.	86674	z.olujic@wbmt.tudelft.nl	1-17	API
Ostayen,dr. ir. R.A.J. van	81647	r.a.j.vanostayen@wbmt.tudelft.nl	5A-1-20	WbMT
Ottjes, dr. ir. J.A.	84318	j.a.ottjes@wbmt.tudelft.nl	8C-4-14	WbMT
Paassen, dr. ir. A.H.C. van	86675	a.h.c.vanpaassen@wbmt.tudelft.nl	8D-2-13	WbMT
Paijens, Ir. A.F.M.	87078	a.f.m.paijens@wbmt.tudelft.nl	1-08	API
Pistecky, ir. P.V.	86583	p.v.pistecky@wbmt.tudelft.nl	5A-2-04	WbMT
Plettenburg, dr. ir. D.H.	85615	d.h.plettenburg@wbmt.tudelft.nl	5A-2-05	WbMT
Polinder, dr.ir. H.	81844	h.polinder@its.tudelft.nl		ITS-et
Post, ir. F.H.	82528	f.h.post@its.tudelft.nl	HB 12.270	ITS-et
Pourquie, dr. ir. M.J.B.M.	82997	m.j.b.m.pourquie@wbmt.tudelft.nl	5B-1-32	WbMT
Rijlaarsdam, mr. ir. A.	83556	a.rijlaarsdam@tbm.tudelft.nl	b.3.030	TBM
Rijsenbrij, prof. ir. J.C.	86573	j.c.rijsenbrij@wbmt.tudelft.nl	8C-4-06	WbMT
Rixen, prof. dr. ir. D.J.	81523	d.j.rixen@wbmt.tudelft.nl	8C-2-11	WbMT
Rongen, van F.I.J.M.	86852	f.j.i.m.vanrongen@wbmt.tudelft.nl	5A-0-29B	WbMT
Santema, prof.mr.dr. S.C.	83076	s.c.santema@io.tudelft.nl	4A-03	IO
Scarlett, prof. MSc B.	83577	b.scarlett@stm.tuelft.nl		
Scherer, prof. dr. C.W.	85899	c.w.scherer@wbmt.tudelft.nl	8C-0-03	WbMT
Schott, ir. D.L.	833.6	d.l.schott@wbmt.tudelft.nl	3B-0-400	WbMT
Schwab, dr. ir. A.L.	82701	a.l.schwab@wbmt.tudelft.nl	8C-2-21	WbMT
Sepers, ir. M.	83614	m.sepers@its.tudelft.nl	HB 12.290	ITS-et
Smit, prof. ir. K.	84978	k.smit@lr.tudelft.nl	1006	LR
Snelders, dr. H.M.J.J.	83108	h.j.m.m.snelder@io.tudelft.nl	4A-25	IO
Sopers, ir. F.P.M.	85343	f.p.m.sopers@wbmt.tudelft.nl	8D-4-24	WbMT
Spliethoff, prof. dr. ing. H.	86071	h.spliethoff@wbmt.tudelft.nl	8D-2-07	WbMT
Spronck ir. J.W.	81824	j.w.spronck@wbmt.tudelft.nl	5A-0-29A	WbMT
Stapersma, prof. D. MSc. FIMarE	83051	d.stapersma@wbmt.tudelft.nl	7-1-122	WbMT
Steinhoff, K.	83144	k.steinhoff@wbmt.tudelft.nl	8D-4-21	WbMT
Teerhuis, ir. P.C.	85246	p.c.teerhuis@wbmt.tudelft.nl	8C-0-02	WbMT
Tichem, dr. ir. M.	81603	m.tichem@wbmt.tudelft.nl	8D-4-11	WbMT
Tomiyama, prof. dr. T.	81021	t.tomiyama@wbmt.tudelft.nl	8D-3-21	WbMT

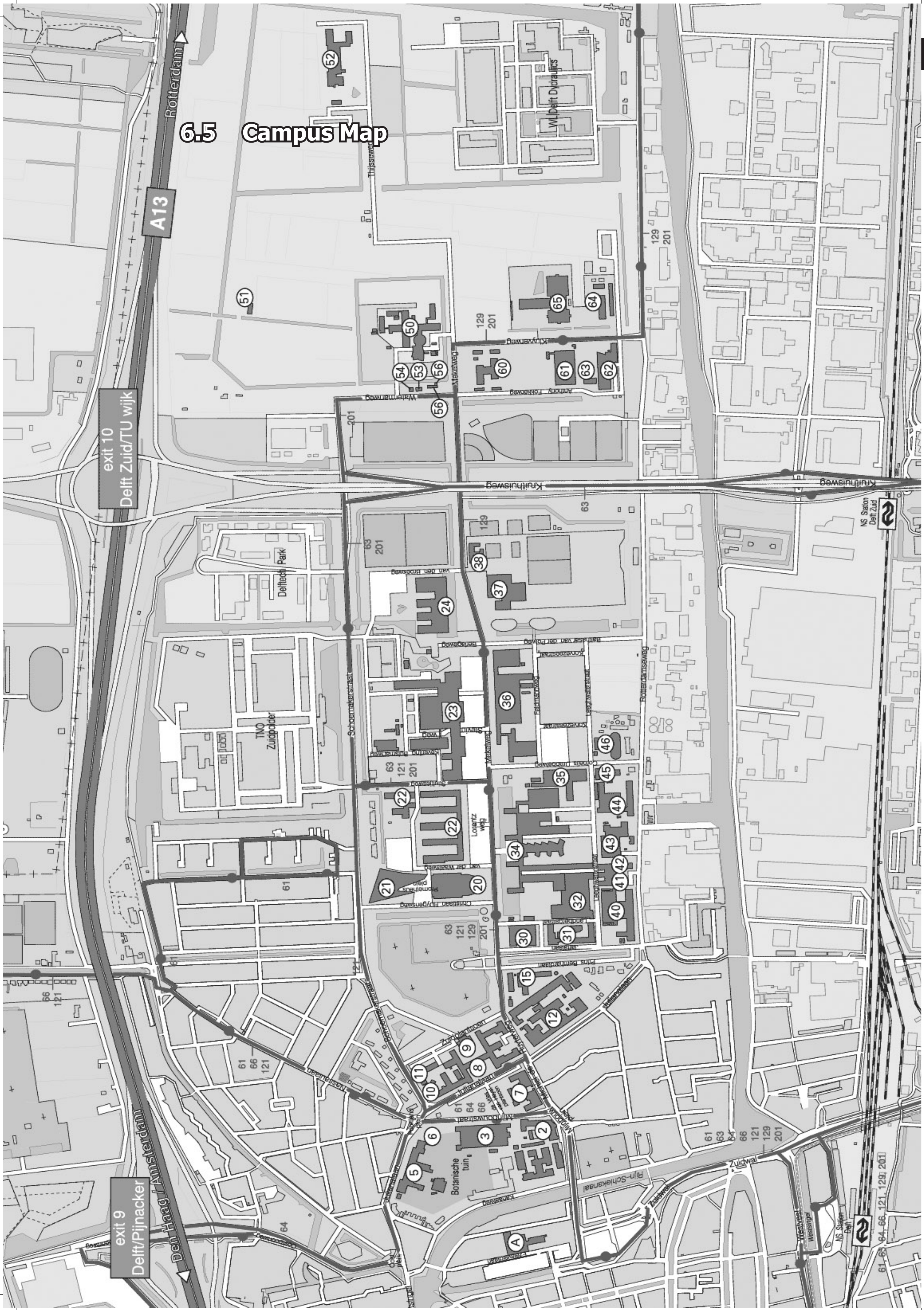
Naam	Tel[1]	E-Mail	Kamer	Gebouw[2]
Toetenel, H.	82518	w.j.toetenel@its.tudelft.nl	HB 08.120	ITS-et
Valstar, dr. ir. E.R.	83538	e.r.valstar@tnw.tudelft.nl	F232	TNW
Veeke, ir. H.P.M.	82706	h.p.m.veeke@wbmt.tudelft.nl	8D-4-25	WbMT
Verheul, ir. C.H.	86720	c.h.verheul@wbmt.tudelft.nl	8C-4-22	WbMT
Vergouwen, ir. F.J.	85603	f.j.vergouwen@wbmt.tudelft.nl	8C-0-05	WbMT
Verkooijen, prof. dr. ir. A.H.M.	86687	a.h.m.verkooijen@wbmt.tudelft.nl	8D-2-24	WbMT
Vlasblom, prof. ir. W.J.	83973	w.j.vlasblom@wbmt.tudelft.nl	3B-0-450	WbMT
Vries, ir. E.J.H. de	86980	e.j.h.devries@wbmt.tudelft.nl	8C-3-18	WbMT
Weiden, dr. ir. A.J.J.	85609	a.j.j.vanderweiden@wbmt.tudelft.nl	8C-0-04	WbMT
Werff, prof. dr. ir. K. van der	85729	k.vanderwerff@wbmt.tudelft.nl	8D-4-17	WbMT
Westerweel, prof. dr. ir. J.	86887	j.westerweel@wbmt.tudelft.nl	5B-1-13	WbMT
Wieringa, prof. dr. ir. P.A.	85763	p.a.wieringa@wbmt.tudelft.nl	8C-1-13	WbMT
Wijting, mr. W.	84710	w.wijting@tbm.tudelft.nl	b3.060	TBM
Wisse, ir. G.	82702	g.wisse@wbmt.tudelft.nl	8C-2-12	WbMT
Wisse, ir. M.				
Woerkom, dr. ir. P.Th.L.M. van	82792	p.vanwoerkom@wbmt.tudelft.nl	8C-2-18	WbMT
Wolffenbuttel, dr. ir. R.F.	86287	R.F.Wolffenbuttel@ITS.TUDelft.nl	HB 13.030	ITS-et
Woudstra, ir. N.	82178	N.Woudstra@WbMT.TUDelft.nl	8D-2-12	WbMT

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

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

2 API: Leeghwaterstraat 44, 2628 CA Delft
CiTG: Stevinweg 1, 2628 CN, Delft
IO: Landberghstraat 15, 2628 CE Delft
ITS-et: Mekelweg 4, 2628CD Delft
LR: Kluyverweg 1, 2629 HS Delft
TBM: Jaffalaan 5, 2628 BX Delft
TNW: Lorentzweg 1, 2628 CJ Delft
WbMT: Mekelweg 2, 2628CD Delft

6.5 Campus Map



Legend Campus map

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

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

1A WK 37-43	DRAFT COURSE SCHEDULE MSC BIOMEDICAL ENGINEERING SEMESTER 1A																													
Day/hours	course / lecturer	MM	BM	TB	MI	CP	BI	code / room	course / lecturer	MM	BM	TB	MI	CP	BI	code / room	course / lecturer	MM	BM	TB	MI	CP	BI	code / room
mon 1,2 0830-1030	control theory	o	o	e	e			sc4020																
	bosgra							34C																
mon 3,4 1030-1230	introduction mms	o	o		e			wb2309	introduction to micro electronics						o	et4248								
	wieringa							34A	beenakker							36D								
mon 5,6 1330-1530	biomed.eng.design	o	o	e	e	e	e	wb2308	pattern recognition	e	e	r	o		e	in4085								
	plettenburg							34C	duin e.a.							36A								
mon 7,8 1530-1730																								
tue 1,2 0830-1030	human movem.control	r	o	o	e	e	e	wb2407																
	vd helm							34C																
tue 3,4 1030-1230	eng.optimization	e	e	o	e			wb1440																
	keulen van							34K																
tue 5,6 1330-1530	medical technology	o	o	o	o	o	o	et4126	structured electronic design						o	et8016	acoustical imaging				o	r		ap3531
	faes								verhoeven							36D	wapenaar / verschuur							22F
tue 7,8 1530-1730	health care systems	o	o	o	o	o	o	et4128	theory of elasticity (start 16:30h)	e	e	o	e			wb1409	electronic instrumentation						o	et8017
	beekum								v keulen							34K	wolffenbuttel							36B
wed 1,2 0830-1030	surgical instr.med.safety	o	r	r	e	r	e	wb2435-03	Radiological health physics	e	e	e	e	o	r	ap3371								
	dankelman							34J																
wed 3,4 1030-1230	mechatronic design	e	e	e	e			wb2414	Radiological health physics	e	e	e	e	o	r	ap3371								
	teerhuis/v eijk							34C																
wed 5,6 1330-1530	adv.fluid dynamics			e	e			wb1427-03	Radiological health physics	e	e	e	e	o	r	ap3371								
	delfos							34J																
wed 7,8 1530-1730	adv.fluid dyn. Seminar			e	e			wb1427-03	Radiological health physics	e	e	e	e	o	r	ap3371								
	delfos							34J																
thur 1,2 0830-1030	hydrolic servosyst.	e	e	e	e			wb2402	Radiation techn.& radiation det.					o		ap3351	introduction to micro electronics						o	et4248
	teerhuis							34D									beenakker							36D
thur 3,4 1030-1230	health care systems	o	o	o	o	o	o	et4128																
	beekum																							
thur 5,6 1330-1530	medical technology	o	o	o	o	o	o	et4126	man machine systems	o	o	e	e			wb2404								
	faes								wieringa							34D								
thur 7,8 1530-1730	structured electronic design						o	et8016																
	verhoeven							36G																
fri 1,2 0830-1030									Radiological health physics	e	e	e	e	o	r	ap3371								
fri 3,4 1030-1230									Radiological health physics	e	e	e	e	o	r	ap3371								
fri 5,6 1330-1530	control theory	o	o	e	e			sc4020	Radiological health physics	e	e	e	e	o	r	ap3371	electronic instrumentation						o	et8017
	bosgra							34C									wolffenbuttel							36B
fri 7,8 1530-1730									Radiological health physics	e	e	e	e	o	r	ap3371								

o obligatory r recommended e elective

DRAFT COURSE SCHEDULE MSC BIOMEDICAL ENGINEERING SEMESTER 1B

1B WK 46-52	course	M M	B M	T B	M I	C P	B I	code	course	M M	B M	T B	M I	C P	B I	code	course	M M	B M	T B	M I	C P	B I	code	course	M M	B M	T B	M I	C P	B I	code
Day/hours	**lecturer**							**room**	**lecturer**							**room**	**lecturer**							**room**	**lecturer**							**room**
mon 1,2 0830-1030	analog integrated circuit design						o	et4252																								
	long / monna							36C																								
mon 3,4 1030-1230	physiol. systems	o	r	o	e	e	o	wb2408																								
	dankelman e.a.							34C																								
mon 5,6 1330-1530	pattern recognition	e	e	r	o		e	in4085																								
	duin e.a.							36A																								
mon 7,8 1530-1730																																
tue 1,2 0830-1030	human movem.control	r	o	o	e	e	e	wb2407																								
	vd helm							34C																								
tue 3,4 1030-1230	eng.optimization	e	e	o	e			wb1440																								
	keulen van							34K																								
tue 5,6 1330-1530	multivar. control systems	e	e	e	e			wb2421	acoustical imaging				o	r		ap3531																
	vd weiden							34J	wapenaar / verschuur							22F																
tue 7,8 1530-1730	theory of elasticity (start 16:30h)	e	e	o	e			wb1409	bio electricity and magnetism	e	e	e	r	r	o	et4130																
	v keulen							34K	van duijl																							
wed 1,2 0830-1030	bone mech.implants	e	r	o	e	e	e	wb2431	silicon sensors						o	et4257	Radiological health physics	e	e	e	e	o	r	ap3371	advanced image processing				o	r	e	et4085
	vd Linden/Valstar							34J	french							36A	tot week 49								hendriks / van vliet							36C
wed 3,4 1030-1230	mechatronic design	e	e	e	e			wb2414	Comp. meth.non-linear mech.			r	e			ct5142	Radiological health physics	e	e	e	e	o	r	ap3371								
	teerhuis/v eijk							34C								CT 1.97	tot week 49															
wed 5,6 1330-1530	adv.fluid dynamics			e	e			wb1427-03	hydrolic servosyst.	e	e	e	e			wb2402	Radiological health physics	e	e	e	e	o	r	ap3371								
	delfos							34J	teerhuis							34C	tot week 49															
wed 7,8 1530-1730	adv.fluid dyn. Seminar			e	e			wb1427-03									Radiological health physics	e	e	e	e	o	r	ap3371								
	delfos							34J									tot week 49															
thur 1,2 0830-1030	Radiation techn.& radiation det.					o		ap3351	multivar. control systems	e	e	e	e			wb2421	analog integrated circuit design						o	et4252								
									vd weiden							34J	long / monna							36C								
thur 3,4 1030-1230	physiol. systems	o	r	o	e	e	o	wb2408																								
	dankelman e.a.							34C																								
thur 5,6 1330-1530	man machine systems	o	o	e	e			wb2404	bio electricity and magnetism	e	e	e	r	r	o	et4130																
	wieringa							34C	van duijl																							
thur 7,8 1530-1730	silicon sensors						o	et4257																								
	french							36A																								
fri 1,2 0830-1030	advanced image processing				o	r	e	et4085									Radiological health physics	e	e	e	e	o	r	ap3371								
	hendriks / van vliet							36C									tot week 49															
fri 3,4 1030-1230	Comp. meth.non-linear mech.			r	e			ct5142	phys.measurem.& image techn.	e	e	e	e	e	r	et4129	Radiological health physics	e	e	e	e	o	r	ap3371								
								CT 1.97	van duijl								tot week 49															
fri 5,6 1330-1530																	Radiological health physics	e	e	e	e	o	r	ap3371								
																	tot week 49															
fri 7,8 1530-1730																	Radiological health physics	e	e	e	e	o	r	ap3371								
																	tot week 49															

o obligatory r recommended e elective

DRAFT COURSE SCHEDULE MSC BIOMEDICAL ENGINEERING SEMESTER 2A

2A WK 6-12	course	MM	BM	TB	MI	CP	BI	code	course	MM	BM	TB	MI	CP	BI	code	course	MM	BM	TB	MI	CP	BI	code
Day/hours	lecturer							room	lecturer							room	lecturer							room
mon 1,2 0830-1030	num.meth.dynamics	e	e	e	e			wb1416																
	rixen																							
mon 3,4 1030-1230	optimization 2			e	e			wb1441																
	keulen van																							
mon 5,6 1330-1530	modelling 2	e	r	e	e			wb2422																
	bosgra																							
mon 7,8 1530-1730	multibody dynamica B	r	o	r	e			wb1413																
	schwab																							
tue 1,2 0830-1030	syst.identif.param.est.	o	o	e	e			wb2301																
	vd helm																							
tue 3,4 1030-1230																								
tue 5,6 1330-1530	data visualization				o	r		in4008tu																
	van nieuwenhuizen							36D																
tue 7,8 1530-1730																								
wed 1,2 0830-1030	bone mech.implants	e	r	o	e	e	e	wb2431	medical physics & rad.techn.2					o		ap33??								
	vd Linden/Valstar																							
wed 3,4 1030-1230	bio mechatronics	r	o	o	e	e	e	wb2432																
	vd helm																							
wed 5,6 1330-1530	syst.identification B	e	e	e	e			sc4110																
	vd hof/bombois																							
wed 7,8 1530-1730																								
thur 1,2 0830-1030	comp. fluid dynamics			e	e			wb1428																
	boersma																							
thur 3,4 1030-1230																								
thur 5,6 1330-1530	microfluidics	e	e	e	e			wb1429-03																
	lindken																							
thur 7,8 1530-1730																								
fri 1,2 0830-1030	modelling 2	e	r	e	e			wb2422	syst.identification B	e	e	e	e			sc4110								
	bosgra								vd hof/bombois															
fri 3,4 1030-1230	measurement theory praxis	o	e	e	e			wb2303																
	teerhuis																							
fri 5,6 1330-1530	experimental mechanics	e	e	e	e			wb1406	medical physics & rad.techn.1					o		ap3361	data visualization				o	r		in4008tu
	booij / v woerkom								van eijk / bos / zoetelief								van nieuwenhuizen							36D
fri 7,8 1530-1730																								
				o	obligatory							r	recommended							e	elective			

DRAFT COURSE SCHEDULE MSC BIOMEDICAL ENGINEERING SEMESTER 2B

2B WK 15-22	course	MM	BM	TB	MI	CP	BI	code	course	MM	BM	TB	MI	CP	BI	code	course	MM	BM	TB	MI	CP	BI	code
Day/hours	**lecturer**							**room**	**lecturer**							**room**	**lecturer**							**room**
mon 1,2 0830-1030	num.meth.dynamics	e	e	e	e			wb1416																
	rixen																							
mon 3,4 1030-1230	optimization 2			e	e			wb1441	cybern. ergonomics	e	e	e	e			wb2306	themes in biomedical engineering	e	e	e	e		e	et4127
	keulen van								vd helm								van duijl							
mon 5,6 1330-1530																								
mon 7,8 1530-1730	multibody dynamica B	r	o	r	e			wb1413																
	schwab																							
tue 1,2 0830-1030	syst.identif.param.est.	o	o	e	e			wb2301																
	vd helm																							
tue 3,4 1030-1230	instrum.proces industry	o	e	r	e			wb2413-04	multibody dynamics	e	e	e	e			wb1310								
	vd weiden								schwab															
tue 5,6 1330-1530																								
tue 7,8 1530-1730																								
wed 1,2 0830-1030	comp. fluid dynamics			e	e			wb1428	cybern. ergonomics	e	e	e	e			wb2306	medical physics & rad.techn.2					o		ap33??
	boersma								vd helm															
wed 3,4 1030-1230																								
wed 5,6 1330-1530	bio mechatronics	r	o	o	e	e	e	wb2432	syst.identification B	e	e	e	e			sc4110								
	vd helm								vd hof/bombois															
wed 7,8 1530-1730	themes in biomedical engineering	e	e	e	e		e	et4127																
	van duijl																							
thur 1,2 0830-1030																								
thur 3,4 1030-1230																								
thur 5,6 1330-1530	microfluidics	e	e	e	e			wb1429-03																
	lindken																							
thur 7,8 1530-1730																								
fri 1,2 0830-1030	syst.identification B	e	e	e	e			sc4110																
	vd hof/bombois																							
fri 3,4 1030-1230	measurement theory praxis	o	e	e	e			wb2303																
	teerhuis																							
fri 5,6 1330-1530	experimental mechanics	e	e	e	e			wb1406	medical physics & rad.techn.1					o		ap3361								
	booij / v woerkom								van eijk / bos / zoetelief															
fri 7,8 1530-1730																								
				o	obligatory							r	recommended							e	elective			