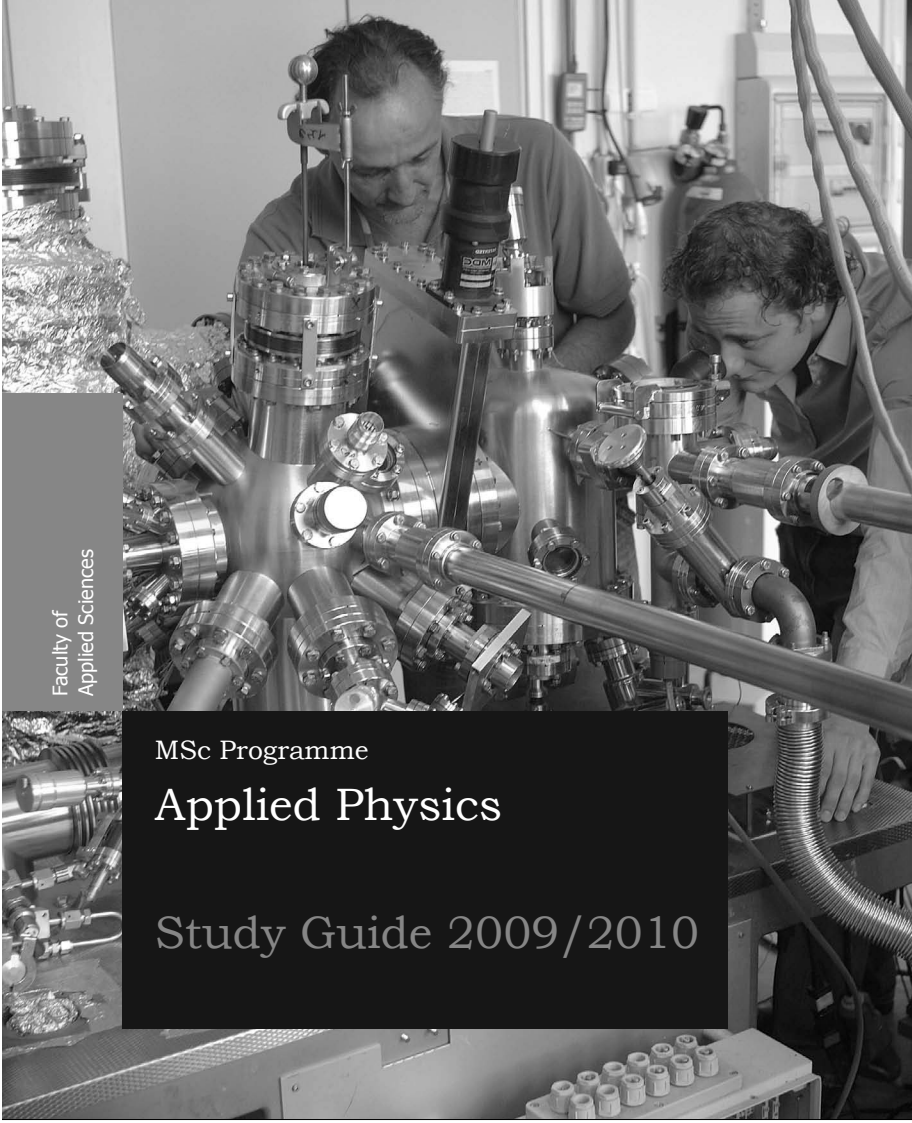

Faculty of Applied Sciences

MSc Programme

Applied Physics

Study Guide 2009/2010

TU Delft Delft University of Technology

Challenge the future

Disclaimer

Every effort has been made by the faculty in putting together this guide. However, further details about a number of subjects will only be available after the guide has been printed. For that reason, the information published by the faculty in this handbook is subject to change. Amendments, further details, and a more extensive description of the subjects can be found on Blackboard: http://blackboard.tudelft.nl and in the digital study guide http://studyguide.tudelft.nl.

Personal Data

name

address

postal code/city or town

date of birth

home phone mobile

work phone work fax

e-mail

student number

giro account no. bank account no.

passport no. valid through

driving licence valid through

social-fiscal no.

family doctor

medications

allergic to medications

blood type RH factor donor card: yes/no

IN EMERGENCIES PLEASE CONTACT

name

address

postal code/city or town

home phone mobile

If found, please return this student guide or contact the owner.

Preface

Dear student,
Welcome to the MSc programme in Applied Physics of the Faculty of Applied Sciences of TU Delft!
This guide contains practical information on the programme. The Applied Physics programme with its core-specialisation structure offers a wide variety of possibilities, enabling you to pursue your particular ambitions and interests. Lecture courses at different levels of specialization will enable you to deepen your physics knowledge and find out how it is applied in modern research and development.
We are convinced that we have created a rewarding and challenging programme that keeps its promise: It prepares you for the future.
We wish you a good start and lots of success!

Dr Jos Thijssen
Programme director
Dr Hans Zoetelief
Programme coordinator

Contents

1.

University Profile

TU Delft aims to be a preferred partner in education for students worldwide by offering intrinsically challenging and didactically inspiring courses. Intrinsically challenging because of the direct connection with urgent societal themes, particularly in the area of sustainability.
Didactically inspiring through the use of active educational methods to give our students' own creativity as much freedom as possible. TU Delft sees its students as its future alumni, alumni who can be flexibly deployed and can take up a prominent position on the international labour market. The programme leading to the qualification of Delft engineer is an A-brand worldwide. To maintain this quality guarantee, TU Delft is constantly developing its curriculum, both intrinsically and didactically.
The university also collaborates closely with national and international universities, research institutes and partners in industry. These ties are a means for our students to gain valuable and relevant knowledge and experience, providing them with the building blocks for a successful future career.

TU Delft (Delft University of Technology)

Visitor address
Mekelweg 5
2628 CC Delft

Postal address
Postbus 5
2600 AA Delft
Tel.: +31 (0)15 27 89111 (switchboard)
Fax: +31 (0)15 27 86522
E-mail: info@tudelft.nl (enquiries)
Web site: www.tudelft.nl

1.1

Education & Student Affairs

The Education & Student Affairs department provides educational activity support: administration, student guidance, support for foreign students, sports, culture and international projects.

Jaffalaan 9A (visitor entrance on Mekelweg)
2628 BX Delft
Tel.: +31 (0)15 27 84670
Fax: +31 (0)15 27 87233
E-mail: os@tudelft.nl
Web site: www.student.tudelft.nl

1.2

E&SA Idea Line

Students and staff can now submit their suggestions, questions and comments to improve services provided by Education & Student Affairs online at:
www.ideeenlijnOS.tudelft.nl

1.3

TU Delft Central Student Administration (CSA)

Your academic career at TU Delft begins at the Central Student Administration.
All students register with CSA, whether you are an international student or a student from another Dutch university coming to attend a course at TU Delft.
Visit the Central Student Administration desk to:

- register and enrol in TU Delft programmes
- hand in enrolment forms
- pay tuition or examination fees with your bank card (direct debit)
- arrange a second programme enrolment within TU Delft or enrol in a programme mid-year
- stop your studies
- change of programme
- apply for financial support under the RAS (Graduation Support Scheme)

- obtain preliminary certificates of enrolment if you do not yet have a CampusCard and/or Certificate of Enrolment yet, for exams, etc.
- apply for official certifications in Dutch, English, French, German and Spanish for other institutions or for:
- preliminary registration (for purposes such as seeking housing)
- record of paid tuition fees and enrolment type (if you wish to enrol at another institution)
- proof of enrolment in prior academic years
- proof of unenrolment as student (required when applying for benefit)
- authentication of copies of diplomas and transcripts (for enrolments, job applications, etc.)
- signature and authentication of forms for the Information Management Group, Social Insurance Bank, healthcare insurers, etc.
- application for duplicate Certificate of Enrolment or replacement CampusCard
- application for refund and termination of enrolment due to graduation, illness, extraordinary family circumstances, termination of study (first-year phase) or non-contiguous programme
- notification of address changes (CSA automatically forwards changed data to faculty programme administration)
- change forms for the Information Management Group

You can also visit the desk for ordering and picking up your CampusCard, requesting a duplicate card, making changes, and for information on having the required (electronic) passport photo taken.

- Have your student number available (a seven-digit number found on your certificate of enrolment)
- To have a digital photo taken, go to the CSA desk, Education & Student Services, Jaffalaan 9A (Mekelweg entrance).
- Open every weekday from 9.30 to 16.30.
- For replacement of a stolen or lost card: go to the CSA desk, Education & Student Affairs, Jaffalaan 9A (Mekelweg entrance), fill out the form and pay a fee of EUR 3.00.
- If you need a replacement card because the first card no longer functions: Go to the CSA desk, Education & Student Affairs, Jaffalaan 9A (Mekelweg entrance), turn in the non-functioning card and complete a form.
- After approximately 4 weeks, you will be notified that your card is available for pickup at the CSA desk (Education & Student Affairs), Jaffalaan 9a (visitor entrance on Mekelweg).
- The CSA desk is located in the Education & Student Affairs building.
- Opening hours: Monday through Friday from 9.00 to 17.00

Visitor address
Jaffalaan 9A (visitor entrance on Mekelweg)
2628 BX Delft

Postal address
CSA TU Delft
Postbus 5
2600 AA Delft
Tel.: +31 (0)15 27 84249
Fax: +31 (0)15) 27 86457
E-mail: csa@tudelft.nl
www.csa.tudelft.nl

1.4

Shared Service Centre

The SSC covers educational administration, study progress administration, and other areas.
Contact Information:

Account group 1: +31 (0)15 27 89826
EEMCS: osa.ewi@tudelft.nl
AS: osa.tnw@tudelft.nl

Account group 2: +31 (0)15 27 89825
Architecture: osa.bk.tudelft.nl
IDE: osa.io@tudelft.nl
TPM: osa.tbm@tudelft.nl

Account group 3: +31 (0)15 27 89827
CEG: osa.citg@tudelft.nl
AE: osa.lr@tudelft.nl
3mE: osa.3me@tudelft.nl

1.5

Service Desk

Every faculty has a service desk. This is the contact point for students (and staff) for all questions concerning educational and student affairs, ICT and facility services, such as:

- Prospectuses
- Transcripts
- Turning in mark sheets
- Certificates for students (such as for completion of programme components, marks or study credits for purposes of switching to another programme or credit-related/achievement-related grant)
- Degree audit application
- Questions on the TAS examination registration system.

More information, including opening times, can be found on www.servicedesk.tudelft.nl

1.6

Student Charter

All rights and obligations of the student and of TU Delft as the institution are detailed in the Student Charter. It includes information on admissions requirements, guarantee months, enrolment, student/staff representation, Ombudsman regulations and codes of conduct. The charter can be consulted on:
www.studentenstatuut.tudelft.nl

Questions about the student charter should be addressed to one of the Student & Career Support student counsellors:
Tel.: +31 (0)15 27 88004
E-mail: studentandcareersupport@tudelft.nl

1.7

BLACKBOARD - Virtual learning environment

Blackboard is TU Delft's virtual learning environment. All TU Delft students registered in the student enrolment system Osiris, all teaching staff and other personnel registered in Peoplesoft, as well as alumni, have access to Blackboard and can make use of the virtual learning environment. Almost all communication between students, instructors and staff goes through Blackboard. After logging in, you will find the relevant information on studying and working at TU Delft.

Tel.:+31 (0)15 27 89194
Web site: http://blackboard.tudelft.nl
Support: http://els.tudelft.nl

1.8

The TU Delft Library

Your virtual reference desk!

All relevant technical and scientific information
The TU Delft Library is the largest technical and scientific library in the Netherlands. The library selects, administers, processes and supplies information relevant to your study collected from the Netherlands and abroad. Much of this information is in electronic form.

All the relevant science and technology information you need
The TU Delft Library is the largest technical and scientific library in the Netherlands. The library selects, administers, processes and supplies information relevant to your studies from in and outside the Netherlands. Much of the information is digital.

Stop searching, start finding!
During your course, you will find that the Virtual Knowledge Centre (VKC) of your programme will come in very useful.
The VKC is the ideal place to start when looking for information in your field, as it provides 'virtually all knowledge in your field'. Learn about your VKC at http://vkc.library.tudelft.nl .

The digital window
At www.library.tudelft.nl you will find not just information on specific subjects, but also practical information about the Library, the online catalogue, databases, works of reference, internet sources, instructions and maps. There are also articles, PhD theses, reports, graduation dissertations, lecture notes, patents and other TU Delft publications at http://repository.tudelft.nl.
If you are looking for specific information, or if you have a question, request, complaint or comment about the services provided by the Library, go to http://AskYourLibrary.tudelft.nl, the digital window of the Library. For maps, go to http://kaartenkamer.library.tudelft.nl .

Get your questions answered immediately
You can communicate with the Library Customer Services via Ask Your Library at a time, place and manner of your own choosing. Many of your questions will be answered immediately. During office hours you can chat to a Library employee, who can also browse along with you. The employee is then able to help you find specific sources by pointing out information with the cursor. The answers to some questions can be found in the Frequently Asked Questions, but you can also telephone us (+31 (0)15 – 27 85678), mail us (library@tudelft.nl), or visit one of our branches. You can find them on www.library.tudelft.nl

Easy
If you use a computer that is connected to the TU Delft campus network, you can use, digitally, virtually every service provided by the Library. The Central Branch on Prometheusplein 1, behind the Aula Congress Centre, is open during the daytime, evening, and at weekends, for browsing through the books, studying with or without a computer, meeting, and making copies. The opening times of the Library are extended yet further during examination periods.
The Central Branch is also where you will find the Trésor, the treasure house with unique, fragile and valuable items. The Trésor can be visited by appointment (http://tresor.library.tudelft.nl).

Central Library
Prometheusplein 1
2628 ZC Delft
Tel.: +31 (0)15 27 85678
E-mail: library@tudelft.nl

1.9

Self-study spaces

Specially set up self-study spaces are available to you in the faculties and library for independent study. You will find these self-study spaces in separate spaces and in the foyers of the buildings. Many self-study spaces are equipped with laptop connections.

1.10

Student & Career Support

Student & Career Support is there to help you when you encounter issues that impede good studying. Both individuals and groups can consult Student & Career Support for support and advice. Consult the student counsellors, student psychologists and/or the information centre for assistance with: legal issues, scholarships/grants and financial support, psychosocial support, help with studies and career orientation on the labour market.

At the desk in the Education & Student Affairs building at Jaffalaan 9a (Mekelweg entrance), you can make an appointment with a student counsellor or student psychologist, or obtain more information about the information centre.

The student psychologists also have an open consultation hour on Tuesday and Thursday mornings from 11.30-12.30, during which you can see a student psychologist without an appointment. Please report to the desk when you come to attend the open consultation. Additionally, Student & Career Support will also appreciate a phone call or e-mail to let the office know that you are coming.

At Student & Career Support you can also attend workshops and trainings such as Constructive Thinking, Relaxing, Mind Mapping, Applications, Studying with Dyslexia, and Personal Effectiveness. For more information, see www.smartstudie.tudelft.nl.
On the ground floor at the Education & Student Affairs desk, you will also find the Information Centre (open from 9.00 to 17.00), where you can go for information about your academic or future professional career. The Information Centre can provide information on subjects such as university and higher professional education programmes, study and career choices, studies abroad, exchange programmes, summer courses, financial aid/

grants and language courses. Most of the day, the desk will be staffed with someone to help you.
Opening hours: Monday through Friday from 9.00 to 17.00.
Jaffalaan 9A (visitors entrance on Mekelweg).
2628 BX Delft
Tel.: +31 (0)15 27 88004
E-mail: studentandcareersupport@tudelft.nl
Web site: www.studentandcareersupport.tudelft.nl

1.11

Facilities for handicapped students

The university will ensure that the education is also accessible to students with a disability. This means that there must be appropriate facilities for disabled students or students with a chronic illness, whether financially or by providing special educational facilities. If you have special needs, contact your academic counsellor. Please give notice of any needs you may have as early as possible, as some facilities may take some time to organise.

1.12

Sports & Cultural Centre

The Sports & Cultural Centre offers nearly every kind of indoor and outdoor sport. Most fields and pitches are lit for evening play.
You can also take part in a variety of cultural activities:

- Courses, including videography, photography, painting, drawing, sculpting, ceramics, instrument building, classical music, light & popular music, computer-assisted sound processing, modern and oriental dance, capoeira, philosophy and writing.
- Vocal and instrumental musical groups.
- Use of musical instruments, including pianos, drum sets, saxophones and guitars.

TU Delft Sports Centre
Mekelweg 8
2628 CD Delft
Tel.: +31 (0) 15 27 82443
E-mail: sportcentrum@tudelft.nl
Web site: www.snc.tudelft.nl

TU Delft Cultural Centre
Mekelweg 10
2628 CD Delft
Tel: +31 (0) 15 27 83988
E-mail: balie.mw10@tudelft.nl
Web site: www.snc.tudelft.nl

1.13

Student ombudsman

If you, as a student, have a complaint about TU Delft, the faculty or staff, you should first try to resolve the situation with your faculty's academic counsellor. If that doesn't work, visit the student ombudsman. The student ombudsman can help you to solve problems and make proposals aimed at preventing others from encountering similar circumstances.
The ombudsman for TU Delft is W.J.M. Knippenberg.

Aula TU Delft
Mekelweg 5
2628 CC Delft
Tel.: +31 (0)15 27 84403
E-mail: ombudsman@tudelft.nl
Contact the ombudsman by e-mail first.

1.14

Health & Safety, University Emergency Services

Like the staff of TU Delft, students are entitled to a safe and healthy workplace/study space. This also entails the obligation to act in the interests of your own safety and that of others. The Netherlands has working conditions legislation ('ARBO legislation') in place governing safety standards and rules of conduct. TU Delft also has specific environmental, health & safety rules.

Basic rules
Students may not enter technical areas. Performance of actions and experiments involving an element of risk are only permitted on the instruction of and with permission of the supervisor. Anyone who suspects that he or she may be exposed to risk in the performance of an assignment may refuse

that assignment and contact the Health & Safety Adviser concerning the matter.

Undesirable behaviour
Aggression, sexual intimidation, threats, pestering and discrimination are considered undesirable behaviour and are not tolerated. Undesirable behaviour can be reported to the Executive Board. You can also contact your faculty's confidential adviser, who can handle complaints discretely.

Smoking prohibited
TU Delft is a non-smoking institution. Smoking is not permitted anywhere except in the smoking areas and locations where smoking is temporarily permitted. Violation of the non-smoking rule is considered undesirable behaviour. Anyone who is being disturbed by smoking can report it to the Health & Safety Adviser or the confidential adviser (www.confidentialadvisor.tudelft.nl).

Computer work
Intensive computer work can lead to neck and upper body problems. These conditions are commonly referred to as 'RSI.' The chance of RSI is increased when working under pressure, in situations such as completing a thesis. Advanced RSI is very difficult to cure and should be avoided at all costs. Make sure your working posture is always correct and take short work breaks at regular intervals. One useful tool to help you do this is the 'Workpace' programme.
The Health & Safety Adviser can help you and evaluate your workspace.

Emergencies and University Emergency Services
TU Delft has a University Emergency Services organisation. The members of the University Emergency Services organisation are known to the staff. They perform first aid and act in the event of an emergency Any time you are injured, always seek treatment. Always report any accidents or near-accidents to University Emergency Services.
In the event of fire, a work-related accident or a dangerous situation, follow these rules:

- A 'slow whoop' siren over the public address system indicates that an alarm has been sounded.

Follow the instructions immediately.

- Get yourself to safety and warn others.
- In the event of fire, activate a fire alarm.
- In the event of an emergency, dial the emergency number (112) on a land line and answer the questions.

- Follow the instructions of University Emergency Services personnel.

For more information, see www.tudelft.nl or www.students.tudelft.nl.

1.15

VSSD - Delft Student Union

The VSSD (*Vereniging voor Studie- en Studentbelangen*) is the Delft Student Union, and as its name suggests its purpose is to represent the interests of the students of Delft. The roots of today's VSSD go back to 1887 (see 'history'). The union is run by and for students.
Over the years, the VSSD has developed a number of services supported by the personnel, such as publishing and book sales.

The VSSD is managed by the Delft Student Council.
This council of 13 learned students meets once every six weeks to discuss the present and future policy of the VSSD. Three factions have seats on the Delft Student Council: ORAS, AAG and DQ.

VSSD
Leeghwaterstraat 42
2628CA Delft
Tel:+31 (0)15 27 82050
E-mail: balie@vssd.nl
Web site: www.VSSD.nl

1.16

The Student Council

The student seats in the TU student council are traditionally divided among two fractions: AAG and ORAS. For the acadenic year 2008-2009, AAG has decided not to participate in the election. In order to provide a choice in the elections for the student council, `Principe' (`Principle') has been founded recently. Together, ORAS and Principle form an instrument for students to influence TU policies. These parties also have representatives in the member's council of the VSSD.

AAG
Mekelweg 4
2628 CD Delft
Tel.: +31(0)15 27 83121
E-mail: fractie@aag.tudelft.nl
Web site: www.aag.tudelft.nl

Het Principe
Website: http://www.hetprincipe.nl
ORAS
Mekelweg 4
2628 CD Delft
Tel.: +31(0)15 27 83349
E-mail: oras@tudelft.nl
Web site: www.oras.tudelft.nl

1.17

Accommodation

TU Delft has a contract with accommodation organisation DUWO for the housing of foreign students and guests. The contracts with the students/ guests or foreign students are fixed-term contracts with the option of extension. Applications for housing will be granted on a 'first come first served' basis.

Visitors address
Stichting DUWO
Kanaalweg 4
2628 EB Delft

Postal address
Postbus 54
2600 AB Delft
Tel.: +31 (0)15 21 92200
E-mail: info@duwo.nl
Web site: www.duwo.nl

The 'consent' system is fairly widely in effect in Delft student residences. This means that you will have to 'interview' with the residents of the house. Finding housing in Delft is difficult, and finding cheap housing is even harder, so start looking as early as possible!

1.18

Medical Care

The student healthcare organisation Stichting Studentengezondheidszorg (SGZ) provides both medical and psychotherapeutic healthcare for students.
Because the SGZ principally provides preventative help, we recommend you have your own GP who can visit you if you are ill. This can be one of the SGZ's own GPs.

SGZ
Beukenlaan 4G
2612 VC Delft

General Practitioners:
Tel.: +31 (0)15 21 35358
E-mail: studentenartsen@sgz.nl

Vaccinations:
Tel.: +31 (0)15 21 21507
E-mail: vaccinatie@sgz.nl

Psychologists:
Tel.: +31 (0)15 21 33426
E-mail: psychologie@sgz.nl.
Web site: www.sgz.nl

1.19

MoTiv

MoTiv is a church organisation at TU Delft. Its aim is to engender motivation, inspiration and passion in those who choose a profession in technology. Participants in the MoTiv programmes explore their inner strength and commitment. MoTiv's activities are designed to augment personal skills and social support and to make a contribution to the technical/cultural debate in society.
MoTiv has pastors with whom you can make an appointment for individual pastoral coaching. For those seeking reflection, there is an Ecumenical church service every Sunday at 11.15 at Noordeinde 4.

Voorstraat 60
2611 JS Delft
Tel.: +31 (0)15 21 23421
E-mail: info@motiv.tudelft.nl
Web site: www.motiv.tudelft.nl

1.20

Public Lecture Series

Studium Generale, the TU Delft Public Lecture Series, helps you stay on top of the oldest and newest developments in science, art, culture and society. Studium Generale offers you the opportunity to expand your horizons and learn about disciplines other than your own area of study.
Twice per year, Studium Generale issues its programme listings announcing all activities. The programme listings are distributed in all TU buildings and can also be obtained individually.
To be sure you are always informed of the programme's offerings, you might want to sign up for the weekly electronic newsletter. You'll never miss a thing!
To register, send an e-mail to studiumgenerale@tbm.tudelft.nl. The latest programme can also be found on www.sg.tudelft.nl.

Studium Generale
Faculteit TBM
Room a.0.260
Jaffalaan 5
2628 BX Delft
Tel.: +31(0)15 27 85235
E-mail: studiumgenerale@tbm.tudelft.nl
Web site: www.sg.tudelft.nl
Secretariat opening hours:
Monday through Thursday, 9.00 uur to 17.00

1.21

Delta

Delta is TU Delft's information and opinion journal, published by a journalistically independent editorial board.

Delta Editorial Board
University Library, room 0.18 – 0. 28
Prometheusplein 1
2628 ZC Delft
Postal address:
Postbus 139
2600 AC Delft
Tel.: +31 (0)15 27 84848
E-mail: delta@tudelft.nl
Web site: www.delta.tudelft.nl

The electronic version of this study guide can also be found on the faculty's campus web site.

2.

Information about the Master programme in Applied Physics

2.1

Admission requirements

BACHELOR STUDENTS FROM DELFT

The Master's degree programme is accessible to all students enrolled in the old five-year Applied Physics degree programme ("doctoraalprogramma") at TU Delft.

Applied Physics Bachelor students at TU Delft are automatically admitted after completion of their Bachelor's degree in Applied Physics. Students enrolled before 2006 into this course, who have not yet finished their Bachelor's education can start the Master's degree programme if they have completed their first year ("propedeuse") and at least 102 EC of the required 120 EC from the second and third years. This should include both the final project (Bachelor's thesis) and, depending on the chosen minor programme, an elective module related to the final project. Students planning to enrol summer 2010 or later, should have finished their Bachelor's programme before they can enter the Master's programme.

All students belonging to one of these categories can enrol into the Master of Applied Physics degree course; an application form is not needed for these students.

OTHER STUDENTS

All applicants from institutions or programmes other than Applied Physics at TU Delft seeking admission to the MSc programme in Applied Physics at TU Delft should apply using the application form available at www.ap.msc.tudelft.nl/

A bridging programme may be required to start the Master's programme.

Dutch Students from other universities and/or other programmes

Students holding a Bachelor of Science degree in Applied Physics from the universities of Eindhoven and Twente are unconditionally admitted.

Students holding a Bachelor of Science degree in Physics from a Dutch (general) university are admitted but, depending on the department they choose, must take one BSc module as part of their Master's programme -- see the table below.

The same is true for students holding a Bachelor of Engineering degree in Physics.

Note that, starting from summer 2010, it is not possible to enrol if the number of courses in the bridging programme exceeds 18 EC.

Foreign students

A minimum GPA (Grade Point Average) and/or GRE (Graduate Record Examination) score may be required. In exceptional cases, a bridging programme may be defined. With some exceptions, the programme is taught in English, so proof of proficiency in the English language, e.g. a minimum TOEFL score or a minimum IELTS (academic version) overall Band score, may be required. Foreign students should apply via an application form which can be found on the web: http://www.ap.msc.tudelft.nl/. Their application will be considered by the university's international office, which performs an initial screening, and then to the admissions officer of Applied Physics. The admissions officer considers these application and takes a decision about acceptance.

Deficiency table

BEng denotes a degree from one of the Dutch Higher vocational education (HBO). BSc denotes a Bachelor degree from a Dutch University.

Code	Name of Module1)	EC	BSc Phys				BEng Phys
			IST	MSP	NS	R3	
TN2545	Systems & Signals*	6	+		+		+
TN2344	Waves	6					+
TN2013 or TN2311 + TN2411	Inleiding Kwantummechanica (3 ECTS) en Kwantummechanica A deel 1 (3 ECTS) *,**	6					+
TN2053	Electromagnetism 1	6					+
TN2785	Physical Transport Phenomena	6		+		+	
TN2953-P	Research laboratory (1 experiment from each department)	2					+
BSc total BSc premaster			6 0	6 0	6 0	6 0	
WI2140	Differential Equations***	4					+
WI2142[1]	Linear Algebra***	6					+
BEng total BEng premaster							36 18

1 Linear Algebra part 1 (WI1142TN) + Linear Algebra part2 (WI2242TN)
* These modules are on the web in the collegerama format, see http://collegerama.tudelft.nl/mediasite/viewer/ at Lectures
** The bridging programme for quantum mechanics consists of the 3 EC course ”introduction to Quantum Mechanics” (TN2311) and the first half of the course ”Quantum mechanics” (TN2311). Both courses are taught in the second year of the applied physics bachelor degree course.
*** Must be done in the pre-master.
IST = Department of Imaging Science and Technology
MSP = Department of Multiscale Physics
NS = Department of Nanoscience
R3 = Department of Radiation, Radionuclides and Reactors

2.2

Important sources of information

This guide contains the most essential information about your degree course. There is lots of additional information to be found on various websites. In this chapter we briefly review these websites.

WEB SITES
The TNW web site is www.as.tudelft.nl
You can find information on the AP masters at www.ap.msc.tudelft.nl

For all information concerning education at the Faculty of Applied Sciences, see www.as.tudelft.nl > student portal

BLACKBOARD
Blackboard provides you with the most recent information about lecture courses and general information about the degree course. It is a commercial E-learning medium that serves as a virtual notice board for announcements, presentation of programme materials, practice materials, exercises and solutions as well as interesting links. You can enter the system using the 'Preview' button in the login screen, but to access all information, you need a personal login ID. You will find recent information about your programme at the programme's organization. An example is a change of schedule. You will be enrolled automatically in the organization for the master Applied Physics. Latest announcements will then automatically be displayed when you log into the blackboard site. You can get an overview of your study results on Blackboard. The web site is:
http://blackboard.tudelft.nl/
Request assistance through Blackboard-support@tudelft.nl
An important Blackboard page is the organization-page for Applied Physics. You are automaticly enrolled in this page.

TIMETABLES
These are found under the 'student portal' of the website of the applied sciences faculty.

EXAMINATION REGISTRATION (TAS) WEB SITE
You should register for a written examination using the Examination Registration System ("Tentamen Aanmeld Systeem-TAS)" at www.tas.tudelft.nl at least two weeks before the examination date. If you cannot show proof of registration you are not allowed to do the examination! If you cannot attend, you should cancel at least 5 days before the examination date using

TAS. If, for whatever reason, you do not register for an exam on time, please contact the Educational Secretariat.
Your NetID for TAS is the same as for Blackboard.

SMART STUDY WEB SITE
If you have any problems making progress in your studies, ask for advice from the Academic Counsellor or your MSc Mentor (see below). A number of useful tips and addresses are on www.smartstudie.nl/

2.3 Important contacts

DEAN APPLIED SCIENCES
Prof. dr. Raoul Bino
Applied Physics building, room C162
Secretariat: Applied Physics building, room C162
Tel: +31 (0)15 27 84841
E-mail: w.j.m.terpstra@tudelft.nl
The Dean has responsibility for all matters in the faculty.

DIRECTOR OF EDUCATION APPLIED SCIENCES
Prof Rob Mudde
Kramers Laboratory, room W210
Tel: +31 (0)15 27 82834
E-mail: r.f.mudde@tudelft.nl

MSC INTERNATIONAL GRADUATE RECRUITMENT OFFICER
Mrs Tamara Bacsik.
Applied Physics building, room C163.
Tel: +31 (0)15 27 88180
E-mail: T.M.Bacsik@tudelft.nl
Your application to enter the programme from abroad should be directed to the Admissions Officer.
Application forms are on the programme's web site
www.ap.msc.tudelft.nl

PROGRAMME DIRECTOR MASTER APPLIED PHYSICS
Dr Jos Thijssen
Applied Physics Building, room F338
Tel: +31 (0)15 27 88457
E-mail: j.m.thijssen@tudelft.nl
You may always approach him with your questions or comments.

PROGRAMME COORDINATOR MASTER APPLIED PHYSICS
Dr Hans Zoetelief
Applied Physics Building, Room A217
Tel: +31 (0)15 27 88987
E-mail: j.zoetelief@tudelft.nl
The Programme Coordinator supervises the daily routine of the programme. If you have an urgent problem with the programme, then consult him.

ACADEMIC COUNSELLOR MASTER APPLIED PHYSICS
Mrs Maricha Reedijk, Applied Physics Building, room A204
Tel: +31 (0)15 27 82408
E-mail: m.reedijk@tudelft.nl
To make an appointment, please contact the secretary at room A216, or phone +31-(0)15 2789076.
The academic counsellor will help you if you have personal problems. These could be: relationship problems, unsatisfactory progress in your studies due to excessive participation in sports, financial problems or difficulties with the programme. In particular, the counsellor can give advice in case you want to deviate from the standard programme. In case of trouble, do not hesitate to contact the academic counsellor. See also www.smartstudie.nl

INTERNATIONAL ADMISSION OFFICER MASTER APPLIED PHYSICS
Dr Jos Thijssen
Applied Physics Building, room F338
Tel: +31 (0)15 27 88457
E-mail: j.m.thijssen@tudelft.nl

TIMETABLES COORDINATOR
Mrs Christel Weber
Tel: +31 (0)15 27 88717
E-mail: C.J.Weber@tudelft.nl
The lecture and examination timetables are compiled centrally in the Shared Service Centre O&S. They are published on the web. Go to TNW website and follow 'student portal' >> timetables

Always consult the website for the most recent timetable. This may prevent you from arriving in the wrong room at the wrong time or discovering that an examination has already taken place when you want to sit it.
When in doubt, always consult the Timetables Coordinator, Christel Weber.

INTERNSHIP COORDINATOR
Mrs Stephanie Hessing
Applied Physics building, Room A210
Tel: +31 (0)15 27 87495
E-mail: stagebureau-tnw@tudelft.nl
Some specialisations have an internship in industry. Please consult the web site www.tnw.tudelft.nl/stagebureau
and/or log into Blackboard to obtain information about internships. Here you will find an up-to-date list of interesting internship offers and all necessary forms.

THE EDUCATIONAL SECRETARIAT
At the Educational Secretariat, you can make appointments with the Programme Director, the Academic Counsellor and the Internship Coordinator.
Location: Applied Physics Building, room A216.
Tel: +31 (0)15 27 89076 / 85995 / 82022
Fax: +31 (0)15 27 88572
E-mail: secr-os@tudelft.nl
Opening hours: working days 8:30 – 16:30 hours (not during lunch and not on Friday afternoons).

THE INTERNATIONAL OFFICE TNW
Mrs. Regina Thé
This office will help you if you are enrolled and want to study abroad.
Applied Physics building, room A208
Tel: +31 (0)15 27 83253
E-mail: exchange@tnw.tudelft.nl
Web site: www.tnw.tudelft/studyabroad

SERVICE DESK

Every faculty has a service desk. This is the contact point for students (and staff) for all questions concerning educational and student affairs, ICT and facilities services, such as:

- Prospectuses
- Transcripts
- Turning in mark sheets
- Certificates for students (such as for completion of programme components, marks or study credits for purposes of switching to another programme or credit-related/achievement-related grant
- Degree audit application
- Questions on the TAS examination registration system.

More information, including opening times, can be found on www.servicepunt.tudelft.nl/
The Service Desk is open Monday to Friday, from 8.00 a.m. to 5.00 p.m.
Location: Applied Physics Building, room F040. This is next to the main entrance.
Tel: +31 (0)15 27 88585 / 89806
E-mail: ServicepuntTNW@tudelft.nl

THE VVTP DESK

The "Vereniging voor Technische Physica" (VvTP – Association for Applied Physics) is the student society of Applied Physics. You can find more information about this society below.
Location: Applied Physics Building, room A109, in the hall of the A wing, first floor.
Tel: +31 (0)15 27 86122
E-mail: vvtp@vvtp.tudelft.nl
Web site: www.vvtp.tudelft.nl/

CONFIDENTIAL ADVISOR

Mrs. Corrie Zeeuw, Applied Physics building, room A206
Tel: +31 (0)15 27 83633
E-mail: vertrouwenspersoon-TNW@tudelft.nl
Every faculty has at least one confidential advisor. Teasing, mocking, gossiping, bullying, sexual or racial intimidation, violence and discrimination are all forms of harassment. The confidential advisor will give you support, in strict confidence, to stop this unwanted behaviour.
Web site: www.confidentialadvisor.tudelft.nl

2.4

Committees and councils

THE EDUCATIONAL COMMITTEE BACHELOR AND MASTER APPLIED PHYSICS

Chairman: Prof. Chris Kleijn
Secretary: Mrs. Helen Emmerink,
Room A216
Tel: +31 (0)15 27 89076
E-mail: w.h.emmerink@tudelft.nl
The Educational Committee advises the Dean and the Programme Director about the programme. Half of the committee members are students. So join the Educational Committee if you want to discuss the programme. The student society, VvTP, can give you all the relevant information.
The Dean decides on the programme. This programme and the programme regulations are incorporated into the Education and Examination Regulations ("Onderwijs- en Examenregeling") and the associated Implementation Regulations ("Uitvoeringsregeling"). The Faculty Student Council (see below) has right of approval and advice.

THE SUB-BOARD OF EXAMINERS BACHELOR AND MASTER APPLIED PHYSICS

Chairman: Prof. Ekkes Brück
Secretary: Mrs Helen Emmerink,
Room A216
Tel: +31 (0)15 27 89076
E-mail: w.h.emmerink@tudelft.nl
The faculty has a central Board of Examiners and Sub-Board of Examiners for each Bachelor-Master's combination or separate Bachelor and Master programmes. The Board of Examiners regulates the way modules are examined and decides if you have passed the MSc examination. You should send requests to depart from the fixed programme to the secretary in writing. If you have complaints about an examination you should contact the Board of Examiners as soon as possible but in any case within 10 working days after the marks have been published.
You can find the Board of Examiners regulations on the faculty's web site.

FACULTY STUDENT COUNCIL APPLIED SCIENCES

The Faculty Student Council (FSR) TNW is an official council. In this council, the Dean consults with students from the Faculty of Applied Sciences. The student council deals with issues such as education and exam regulations,

study pressures and planning, facilities like computers and space for practical work. The Dean needs permission from the student council on certain topics before he can implement changes. On other topics, the student council gives advice.
Twelve students form the Faculty Student Council. They represent the undergraduate students in Life Science and Technology, Molecular Science and Technology, and Applied Physics, and the Master's students in Applied Physics, Biochemical Engineering, Chemical Engineering, Life Science and Technology, Nanoscience, Industrial Ecology, Sustainable Energy Technology, and Science Education and Communication.
The council has internal meetings on a regular basis as well as meetings with the dean, programme directors and administrative staff, and meetings with the central student council and other student councils. Every spring the student council is chosen by election.
If you have any questions, remarks or comments, please let us know by email: fsr@tnw.tudelft.nl or see the Blackboard site at Facultaire Studentenraad.

APPLIED PHYSICS STUDENT SOCIETY

The 'Vereniging voor Technische Physica' (VvTP) is the student society for Applied Physics at Delft University It is a very active and flourishing society with about five hundred members; some eighty of these are actively involved in various committees.
The VvTP's main aims are to represent the interests of the students, and to promote the spread of knowledge in physics. The Society's activities are not only centered on organising excursions and lectures, but also on the initiation and organisation of many other useful and social events. Together with the faculty public relations office, the VvTP organises a number of Open Days to give prospective students an idea of what studying Applied Physics at the University is like. The society monitors the quality and content of the education by means of 'lecture response meetings'. These give students the opportunity to discuss education related issues directly with the lecturers and with the Programme Director. The VvTP's Education Secretary has a seat on the Education Committee, which discusses the content of the course and its evaluation. You can contact the Education Secretary via e-mail at onderwijs@vvtp.tudelft.nl. The VvTP also sells books to students at reduced prices. In August, there is a weekend where new Bachelor's students, the VvTP, educational officers and lecturers can meet up in a leisurely atmosphere. The VvTP organises an annual conference on a physics related topic, such as nuclear power or astrophysics. Excursions to companies and research institutes provide students with an opportunity to acquire knowledge about working environments. As many Applied Physics

students will make their careers in business, the VvTP organises activities where students and company recruiters can meet. An example of these activities is the annual Delft Career Fair, which is visited by over a hundred companies and more than a thousand students. Last, but not least, the VvTP publishes a quarterly periodical called 'De Physicus' ('The Physicist') and a year-book containing information on the society's previous year's activities.
Students enrolling into the Master Applied Physics from outside Delft are invited to register as a member of the VvTP, not only for buying books, but also to become a member of the student community.
The VvTP desk is located in the Applied Physics building, room A109
Tel: +31 (0)15 27 86122
E-mail: vvtp@vvtp.tudelft.nl
Web site: www.vvtp.tudelft.nl/
You can order your books using this website.

2.5 Facilities

BOOKS AND LECTURE NOTES
Most lecturers will give you a list of books and supplementary reading. This information should also be on Blackboard. Nearly all textbooks are available in the Central Library.
The Student Society VvTP sells the more popular, subject-specific, text-books at reduced prices. You should order your books via the VvTP web site, www.vvtp.tudelft.nl
Some lecturers use printed lecture notes or other printed materials like readers. Some of them are on Blackboard. Others can be ordered through the internet, as publicised.

COMPUTING FACILITIES, STUDY ROOMS AND MEETING ROOMS
All new students are automatically registered to use the university's computing facilities. The university provides each student with an e-mail account. The university facilitates computer work by supplying free software, low cost campus licensed software, fast network connections in student houses, and financial support towards the purchase of computer hardware. Ask the Service Desk for details.

To facilitate computer work, there are a number of computer rooms available within the faculty for general student use. These are:

- Rooms A201 and A203 in the A wing of the Applied Physics building at Lorentzweg 1. During restricted periods, rooms A166 and A168 will also be available for free use.
- Rooms 1.407 and 1.501 in the DelftChemTech building at Julianalaan 136.
- Room 1.630 of the Kluyver Laboratory at Julianalaan 67.

The TU Delft Library also has computer rooms. All libraries have study areas.
A large study room is available in the Applied Physics building on the third floor, room F304. This room has been equipped for the use of laptops. Room F107 in the Applied Physics building is available as a meeting room. Wireless network facilities are available throughout the campus, see http://luchthaven.tudelft.nl/

IN-HOUSE EMERGENCY RESPONSE INSTRUCTIONS

In case of accident:

- CALL 112
- Report the location.
- State your name.
- Report the nature of the accident.
- Remain with the victim.
- Wait for help.
- Follow the instructions of the company relief workers.

In case of fire:

- CALL 112
- Report the location.
- Report the nature of the fire.
- Report the scope of the fire.
- Follow the instructions of the company relief workers.
- Alert those who are in danger.
- Bring people to safety.
- Attempt to extinguish small or newly ignited fires.
- Proceed to the designated assembly area.
- In-house emergency response services (BHV).

Each faculty and building of TU Delft either has its own in-house emergency response team (BHV) or falls under the jurisdiction of the emergency-response team (BHV) of an adjoining building.

The offices of the company relief workers can be identified by the green EHBO (first aid) signs above the door. The first-aid station is located at the porter's lodge of the building.
Who: The emergency-response team (BHV) is staffed by university employees. They can be recognised by their orange BHV vests.

3.

The Programme

In this section, the programme of the Applied Physics Master course is described. The core-track-specialization structure is explained, and you can find which modules you need to take.

3.1

Programme regulations

FORMAL REGULATIONS

There are a number of documents containing the formal regulations for the faculty organization, the programmes and their execution. These are:

- The Teaching and Examination Regulations ('Onderwijs- en Examenregeling').
- (Per programme) Implementation Regulations ('Uitvoeringsregeling').
- The Rules and Guidelines of the Board of Examiners ('Regels en Richtlijnen van de Examen Commissie').

These regulations are published yearly on the faculty's web site at www.tnw.tudelft.nl/regulations

If you have any questions the Director of Education or the Academic Counsellor will be happy to be of assistance.

ATTENDANCE

We expect you to attend lectures, group tutorials, etc., even when they are not compulsory. However, you must attend all laboratory practicals and projects. Some modules have compulsory attendance or other requirements like homework or participation in quizzes and tests. You should check this in advance. In view of the intensity of the programme, we strongly recommend that you do not take leave of absence during term time as you run the risk of missing essential lectures or practical work. The Faculty is not responsible for unsatisfactory progress in your studies resulting from such action and will not take any remedial action.

FREQUENCY, REGISTRATION AND ATTENDANCE OF EXAMINATIONS

As a rule there are two opportunities per module to pass a written examination ('tentamen') per year. One is immediately after the lectures, the second in a subsequent examination period. Notification of this can be found on the examination timetable on the campus website.

In a number of cases, the examination is oral and you should make an appointment with the teacher. If for some reason you want an extra opportunity to take the examination, you should ask the Academic counsellor to give you a letter of support and then ask the teacher for permission.

You should register for a written examination at the TAS web site www.tas.tudelft.nl at least two weeks before the examination. No registration means no participation.
At the exam you should show proof of registration at the university ('collegekaart'). As a rule, no study materials are allowed ('closed book examination'). In some cases, books, lecture notes, etc. are allowed ('open book examination'). This will be announced beforehand, for example on the Blackboard course site.

CREDIT
The load per module is expressed in European Credits (EC). 1 EC is 28 hours of study. This comprises everything: attending lectures, studying at home, examinations, etc. One year of study is 60 EC. This means that you should devote on average 1,680 hours a year to your study to stay on track.

MARKS AND COMPENSATION
The scale used for marking is 1-10, i.e. each examination awards a minimum mark of 1 ('failed very badly') and a maximum mark of 10 ('passed excellently'). The lowest pass mark is a 6. A 5 or lower is a fail. In some instances you are not awarded a numerical mark, rather you either pass ('voldoende') or fail ('onvoldoende').
A conversion table from the Dutch marking system to the European Credit Transform System (EC) has been proposed, but this has not yet been adopted.

Dutch marking system	Distribution percentage	EC mark
8 < mark < 10	best 10 %	A
7.5 < mark < 8	next 25%	B
7 < mark < 7.5	next 30 %	C
6 < mark < 7	next 35%	D or E
mark < 6	Fail	F of FX

Note that the percentages are given based on the total number of passes. Not all your marks have to be a pass (> 6).

NOTIFICATION AND VALIDITY OF MARKS
Marks for written exams are published on Blackboard within 20 working days after the examination. You can obtain an overview of all your marks to date on Blackboard if you are a registered member. In case of doubt, you should consult the faculty Service Desk.

The validity of marks for individual courses of your programme is 10 years. Once you complete your programme your degree is valid forever. Note that the validity of assessments of parts of modules, such as quizzes, (computer)tests, sub-examinations, homework, exercises, etc. may be quite limited!

RIGHT OF REVIEW AND APPEAL

You have at least twenty working days in which to review your work after the exam results have been published. You are permitted to make a copy of the work. During this period you can also make an appointment with the lecturer to discuss the work. In many cases the lecturer will hand out answer sheets or publish these on Blackboard.
If you wish to appeal, you must do so within ten working days following receipt of the result by sending a letter of appeal to the sub-Board of Examiners Technische Natuurkunde and Applied Physics (see page 32).

FRAUD

If you try to pass an examination in a way that is not allowed, this is considered fraud. A suspension may be the consequence. Examples are:

- Copying or using illegal facilities like notes or digital connections during examinations.
- Copying reports.
- Using web searches without reference.

If we suspect fraud we will bring this to the attention of the Board of Examiners that will decide on measures. Details are given under "organization" master applied physics > StudyInformation.

PROGRAMME EVALUATION AND QUALITY CONTROL

The Faculty of Applied Sciences strives to continuously improve its programmes. Part of this is to ask your opinion of the programme. This is done in two ways. Firstly the student society VvTP organizes 'lecture response meetings' of groups of students to discuss ongoing teaching activities. The Programme Director and the Programme Coordinator attend these meetings. Secondly the faculty asks you to fill in questionnaires. These questionnaires contain standard questions. We urge you to participate in these evaluation activities, because we think the results are very important for the improvement of our programmes.
You also may join the Educational Committee or the Faculty Student Council to give your opinion on the programme and to advise or even decide on programme change. The Educational Committee yearly publishes an Internal Quality Assessment Report ('Kwaliteitszorgrapport' in Dutch) that contains all data on response meetings and questionnaires and on passing

rates. This report is published on Blackboard together with a curriculum proposal. In this way you may take notice of the effects of your participation in the evaluation process.

GRADUATION CEREMONIES

The great day has arrived! You have completed all the necessary courses, internship and final research project of your degree programme and you may participate in one of the graduation ceremonies. You should register at the Service Desk at least four weeks in advance of the ceremony. All necessary marks should be known at the student administration at last 5 working days before the ceremony date. A check will be performed to ensure that you are entitled to graduate and whether you deserve the designation 'cum laude'. The Graduation Ceremony is, in itself, merely a formality but it marks an important milestone in your academic career and provides the opportunity for you to be publicly congratulated by family, friends and academic staff – much deserved accolades after an intensive period of study!

Once you have fulfilled your last obligation you may end your university registration and no further payment is needed. Because the official document of passing may be delayed weeks or months depending on the ceremony date, you may receive a letter that you have passed.

Students are encouraged to invite friends and family to the graduation ceremony rather than the presentation of their master thesis (afstudeerpraatje). The graduation ceremony will be made more attractive, e.g. by presentation of of scientific achievements.

3.2

Core-track-specialisation structure

The Applied Physics Master's Programme is a two-year (four semesters) advanced level programme, with a total of 120 European Credits (EC). The programme is taught in English, with the exception of the teacher training specialisation.
The programme has a core-track-specialisation structure. An exception however is the OpSciTech track, see below.
The core programme consists of 90 EC. This consists of modules (42 EC) and a Master's thesis project (48 EC). All admitted students are obliged to follow the core part of the programme unless the Board of Examiners decides otherwise. Within this core, tracks can be chosen which correspond to the four research departments focusing on physics research within the faculty of Applied Sciences. These are:

- Imaging Science and Technology (IST)
- Multi-Scale Physics (MSP)
- Nanophysics (NS)
- Radiation, Radionuclides and Reactors (R3)

As of 1 January 2010 a fifth research department BioNanoscience (BN) will come into life. It will from then on be possible to choose a fifth track.

In addition, a sixth track can be chosen within Optics in Science and Technology (OpSciTech). This is a so called Erasmus Mundus programme. It is a joint programme between five European universities and its programme structure differs from that of the other tracks. You can find a detailed description of the core programme below.

Within the R3 track, a programme on Nuclear Science and Engineering (NSE) can be chosen. A detailed description of the programme is given below.

The remaining 30 EC is dedicated to a specialisation. An internship may be part of this specialisation. Currently we offer the following specialisations:

- Research and Development
- Management of Technology (MoT)
- Sustainability in Technology (SiT)
- Education (Ed1 and Ed2, in Dutch)
- Astronomy and Instrumentation (AI).
- Annotation in Entrepeneurship (AE)

Graduates from all core-specialisation combinations receive a Master of Science (MSc) degree in Applied Physics and are fully qualified academic engineers.

3.3

Deviations from the standard programme

In exceptional cases, the Board of Examinors may approve changes to the standard program. The student should submit a written request to the Board of Examinors before making changes to the program. Examples of exceptional cases are: taking master level courses at another university, participation in international exchange programs, requests for exemptions in case of equivalent experience before entering the master program in Applied Physics. You may consult the academic counsellor in preparation of your request to the Board of Examinors.

3.4

The core programme (90 ec)

We first describe the core programme for the reseach tracks corresponding to the physics-oriented departments. More information about the OpSciTech programme can be found below.
The core programme consists of:

1 A set of modules of 30 EC, structured as follows:
   a 18 EC chosen from the general (G) list of advanced modules which cover general physics and mathematics in more depth than the Bachelor programme. From this list, at least one mathematics and two physics subjects must be chosen.
   b 12 EC chosen from the departmental (D) list of technical and science subjects related to departments. This list contains specialised modules, which aim at covering, in part or in full, the research areas within the physics departments: IST, MSP, NS, BNS and R3. The student must choose at least one module that belongs to the department of his or her choice and at least one from another department.
2 A set of modules of 12 EC structured as follows:
   a 6 EC freely chosen from subjects within or outside the faculty, to be approved by the master thesis advisor. Possible subjects include those from the G, D, R or M lists. Subjects on the R list are specialised research topics. Subjects on the M list are specialised mathematical topics, which may be of interest to different research groups.

If a student, on the advice of his or her thesis advisor, wants to follow a subject that is not on the G, D, R or M lists, prior approval of the Board of Examiners should be obtained.

b 3 EC of Ethics

c 3 EC chosen from the S list of society related topics (This may be an extension of the Ethics module mentioned above).

3 A Master thesis project of 48 EC in a research section of one of the physics departments, IST, MSP, NS, BNS or R3, including affiliated groups (such as the Fluid Dynamics section or the Delft Centre for Systems and Control, both in the Department of Mechanical Engineering) or in another group within or outside TU Delft. If the thesis work is performed outside one of the physics departments - IST, MSP, NS, BNS or R3, including affiliated groups - then the Board of Examiners should approve this beforehand. Upon approval, the Board of Examiners will appoint a supervisor from one of the physics departments or one of the affiliated groups. As a rule, the set of G and D list modules should be completed before the student embarks upon his or her Master's thesis work.

3.5

The core programme for OpSciTech

The program of the Erasmus-Mundus course consists of one year at Delft, and another spent at one of the partner universities in this scheme: Friedrich Schiller University Jena (Germany), Université Paris-Sud/Institut d'Optique Graduate School (Paris, France), Warsaw University of Technology (Poland) and Imperial College London (United Kingdom).

3.6

Specialisations

RESEARCH AND DEVELOPMENT

In addition to the core programme, this programme consists of:

1 18 EC of internship in an R&D institution preferably in industry or a research institute outside TU Delft.

2 6 EC freely chosen from the G, D, R or M lists.

3 6 EC freely chosen from subjects within or outside the faculty under the condition that the thesis supervisor gives his or her permission. Possible modules include those from the G, D, R or M lists. If a student, on the

advice of his or her supervisor, wants to take a module that is not on these lists, prior approval of the Board of Examiners should be obtained.

ASTRONOMY AND INSTRUMENTATION

Please note:
Courses in Leiden are taught on Thursday
Courses in Delft (with a TU Delft code) are taught on Friday

This specialisation is a joint undertaking of the Leiden Observatory of Leiden University and the Faculty of Applied Sciences of TU Delft. It underlines that observational astronomy and atmospheric research uses and develops leading edge technology in particular in the field of highly sensitive detection (such as at ESA/ESTEC in Noordwijk, at TNO Science and Industry in Delft, at ASTRON in Dwingeloo and at SRON in Utrecht/Groningen).

All students who opt for this specialisation should follow the usual Applied Physics core of 90 EC. As part of the specialisation they choose 6 EC of the block of applied physics courses from the G,D, R or M list which should be approved by the coordinators, a 10 to 14 EC block of astrophysics courses and a 10 to 14 EC block of instrument-related astronomy courses (with a total of 24 EC). Your master thesis project should be related to astronomical or some other form of space research.

Students who followed a minor in astronomy may enroll in this program without any further preparation. Students who did not follow a major or minor programme in astronomy in their BSc education should study the courses on Introduction in Astrophysics (Israel) and Radiation Processes in Astrophysics (Icke) from the Leiden BSc programme in Astronomy before starting this programme.
Before starting this track you should contact one of the track coordinators, Prof. F.P. (Frank) Israel of the Leiden Observatory, israel@strw.leidenuniv.nl, Prof. T.M. (Teun) Klapwijk from the Kavli Institute of Nanoscience (Applied Sciences) at TU Delft, t.m.klapwijk@tudelft.nl, or dr. L.L.A. (Bert) Vermeersen of Astrophysics and Satellitesystems (Aerospace engineering) at TU Delft l.l.a.vermeersen@tudelft.nl

The electives of astrophysics courses are in this academic year:
- Computational Astrophysics (3EC) (spring 2010)
- Gravitational Lensing (3 EC) (fall 2009)
- Galaxies, Structure dynamics and Evolution (6EC) (spring 2010)
- Stellar Structure and Stellar Evolution (6 EC) (spring 2010)

- Star and Planet Formation (6EC) (fall 2009)
- Planetary Sciences (extended 4 EC)(2009/2010) AE4-890

The electives of instrument-related astronomy courses are:
- Detection of Light (6 EC) (fall 2009)
- Physics of Scientific Space Science Instruments (4 EC) (fall 2009)
- Inter Academical College: Virtual Observatories (data handling, data mining etc.) (6 EC) (spring 2010)
- Astronomy from Space (ESTEC) Space astronomy (6 EC) (spring 2010), (ESTEC)
- Advanced Digital Image Processing (6EC) (2009/2010), ET 4283
- Theoretical optics (2009/2010), AP3381
- Experimental Astronomy (3 EC) (2009/2010), AP3701

MANAGEMENT OF TECHNOLOGY

The Faculty of Technology, Policy and Management offers this specialisation. It consists of the first semester of the MSc programme Management of Technology. See www.tbm.tudelft.nl/mot. Before starting this specialisation you should contact Dr Roland Ortt from the TPM faculty,
tel. +31 (0)15 27 84815,
e-mail j.r.ortt@tudelft.nl

SUSTAINABILITY IN TECHNOLOGY

This specialisation is a university initiative. The programme consists of:
1 18 EC of internship in an R&D institution, preferably in industry or a research institution outside TU Delft.
2 12 EC set of modules:
   a AP3141 D Environmental Physics (6 EC) from the Multiscale Physics D list (this cannot be a substitute for the core D list choices)
   b 5 EC chosen from two cluster lists. The lists can be found at www.tudelft.nl/tisd.
   c 1 EC from Colloquium on Sustainability.
3 Approval for the master's thesis work by the faculty's advisor on sustainability, Prof. Chris Kleijn, tel. +31 (0)15 27 82835, e-mail: c.r.kleijn@tnw.tudelft.nl.

A colloquium on sustainability of which 3 EC is part of the thesis work www.tbm.tudelft.nl/mot

You should contact Prof. Chris Kleijn before starting this specialisation.

EDUCATION (IN DUTCH)

The Teacher Training Department offers these specialisations. The educational specialisation graduates are fully qualified secondary school physics teachers if they chose the basic part/minor education followed by a specialisation part during their Master's programme. The educational programmes are aimed at Dutch-speaking students only, because they are oriented towards the Dutch school system. Consequently, the educational specialisation modules are taught in Dutch.

Basisdeel / Minor Educatie

Code	EC	Omschrijving
SL3011	3	Inleiding kennisoverdracht
SL3031	3	Didactische vaardigheden
SL3041	3	Praktijkoriëntatie 1/ Schoolpracticum 1
SL3111	3	Methoden van onderzoek
SL3461	2	Onderwijskunde: Pedagogische opdracht & Begeleidingstaken
SL3471	2	Onderwijskunde: Adolescentie psychologie
SL3121	3	Vakdidactiek Natuurkunde 1
SL3331	3	Vakdidactiek Natuurkunde 2
SL3163	8	Schoolpracticum Natuurkunde 2

Verdiepingsdeel

SL3451	2	Onderwijskunde: Onderwijstaken
SL3021	6	Ontwerpen van educatieve en/of communicatieve producten
SL3311	6	Onderzoek van onderwijs
SL3371	3	Vakdidactiek Natuurkunde 3
SL3413	13	Schoolpracticum Natuurkunde 3

For more information on these programmes, contact Martin Jacobs, tel. +31 (0)15 27 85594, e-mail: m.a.f.m.jacobs@tudelft.nl

ANNOTATION ENTREPRENEURSHIP

A student can get an Annotation in Entrepreneurship (AE) if the following three conditions are met:

1 completed courses on entrepreneurship totalling 20 EC
2 followed successfully the Entrepreneurship Annotation Week (WM 4001TU) 2 EC

3 completed successfully the Annotation Entrepreneurship Final Thesis (WM4003TU) 8 EC.

The student makes a proposal for the courses to be followed and for the final thesis. He will discuss the proposal with:
- a coordinator of the Delft Centre for Entrepreneurship (DCE), Dr.ir. M.A. van Veelen
- a coordinator of the faculty

The AE certificate will be granted during the graduation ceremony.

Double degree at the TU Delft
For students enrolled in more than one master programme, there are several constraints to be kept in mind in case they want to obtain a double degree. These are
- You need at least 60 EC extra on top of a single master degree, which means that, for most students, 180 EC are needed.
- The master project is a combination of two master projects, for which the student should write separate theses (these may be part of a larger combined thesis, provided the separate parts pertaining to the different degree courses can clearly be identified.
- For acknowledgement of a double degree course, the deans of the respective faculties should request permission to the board of the university (College van Bestuur). As soon as the student envisages this possibility, this request is submitted.
- The financial degree reward paid is paid to a single faculty; the deans should agree on partitioning the reward in view of the costs and income associated with the project. (Note that this is not of concern to the student.)
- The student should register with the two degree courses.

In case the tuition fees (collegegeld) for the two degree courses are different, the student will pay the highest of the two.
- A clear and unambiguous agreement should be made between the relevant faculties for the guidance and supervision of the candidate.

Note that the rules above apply to two master degree programs, both from TU Delft. For other combinations (such as two masters from different universities) you should consult the academic counsellor Maricha Reedijk. For the Erasmus-Mundus programme OpSciTech, the conditions for obtaining the double degree are automatically satisfied within this programme. For the existing double-degree programme AP-MoT, there is no need to in form the dean with the request to arrange this with his colleague

of the other faculty. Note that this is a translation and specifications of the official regulations (which are in Dutch). For further queries, see the student counsellor Maricha Reedijk.

3.7

Information on modules

Descriptions of the modules are kept in the system CourseBase. You can access this information at:
http://studyguide.tudelft.nl/

A number of modules, especially those on the G and D lists, have special pages on the digital learning environment Blackboard, see http://blackboard.tudelft.nl/

We strongly advise you to enrol on the Blackboard courses that are relevant to you, because they contain important information, for example on requirements concerning attendance, homework assignments, etcetera. Please unsubscribe if you are no longer interested in the course.
For more information on S list modules, you should consult the website of the Faculty of Technology, Policy and Management, see www.tbm.tudelft.nl or www.tpm.tudelft.nl

For the educational specialisations you should consult the TULO ('Technisch Universitaire Lerarenopleiding') website or the website for the MSc programme in Science Education and Communication, see http://sec.msc.tudelft.nl/ or www.tulo.tudelft.nl/

Information on the cluster lists of the sustainability specialisation can be found at www.odo.tudelft.nl/

G, D, R, M and S LISTS OF MODULES
The G (General) list subjects will deepen and broaden your knowledge of physics and mathematics beyond the bachelor degree level. They are not coupled to the research themes of the departments, but knowledge of them will improve your understanding of advanced research topics. You should choose at least two physics subjects and one mathematics subject. If you already know the research group you are interested in for your final project, then it may be a good idea to ask them for advice.
The D (Departmental) list is coupled to the department's subjects. You should choose at least one D list module belonging to the department of your choice and one from another department.

The G and D lists, together with the R (Research) and M (Mathematics) lists are also on the list of electives from which you should choose modules, together with your Master thesis supervisor. Therefore the number of G modules chosen may be higher than three. See the description of the programme above.
Concerning the S (Societal) list, which can be found in Blackboard annoucements for master Applied Physics, you may extend the compulsory 3 EC on Ethics to 6 EC or you may take modules (at least 3 EC) from the educational programme of the Faculty of Technology, Policy and Management. This faculty offers a large number of society-oriented electives for all students of TU Delft. In general, they have a WM code. The "Instituut voor Techniek & Communicatie" is part of the faculty. This institute offers language courses. Consult the academic counsellor if you are in doubt. The OpSciTech track has a different structure.
Please consult www.master-optics.eu/ for an overview.

3.8
List of modules

Code	**Name**	**EC**
G list		
AP3011 G	Chaotic processes	6
AP3021 G	Advanced Statistical Mechanics	6
AP3032 G	Continuum Mechanics	6
AP3051 G	Advanced Quantum Mechanics	6
AP3061 G	Advanced Wave Propagation	6
AP3071 G	Advanced Electrodynamics	6
AP3081 G	International Master's Course on Computational Physics	6
AP3091 G	Elementary Particles	6
WI4014TU	Numerical Analysis	6
WI4143TN	Complex Analysis	6
WI3150TU*	Partial Differential Equations I	3
WI4150TU*	Partial Differential Equations II	3
* WI2607	The contents of WI2607 (in Dutch, 0/0/4/4) is the same as courses WI3150TU + WI4150TU	

D lists		
Interdepart-mental D list		
TN2881	General Theory of Relativity	6
AP3141 D	Environmental Physics	6
IST D list		
AP3111 D	Quantum Electronics and Quantum Optics	6
AP3121 D	Imaging Systems	6
AP3131 D	Advanced Signal Analysis and Processing	6
AP3231 D	Medical Imaging	6
AP3671	Optical Wave Guiding, Photonic Crystals and Optical Functions	6
MSP D list		
AP3171 D	Advanced Physical Transport Phenomena	6
AP3181 D	Applied Multiphase Flow	6
WB1422A TU	Advanced Fluid Dynamics A	6
WB1424A TU	Turbulence A	6
NS D list		
NS3501	Nanotechnology	6
NS3521TU	Mesoscopic Physics	6
BNS D list		
AP3511TU D	Biophysics	
R3 D list		
AP3351 D	Radiation Technology and Radiation Detection Principles	6
AP3371 D	Radiological Health Physics	6
AP3341 D	Nuclear Reactor Physics	6
AP3311 D	Condensed Matter	6
CH3721	Nuclear Chemistry	6
CH3771	Nuclear Science	3
AP3241 TU D	Particle therapy Holland	6
R lists		
IST		
AK R list		
AP3521	Sound control	6
AP3531	Acoustical imaging	6

DO R list		
AP3401	Introduction to charged particle optics	6
OP R list		
AP3381	Theoretical optics	6
AP3391	Geometrical optics	6
AP3601	Optical Fabrication Technology	6
QI R list		
ET4283	Advanced Digital Image Processing	4
IN4085	Pattern recognition	6
MSP R list all sections		
AP3551	Computational Multiphase Flow	6
AP3561	Turbulent Reacting Flows	6
AP3571	Radiative Heat Transfer	6
WB1428-01 and WB1428-03	Computational Fluid Dynamics	3
CH3052	Applied Transport Phenomena	6
AP3151 D	Advanced Thermodynamics	6
WB1429-03	Microfuidics	3
NS R list all sections		
NS3531	Molecular Electronics	6
NS3621	Quantum Information Processing	6
AP3651	Electronics for Physicists	6
AP3661	Quantum Entanglement	6
BNS R list		
NS3021	Supramolecular Chemistry	6
NS3161	Advanced Biophysics	6
NS3131	Biomolecular Motors	6
R3 R list		
PNR R list		
AP3321	Nuclear Reactor Physics, special topics	6
AP3631	Kinetics and Dynamics of Nuclear Reactors	3
AP3641	Nuclear Thermal Hydraulics	3

RDM & RIH R list		
AP3361TU	Medical Physics & Radiation Technology: Imaging	6
AP3581TU	Medical Physics & Radiation Technology: Radiotherapy	6
Affiliated R list		
3mE AHD R list		
WB1429	Microfluidics	3
3mE DCSC R list		
SC4020	Control Theory	6
SC4110	System Identification	5
SC4120	Special Topics in Signals, Systems & Control,	3
SC4170	Inverse Problems and Statistical Signal Processing	3
M list		
WI4005	Wavelets	6
WI4006	Special functions	6
WI4037TU	Tensor Analysis	4
WI4211	Advanced Topics in Analysis	6
S-list		
WM0320TU	Ethics for Engineering (obligatory)	3
	There are two options for the 3 remaining EC points: either you extend your Ethics course to 6 EC or you choose a module offered by the aculty of Technology, Policy and Management with a WM code. You can find a list of these modules in CourseBase. On the TNW website, click TNW campus/intranet, then Onderwijs Informatie, then SIS, then the faculty TPM and finally Elective courses/WM keuzevakken. This brings you the Blackboard environment. Note that there are 7 pages! You may then enroll on the module of your choice.	

3.9

Overview of the programme

In the table below, we give an overview of the programme. Numbers are EC. Note that the OpSciTech track has a different programme, see www.master-optics.eu/ and the next section.

		Specialisations					
	Core	R&D	MoT	SiT	Ed	AI	AE
G (Phys)	12						
G (Math)	6						
D	12			6=Env. Phys.			
G/D/R/M	6[1]	6+6[1]				6[3]	
S	3=Ethics + 3						
Master thesis	48[2]						
Internship		18		18			
Other			30	6	30	24	
Total	90	30	30	30	30	30	30

1 Should be approved by the thesis supervisor
2 Should be approved by the faculty's advisor on sustainability if one follows the SiT specialisation
3 Should be approved by the coordinators

DEFICIENCIES

Students lacking specific education in particular areas may also use the specialisation component to remedy this. They may use up to a maximum of 18 EC for modules from the second or third year level of the Bachelor's degree programmes. The remaining 12 EC can come from an individual bridging programme at Master's level. The Board of Examiners must approve this programme.

There are set bridging programmes for a number of student categories such as bachelor of engineering from a Dutch professional school (HBO). See the chapter above on admissions.

3.10

Overview of the OpSciTech programme

In the table below, you find the programme of the "Optics in Science and Technology" option. Note that this covers only the first of the two years of the full programme; the second year is spent at one of the other institutions involved in this Erasmus-Mundus programme. These are: Friedrich Schiller University Jena (Germany), Université Paris-Sud 11/Institut d'Optique Graduate School (Paris, France), Warsaw University of Technology (Poland) and Imperial College London (United Kingdom). If you spend the second year of the OpsciTech programme in Delft, you will execute a master project in an appropriate research section.
For more details you are advised to look at
www.master-optics.eu/
or on the BlackBoard page of the master applied physics.
You can also contact the programme coordinator,
Dr Florian Bociort, tel +31 (0)15 27 81457
e-mail: f.bociort@tudelft.nl

Code	**Name**	**EC**	
G-phys list	= General optical physics courses		
AP3061 G	Advanced Wave Propagation	6	Compulsory
AP3071 G	Advanced Electrodynamics	6	Compulsory
G-math list	= General mathematics courses		Choose at least 6 ECTS credits
WI4014TU	Numerical Analysis	6	
WI4143TN	Complex Analysis	6	
WI3150TU	Partial Differential Equations I	3	
WI4150TU	Partial Differential Equations II	3	
S-list	= Societal/Non-technical courses		
WM0320TU	Ethics for Engineering	3	Compulsory[1]
	English (level depending on intake test)	3	Compulsory[2]

Code	Name	EC	
D-list	= Courses at the Department of IST		Choose at least 12 ECTS credits
AP3121 D	Imaging Systems	6	
AP3131 D	Advanced Signal Analysis and Processing	6	
AP3231TU D	Medical Imaging	6	
R-list	= Research course modules		
AP3401	Introduction to charged particle optics	6	Choose at least 12 ECTS credits3
AP3381	Theoretical optics	6	
AP3391	Geometrical optics	6	
AP3601	Optical Fabrication Technology	6	
ET4283	Advanced Digital Image Processing	4	
AP3471-P	Image Processing Laboratory Course4	2	
WB2433	Humanoid Robots	3	
IN4085	Pattern recognition	6	
AP3361TU	Medical Physics & Radiation Technology: Imaging	6	
Project	= Practical research project		
AP3941	Research project in the Department of IST	12	Compulsory

3.11

Nuclear Science and Engineering (NSE) Special Track

The programme is an R&D specialisation of the R3 track

General

NSE may have a "health" or a "energy" orientation. Health and Energy are the main areas of research of the Department of R3.

Core-specialisation structure

De MSc AP R&D-NSE contains a core (90 EC) and a R&D-specialisation NSE (30 EC).

CORE courses (90 EC):
- 18 EC G-courses
- 12 EC D-courses (selected from G,D,R lists below)
- 06 ECTS G,D,R or M courses (selected from G,D,R lists below)
- 03 EC Ethics WM0320TU
- 03 EC S courses
- 48 EC master thesis work

R&D-specialisation NSE (30 EC):
- 18 EC traineeship
- 06 EC G, D, R or M courses (selected from G,D,R lists below)
- 06 EC within or beyond the faculty approved by the thesis advisor

NSE boundary conditions:
48 EC MSc thesis within NSE
18 EC traineeship within NSE

G List
Recommended G-courses
- Elementary Particles AP3091 G
- Advanced Quantum Mechanics AP3051 G
- Chaotic processes AP3011 G

D and R lists
- D-Nuclear Science (3) CH3771
- D-Nuclear Chemistry (6) CH3721
- D-Chemistry of the Nuclear Fuel Cycle (6, of 3+3)
- Nuclear Engineering (3, 3mE) WB4416
- D-(Nuclear) Reactor Physics (6) AP3341
- (R) Nuclear Thermal Hydraulics (3) AP3641
- (R) Kinetics and Dynamics of Nuclear Reactors (3) AP3631
- R-(Nuclear) Reactor Physics Special Topics (3+3) AP3321
- D-Condensed Matter: Structure and Dynamics (6) AP3311
- Nuclear Materials (3, 3ME)
- R-Medical Physics & Radiation Technology: Imaging (6) AP3361
- R-Medical Physics and Radiation Technology: Radiotherapy (6) AP3581
- D-Radiation Detection Methods (6) AP3351
- D-Radiological Health Physics (6) AP3371
- D-Particle Therapy (AP3241)

3.12

Special Casimir pre-PhD track

The long-standing research collaboration in the field of nanoscience between Leiden University and Delft University of Technology has led in 2004 to the establishment of the Casimir graduate school (http://casimir.researchschool.nl) which accomodates PhD students within the Kavli Institute for Nanoscience in Delft and the Leiden Institute of Physics (LION). The research within the school is grouped into 6 themes, each containing theoretical, experimental and applied projects both at Leiden and at Delft. Starting in the year 2009/2010, the Casimir activities will be extended to include a special track in the Applied Physics degree course in Delft and the Master of Physics course in Leiden. This track focuses on educating students especially for a PhD position at these departments (LION and/or Kavli) or elsewhere and is designed to respond to the increased mobility of students after their BSc. This materialises in a particular set of courses and research experience in more than one department. A selection will take place for entrance into this track. For a limited number of students within this track, a PhD position is guaranteed. For the other students within this track, PhD-job prospects are expected to be very good.

The programme for this track consists of

- Advanced statistical mechanics AP3021G and advanced quantum mechanics AP3051G (both 6 EC)
- One other course from the list of foundational courses (see below, 6 or 10 EC)
- A math course: Complex Analysis WI4143TN or Partial Differential Equations (WI3150 and WI4150)
- 2 courses from the `topical' list below (all 6 EC)
- One course of at least 6 EC from the `methods' list (see below)
- Writing a research proposal (12 EC)
- Ethics (3 EC)
- A course from the S-list (3 EC)
- A 48 EC master project work, consisting of one long research project including a thesis and scientific presentation, followed by two short projects in different research groups.
- The remaining EC (at least 14) are filled with courses from the `foundations', `topical' and `methods' list. At least 6 EC from these are chosen together with the supervisor of the long research project.

Note that the courses in Leiden are currently taught once in two years!

Note:
This programme fits by and large into the standard AP physics degree programme:

- 3 courses from the G list, at least one math course
- 2 D-list courses (if we include the Leiden offerings)
- Ethics and S-list
- 48 EC research project
- One R-list (methods) course
- The remainder is done as a `Casimir' specialisation: Writing research proposal (12 EC) and additional coursework (18 EC)

Courses (currently active list)

Course	**Location**	**Teacher**
Foundational		
Advanced quantum mechanics	Delft	Nazarov
Advanced statistical physics	Delft	Thijssen
Quantum field theory	Leiden	Achucarro
Quantum optics and quantum information	Leiden	Nienhuis
Theory of condensed matter	Leiden	Zaanen
Theory of general relativity	Leiden	Schalm
Quantum theory	Leiden	Denteneer
Statistical physics	Leiden	Schiessel
Quantum computing	Leiden	Beenakker
Topical		
Mesoscopic physics	Delft	Van der Zant
Advanced Solid State Physics	Delft	Blanter
Quantum transport	Delft	Nazarov
Molecular Electronics	Delft	Van der Zant
Physics of Semiconductor Devices	Delft	Rogge
Quantum Information processing	Delft	Vandersypen
Biophysics	Delft-Leiden	Keymer
Advanced biophysics	Leiden-Delft	Dogterom
Experimental Classical and Qauntum Optics	Leiden	Van Exter
Single molecule optics	Leiden	Orrit

Course	**Location**	**Teacher**
Intro astro-particle physics	Leiden	De Jong
Surface physics	Leiden	Rost
Methods		
Computational Physics	Delft	Thijssen
Electronics for Physicists	Delft-Leiden	Zwiller-Van Spengen
Frontiers of measurements	Delft-Leiden	Nienhuis
Scanning probe microscopy	Leiden	Frenken
Computational physics	Leiden	Barkema
Nanotechnology	Delft-Leiden	Schmidt-Salemink
Physics of scientific space instruments	Leiden	Beijersbergen
	Delft-Leiden	Keymer

3.13

Fullbright options

Students with proven exceptional talents for physics are encouraged to exploit their time spent in the master programme by an extra effort. There are three major options available for these students. The first is to simply finish the degree program within a shorter period of time. This can be particularly useful if you plan to carry on with a PhD in the same field in which you did your master project. A major advantage of this option is economical: you enter the job market sooner. Also, your `job market value' may be higher when you can show you completed the programme in a short time.

The second option is to do a second master in addition to the Applied Physics programme. The second master may be anything, but there is a special double degree programme on Management of Technology which is described below.

A final option is the so-called honours track. This is an individual programme of about 30 EC which consists of a specially developed 6 EC course for all TU Delft honours track students. This course is interdisciplinary and focuses on academic competences such as communication skills, philosophy of science, methodology and ethics. The rest of the track is a package of courses which the student selects together with the programme director. This package may consist of challenging courses on physics or another subject. These courses may be taken outside Delft. It is also possible to take courses on transferable skills (communication, manage-

ment etcetera). Note that this track is not intended for taking more courses on similar subjects and on the same level as the modules of the ordinary Applied Physics programme, nor is it acceptable to take 30 EC in this track and finish 6 months later than the usual standard duration of two years. The honours track should on the other hand be a coherent programme and contain a substantial part of activities or courses at the PhD level.
If you feel ambitious and confident that you can finish an honours track, please contact prof. Leo Kouwenhoven in order to formulate a program for this track. When you start such a track, all requirements are listed in an agreement formulated by the programme director, who also has the responsibility for awarding your honours track. The honours track will result in a certificate that will be received together with the master thesis diploma.

APPLIED PHYSICS AND MANAGEMENT OF TECHNOLOGY - THREE-YEAR DOUBLE DEGREE PROGRAMME
This programme will enable the student to get a Master's degree in both Applied Physics and Management of Technology in three years.
Only selected students are admitted to this double degree programme. Interested students should be on track in their programme and be up-to-date with their work. Students who want to do this double degree programme should contact Dr Roland Ortt from the TBM Faculty, e-mail j.r.ortt@tudelft.nl.
The first year of this programme is the first year of the MoT MSc programme. The second and third years are the core programme of the MSc Applied Physics and a MoT thesis project.

3.14

The internships and the master's thesis project

Internship
The goal of the internship is

- to become familiar with a professional working environment for a physicist
- to use academic knowledge and skills, acquired in the degree course, to solve problems or be active in design related to physics, in a professional working environment

The internship is guided by an internal and an external supervisor. The mark for the internship is awarded by these two supervisors. The mark is based on an individual report of the student, in which the experiences concerning both main goals, including the experience in the working environment, are discussed.

Remarks:

1 It is desirable for the internship to have a physics content. However, in some cases it may be acceptable if this component is lacking, provided that the work requires problem solving or design skills, for which physicists should be particularly well equipped.
2 The internship is in principle intended as a way for students to broaden their awareness of working environments outside academia. For students with a particular ambition and skill to pursue a career in science, an internship in an academic environment (not a Dutch university or FOM institute) may however be acceptable.
3 The criteria formulated here do not exclude activities in a startup company (maybe initiated by the student) to be accepted as internships. The criterion is that there should be an internship supervisor with a sufficiently strong involvement to be able to act as such.

The R&D track and the Sustainability specialisation have internships (traineeships) of 18 EC. You should contact the internship coordinator (see below) at least six months in advance. She will arrange supervision and assessment of your internship. If you have arranged an internship yourself, you should inform the coordinator and get approval before starting. A written report on the work is compulsory. Consult your supervisor and the coordinator regarding the rules for the content and the form of the report. In principle, the language of the report is English, but you can change this by mutual agreement to Dutch, German or French. You should submit the report within one month of the end of your internship period. Copies should be given to your supervisor and to the coordinator.
The Applied Sciences Internship coordinator is Mrs Stephanie Hessing.
Applied Physics building
Room A210
Tel: +31 (0)15 27 87495
E-mail: stagebureau-tnw@tudelft.nl
You can find detailed information concerning internships, such as frequently asked questions, forms, links etcetera, on
www.tnw.tudelft.nl/stagebureau

The most important part of your Master's programme is the Master's thesis project (Master's dissertation). From the very beginning of your Master's education you should familiarise yourself with the opportunities for doing research work in one of the research sections of the Departments of Imaging Science and Technology; Multi-Scale Physics; Nanoscience; BioNanoScience and Radiation, Radionuclides & Reactors, or one of the research groups affiliated with these departments.
Although the Master's thesis work is part of the second year of the programme, your choice of research subject may influence your choice of electives from the G, D or S lists in your first year. You can get information about the possibilities for the Master's thesis by:

- Reading the descriptions of the research groups in this handbook.
- Reading the booklet 'Sectie Keuze Gids' from the Student society VvTP (in Dutch, available at the VvTP desk and on the MSc AP Blackboard community).
- Visiting the information market organised yearly by the VvTP.
- Consulting the Blackboard course site on the Master's thesis.
- Consulting the section contact person and participating in guided tours
- Consulting the academic counsellor
- Consulting the Director of Education who is the Master's Thesis Coordinator.

Consult blackboard (Thesis Project Administration) for detailed information and various forms. Enroll to this blackboard community by choosing the Organizations tab on the MyTUDelft page and follow the links
Education > Applied Sciences > Eindprojecten Administratie TNW

The procedure of a Thesis Project consists of the following steps:

1 Orientation
2 Careful consideration and consultation of different sections.
3 Handing in the application form and a list of the achieved courses
4 Providing the Thesis Project Administration with the names of the review committee
5 Presentation
6 Assessment and calculation of the examination mark

Important!

- You should have completed your G and D list modules from the core programme before starting your thesis work.
- The final mark will only be registered after the Thesis Project Administration has received a digital copy of the thesis report and survey.
- For questions & handing in the digital version of the report, please contact **eindprojecten-tnw@tudelft.nl**

4.

Descriptions of the departments and research groups

As a rule, you will do your Master's thesis work in a research group of one of the four physics departments in the Faculty of Applied Sciences or in an affiliated group. In this chapter, you find short descriptions of these departments and groups. You should consult the group's website or ask for information or a guided tour to get more information about the possibilities for your Master's thesis work.

4.1

Department of Imaging Science and Technology

Applied Physics Building, Lorentzweg 1, 2628 CJ Delft
Chairman: Professor Lucas J. van Vliet
Tel: +31 (0)15 27 87989
E-mail: L.J.vanVliet@tudelft.nl
Secretary: Liesbeth Secker-Versteegh
Tel: +31 (0)15 27 87164
E-mail: m.e.secker@tudelft.nl
Secretariat: Anjella van Vliet, room F240
Tel. +31(0)15 27 81416
E-mail: J.T.vanVliet@tudelft.nl
Web site www.ist.tudelft.nl/

Imaging systems play an important role in modern science and technology and have a large societal impact. The acquisition, processing, and analysis of images provides a wealth of intellectual, scientific and technical challenges. Breakthroughs in imaging physics are instrumental in scientific discoveries of numerous multidisciplinary research fields. Imaging systems are ubiquitous. They are at the basis of biomedical diagnostics, seismic exploration of oil and gas, nano-patterning, lithography, and optical data storage. The department conducts research into novel imaging principles and develops new technologies for this emerging field, often in cooperation with industrial partners.
The research programme of the IST department, involving some 20 permanent faculty members, concerns itself with the development of new image acquisition and processing systems as well as the quantitative analysis of the two-, three-, and four-dimensional images obtained through such systems. A variety of imaging modalities and a broad range of application domains are represented in this programme.

Research sections

IST-AK: ACOUSTIC IMAGING AND SOUND CONTROL
Head: Prof. Dries Gisolf
Tel: +31 (0)15 27 85299
E-mail: a.gisolf@tudelft.nl
Secretariat: Margaret van Fessem, room D218
Tel: +31 (0)15 27 81804
E-mail: m.m.vanfessem@tudelft.nl
Web site: www.ak.tn.tudelft.nl/
Information and guided tour: Dr Eric Verschuur, room D205
Tel: +31 (0)15 27 82403
E-mail: d.j.verschuur@tudelft.nl

Acoustic Imaging
Contact person: Dr Eric Verschuur
Tel: +31 (0)15 27 82403
E-mail: d.j.verschuur@tudelft.nl
The education and research concentrates on the area of elastodynamic imaging. Application fields include seismic imaging, medical echo-diagnostics and non-destructive inspection of materials. The group forms part of the Research Schools 'Centre for Technical Geosciences' and 'Delft Research Centre Earth'.

Sound Control
Contact person: Dr Diemer de Vries
Tel: +31 (0)15 27 85220
E-mail: d.devries@tudelft.nl
The education and research concentrates on the areas of room acoustics, outdoor sound control and audiology. Application fields include the acoustics of auditoria, wavefield analysis and wavefield synthesis with multiple-channel audio systems, and improvement of speech intelligibility in directional hearing aids and mobile telephony.

Medical Acoustical Imaging
Contact person: Dr Koen W.A. van Dongen
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E-mail: k.w.a.vandongen@tudelft.nl
The aim of the Medical Acoustical Imaging research section is to develop methods to obtain images of the human body for clinical purposes using acoustical wave fields. Attention is paid to the development of both imaging systems (hardware) and imaging algorithms (software).

IST-DO: CHARGED PARTICLE OPTICS

Head: Prof. P. Kruit
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Secretariat: Elly van der Most, room F132
Tel: +31 (0)15 27 81497
E-mail: E.P.vanderMost@tudelft.nl
and Margaret van Fessem
Tel: +31 (0)15 27 81497
E-mail: secr-DO-TNW@tudelft.nl
Web site: www.ist.tudelft.nl/cpo
Information and guided tour: Dr C.W. Hagen, room F134
Tel: +31 (0)15 27 86073
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Charged particle optics is the creation and manipulation of electron and ion beams and the study of the interaction of electrons and ions with matter. The ambition of the Charged Particle Optics group is to develop improved tools to look at the microscopic world and to invent new methods to create microscopic structures, even down to nanometer size. For that purpose we advance the fundamental understanding of relevant physical phenomena such as electron emission and we design innovative, sometimes revolutionary electron- and ion beam instruments, for the future semiconductor production, as well as for the fabrication of nanostructures. We presently hold the world record for the direct-writing of small structures using a focused electron beam and are internationally known as the originators of the MAPPER technology (now further developed in the spin-off company MAPPER lithography).
All our master thesis projects relate somehow to an industrial product such as electron microscopes from the world market leader in electron microscopes (FEI) or electron lithography machines from MAPPER. It is our aim that everything you discover in your master thesis work has a relatively short term application in industry. Students select the Charged Particle Optics group both for the practical, yet highly scientific attitude of the people in the group and because they are given their own project, in which they are allowed to take responsibility. The group has a large amount of modern equipment (such as 4 scanning electron/ion microscopes) that students are allowed to operate. For all projects ample financial and technical support is available, so you don't waste time on trivial issues and can concentrate on the core of the project. This makes that during your time in the research group you learn a great deal about project management, experimental work, electronics, vacuum, dealing with suppliers and part-

ners and cooperating with other members of the group. While allowing a high level of independence, everybody in the group works together closely. This also means students experience far more than their own project has to offer, making this easily the most valuable time of the physics studies.

Typical projects:

- Electron induced deposition of nanometer sized patterns: a combination of advanced instrumentation and deep understanding of electron beam interaction with matter.
- Testing of a novel ion source based on electron impact dissociation of gases.
- Photo-assisted electron emission from thermal field emitter electron sources (so-called Schottky sources, the most wide-spread electron source used in microscopes).
- Studying the interaction between ion beams and matter at the nm level.
- Phase determination of the electron wave emitted from a single Carbon nanotube. This is work at the boundaries of the wave-particle duality.
- Development of multi beam lithography and microscopy systems.

IST-OP: OPTICS RESEARCH GROUP

Head: Prof. Paul Urbach, tel. +31 (0)15 27 86146,
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Secretariat: Yvonne van Aalst and Lucia Heijenga, room E010,
tel. +31 (0)15 27 81444,
e-mail: y.vanaalst@tudelft.nl L.M.J.M.Heijenga-Becht@tudelft.nl
Web site: www.optica.tnw.tudelft.nl/
Information and guided tour: tel. +31 (0)15 27 81444,
e-mail: y.vanaalst@tudelft.nl

The focus of the Optics Research Group is on wave propagation and image formation using radiation that ranges from the extreme ultraviolet to THz-frequencies.

- For the study of light diffraction and scattering by two-dimensional and three-dimensional micro- and nano-structures, the modelling is based on the solution of Maxwell's equations. Theoretical and experimental problems of this type are encountered in optical lithography, optical data storage and light-guiding structures for modern high-efficiency light sources like light-emitting diodes and compact semiconductor lasers.
- In the THz-domain, far sub-wavelength resolution is aimed at, down to the one micron level and below, using a probe-assisted coherent detec-

tion technique of the THz-radiation. New applications are found in the medical and pharmaceutical field
- The design of complicated high-quality imaging systems is studied from the general view-point of system optimisation using geometrical optics.
- Synthetic aperture imaging techniques are studied in the framework of astronomical observation and exo-planet detection.
- Various metrology problems are studied by the group to ensure the optimum functioning of high-performance imaging systems like those used in optical lithography and astronomy. A central tool in this respect is the white-light frequency comb laser.

The group participates in the European Erasmus Mundus MSc programme OpSciTech, Optics in Science and Technology.

IST-QI: QUANTITATIVE IMAGING

Heads: Prof. Ian T. Young, tel. +31 (0)15 27 85390,
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Prof. Lucas van Vliet, tel. +31 (0)15 27 87989,
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Secretariat: Mandy Jungschlager, room F240
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Web site: www.qi.tnw.tudelft.nl/
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Advances in imaging systems and sensor technology produce an increasing stream of digitized image data. To explore the enormous wealth of information present in these images calls for advanced processing and measurement techniques. The Quantitative Imaging group (QI) performs research (and provides education) on a wide variety of topics involving the acquisition, processing, and analysis of digitized images with applications in medical, molecular and industrial imaging. In our research we focus on:
- Multi-dimensional image processing and analysis: Fundamental research in multi-dimensional signal and image processing aims at improving the extraction of quantitative information from multi-dimensional signals. We are developing new measurement paradigms to find novel ways for image representation, segmentation, analysis and recognition.
- Bio-imaging and quantitative microscopy: We aim to develop new methodologies for the detection, visualization and measurement of single molecules, molecule interaction and dynamics in living cells. To achieve these goals, we work to improve (electron) optical resolution, detection and quantification in microscopy by applying and developing advanced

image processing techniques and measurement strategies. These technologies contribute important tools to the relevant issues such as understanding the mechanisms behind diseases.
- Medical imaging: In modern medicine, imaging plays an increasingly important role. Imaging modalities, such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) provide high-quality three-dimensional or even four-dimensional pictures. These pictures do not only include the human anatomy, but also its function and the changes over time, aspects that are truly characteristic of the medical field. This is particularly valuable for monitoring the progress of diseases under treatment, and for minimally invasive (image-guided) interventions.

The group has cooperative research projects with a number of industries, large and small, with national and international research institutes, and with universities throughout the world. The group also plays a central role in Medical Delta (Health Science & Technology) research institute, a collaborative initiative of the universities and medical schools in Delft, Leiden and Rotterdam.

4.2

Department of Multi-Scale Physics

Education and research are carried out at two locations:
• Applied Physics Building: Lorentzweg 1, 2628 CJ Delft
• Kramers Laboratorium: Prins Bernhardlaan 6, 2628 BW Delft
Chairman: Prof. Harrie van den Akker,
tel. +31 (0)15 27 85000,
e-mail: h.e.a.vandenakker@tudelft.nl
Secretary: Dr. André R. Groenhof, tel. +31 (0)15 27 84583,
e-mail: a.r.groenhof@tudelft.nl
Kramers Laboratory, tel. +31 (0)15 27 81218,
Early 2010, the department will move into a single, new experimental and office facility located at the Leeghwaterstraat
e-mail: a.vandervlist@tudelft.nl
Web site: www.msp.tudelft.nl/

The department of Multi-Scale Physics studies phenomena and processes of flowing matter and heat transfer at molecular and macroscopic scales and how these are related to the material and energy flows found both in nature and in industrial process equipment. We face interesting challenges analyzing processes in industrial settings and in the environment and describing them in terms of the underlying continuum and molecular

events. Students graduating in MSP can choose between projects in the following areas:

- Computational Reactor Engineering (Prof. Harrie van den Akker)
- MultiPhase Flows (Prof. Rob Mudde)
- Thermal & Materials Processes (Prof. Chris Kleijn)
- Reactive Flows & Explosions (Prof. Dirk Roekaerts)
- Clouds, Climate & Air Quality (Dr. Harm Jonker)

The great potential of a wide variety of computer simulations (Computational Fluid Dynamics, large-eddy and direct numerical simulation, Lattice-Boltzmann simulations, Monte-Carlo techniques) makes it possible to simulate fundamental flow phenomena and also most aspects of industrial and environmental processes in great detail and very close to reality. Advanced measuring techniques allow us to penetrate deeply into the details of flow and transport phenomena as occurring in process equipment, and to analyse their mutual relations and their impact on physical and chemical processes. Environmental issues, including cloud dynamics and cloud microphysics, but also atmospheric dispersion (fine dust) in urban areas, are studied to improve computational and climate/weather models. A detailed understanding of the underlying principles should lead to a better control of various processes, producing better products in a cleaner, safer and more efficient way. In this way, MSP contributes to more sustainable industrial processes and a better world.

For MSc students planning to graduate within the MSP department it is important to acquire sufficient knowledge of the physics of fluid flow and turbulence. It is, therefore, strongly advised that all students, prior to entering the MSP department, take the following courses:

G-list courses

- Continuum Physics (AP3031 G)
- Partial Differential Equations I and II (WI3150TU + WI4150TU)

D-list courses

Two courses from the list below

- Advanced Physical Transport Phenomena (AP3171 D)
- Turbulence A (WB1424A TU)
- Applied Multiphase Flow (AP3181 D)

Students persuing the R&D specialisation are advised to also take the course

- Advanced Fluid Dynamics A (WB1422A TU)

Additional courses should be chosen in accordance with the thesis advisor.

4.3

Department of Nanoscience (Kavli Institute of Nanoscience Delft)

Applied Physics Building, Lorentzweg 1, 2628 CJ, Delft
Chairman: Prof. H.S.J. van der Zant,
tel: +31 (0)15 27 87733,
e-mail: H.S.J.VanderZant@tudelft.nl
Secretary: Dr Patrick van Veenendaal,
tel: +31 (0)15 27 81489,
E-mail: P.A.T.T.vanVeenendaal@tudelft.nl
Secretariat: Simone Bots,
tel: +31 (0)15 27 83163
E-mail: S.C.Bots@tudelft.nl
Web site: www.ns.tudelft.nl/

The department consists of six or seven groups and a nanofacility group, all aimed at innovative research at the current frontier of science on a nano-scale. Besides participating in the Applied Physics master programme the department also participates in the master of NanoScience programme together with Leiden University.

NS-HREM: HIGH RESOLUTION ELECTRON MICROSCOPY

Head: Prof. Henny Zandbergen,
tel: +31 (0)15 27 82266,
E-mail: h.w.zandbergen@tudelft.nl
Secretariat: Marijke van der Veen, room B206,
tel. +31 (0)15 27 87213,
E-mail: M.M.H.vanderveen@tudelft.nl
Web site: http://nchrem.tnw.tudelft.nl/
Information and guided tour: Prof. Henny Zandbergen.

The experimental methods used for characterizing materials at an atomic level are scanning and transmission electron microscopy, including the world's most advanced high-resolution electron microscope. Computer modelling is increasingly becoming a crucial tool for finding a quantitative interpretation of experimental observations and understanding of behaviour.

Research topics:

- Structure determination of nanoparticles of oxides and metals.
- Characterization of thin films of oxides with useful functional properties.
- Use of an electron beam for nanosculpting of materials.

- Relation between the local electronic structure and overall properties.
- Guided nucleation of proteins.
- Improvements in quantitative interpretation of HREM images.
- Development of remote experimentation with electron microscopes.
- Microreactors based on MEMS techniques.

NS-MED: MOLECULAR ELECTRONICS AND DEVICES

Head: Prof Herre van der Zant,
tel. +31 (0)15 27 87733,
e-mail: h.s.j.vanderzant@tudelft.nl
Secretariat: Maria Roodenburg-Van Dijk, room F364,
tel. +31 (0)15 27 82600,
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Web site: med.tn.tudelft.nl/
Information and guided tour: Prof Herre van der Zant

The main focus of research in the Molecular Electronis and devices (MED) group is the study of the electronic properties of molecular materials, aiming at their basic understanding as well as at the development of new device applications. This research programs exploits both a top-down and a bottom-up nanotechnology approach. A top-down approach is used for the fabrication of nanometer-scale structures consisting of ideally one molecule connected to electrodes. This enables the investigation of electronic transport at the molecular level. The bottom-up approach is used to self-assemble molecular structures under controlled conditions.
Self-assembly techniques enable us to grow molecular crystals of unprecedented chemical and structural purity or for the production of one-dimensional molecular fibers, both of which are used for fabrication of transistors. Although the main lines of research is driven by fundamental scientific questions, our work involves the use of new materials and the development of new device concepts that are directly relevant for electronics applications.

NS-NF: PHYSICS OF NANO-ELECTRONICS

Head: Prof. Teun Klapwijk,
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e-mail: t.m.klapwijk@tudelft.nl
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tel. +31 (0)15 27 82600
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Web site: www.nf.tn.tudelft.nl/
Information and guided tour (incl. lunch): Prof. Dr Teun Klapwijk

Tomorrow's electronics finds its ultimate limit at the atomic scale and, paradoxically, its first application in astrophysics, the core themes of Physics of Nanoelectronics. In 2007 the Herschel Space Telescope will be launched based on quantum-limited detection using superconducting tunnel devices developed in our group. It demonstrates that "nano" also means "high-frequency", smaller devices work faster and enter the hundreds of GHz to THz range, a fascinating new frontier.

NS-PD: PHOTRONIC DEVICES

Head: Prof Huub Salemink,
tel. +31 (0)15 27 83310,
e-mail H.W.M.Salemink@tudelft.nl
Secretariat: Marja Plas, room B206,
tel. +31 (0)15 27 887213,
E-mail: M.J.Plas@tudelft.nl
Web site: www.ns.tudelft.nl/pd
Information regarding guided tour (around an informal lunch with the group):
Dr Sven Rogge,
tel. +31 (0)15 27 82495,
e-mail S.Rogge@tudelft.nl
The Photronic Devices group concentrates on the physics of devices operating on the basis of controlling photonic and electronic waves on the nanoscale. In particular, we use photonic bandgap materials and inorganic semiconductors for new optical and electrical device operation. Phenomena in devices made from these material systems exhibit both interesting similarities and differences, while in either case doping (optical doping and electrical doping, respectively) is essential for device functionality. Projects are arranged according to two research themes: photonic crystal research and atomic-scale electronics.

NS-QT: QUANTUM TRANSPORT

Head: Prof. Leo Kouwenhoven
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e-mail: A.C.H.Fontijn@tudelft.nl
Web site: www.ns.tudelft.nl/qt
Information for students: Dr. Ronald Hanson, room F032
Email: r.hanson@tudelft.nl

The Quantum Transport group studies and exploits novel quantum mechanical phenomena in nanometer-scale structures. Our current research focuses on superconducting rings, quantum dots, nanowires, carbon nanotubes, diamond, and graphene. We employ in-house design and fabrication of (opto-)electronic devices and custom-made electronic and optical measurement techniques, from room temperature down to the milliKelvin regime. We use these devices for controlling quantum behaviour at the level of single spins and single photons, with the potential for fundamental breakthroughs and possible application to quantum computing and novel optoelectronics devices.

NS-TN: THEORETICAL PHYSICS

Head: Prof. Gerrit Bauer,
tel. +31 (0)15 27 84719,
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e-mail: m.deniet-dejager@tudelft.nl
Web site: www.tn.tudelft.nl/tn
Information and guided tour: Prof. Gerrit Bauer
Research and education activities of this group are in the area of theoretical physics with emphasis on the quantum mechanics of nanoscale electronic devices made from semiconductors, superconductors, ferromagnets as well as hybrid structures. This embodies theoretical support of ongoing experiments, the stimulation of new experiments by theoretical predictions, and general research on quantum transport theory.

NS-NAF: Nanofacility

Head: Dr. Emile van der Drift
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Secretariat: Simone Bots, room F214
tel. +31 (0)15 27 83163
e-mail: s.c.bots@tudelft.nl
Web site: www.ns.tudelft.nl/nanofacility
Information and guided tour: Dr. Emile van der Drift
The Nanofacility group is responsible for the operation of the cleanroom of the new Van Leeuwenhoek Laboratory (VLL). Its scientific and technical staff educates, trains and assists people in using the nanofabrication tools of this lab.
The group has its research activities in high resolution electron or ion beam lithography and in growth, structuring and characterisation of materials in the nanometer length scale. The research is mainly experimental and is

aimed at the newest developments in fabrication methods in nanotechnology.

NS-MB: Cluster Molecular Biophysics
(in transition to department of BioNanoScience per 1/1/2010)
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tel. +31 (0)15 27 86094,
e-mail: c.dekker@tudelft.nl
Secretary: L. de Lege,
tel. +31 (0)15 27 81979,
L.deLege@tudelft.nl
Secretariat: room F061,
tel. +31 (0)15 27 81428,
e-mail: e.vanhartrop@tudelft.nl
Web site: www.mb.tn.tudelft.nl/
Information and guided tour: Dr Nynke Dekker, tel. +31 (0)15 27 83219,
e-mail: n.h.dekker@tudelft.nl
The Molecular Biophysics cluster groups four different principal investigators whose groups perform biophysical research at the single-molecule and single-cell level, examining enzymes and molecular motors as well as individual cells

The experimental infrastructure of this group encompasses single-molecule techniques such as magnetic and optical tweezers, fluorescence detection, scanning probes (AFM), and electronics for electrical measurements at the femto-Ampere scale. In addition, the group employs nanofabricated structures constructed in the Nanofacility to probe biomolecular systems, as these structures are on the same length scale as the molecules themselves.

The world-class research in the group is driven by a wish to understand basic physical and biological processes, as well as their interactions. .

Current research efforts include:
- Development of novel tools for single-molecule force spectroscopy
- Studies of DNA- and RNA-processing enzymes, involved in replication, transcription, and repair.
- Translocation of biomolecules through nanofabricated pores and nanofluidic channels.
- Evolution of microorganisms in microfabricated habitats.
- Understanding the role of ions in biophysical properties, as well as efforts towards expanding electrical detection of molecular processes.

4.4

Department of Radiation, Radionuclides & Reactors (R3)

Reactor Institute Delft, Mekelweg 5, 2629 JB Delft
Chairman R³ and Director RID: Prof. Tim van der Hagen,
tel. +31 (0)15 27 82105,
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Secretary: drs. Anne Marie Kraal
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Secretariat: Linda Hoogendonk
Room 01.01.160
Tel. +31 (0)15 27 86712
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Web site: www.rrr.tudelft.nl/

A binding element of the Radiation, Radionuclides & Reactors department is radiation. However various our areas of interest, all research is somehow related to radiation. Follow medical processes in the human body, study safe hydrogen storage in complex metal structures for car design, follow the phase transition of foodstuff to improve their taste, detect plastic landmines in the ground or unravel coast information for a safer Netherlands, these are just examples of our research.
Close collaboration with both the Reactor Institute Delft and international institutions guarantees us access to first-class reactor and radiation facilities and forms the basis for three important knowledge centres: the positron Centre, the neutron centre and the Luminescence Centre. The confluence of this abundance of knowledge makes our research unique in the Netherlands.
In experimental research, extensive use is made of the research facilities of the Reactor Institute Delft such as the 2MW research reactor (HOR), the neutron reflectometer (ROG), the novel and unique Spin-Echo Small-angle Neutron Scattering (SESANS) instrument, the Poly-Axis Neutron Depolarisation Analyser (PANDA) and a Positron Source (POSH) linked to the Hoger Onderwijs Reactor, as well as of large, international research facilities.

R³-RD&M: RADIATION DETECTION & MATTER

Head: Prof. Freek Beekman
Tel. +31 (0)15 27 81336,
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Secretariat: room 1.00.110
Tel. +31 (0)15 27 86560
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Web site: www.rrr.tudelft.nl/
Information and guided tour: Prof. P. Dorenbos
Tel. +31 (0)15 27 81336,
E-mail: p.dorenbos@tudelft.nl
The main areas of research are:

- Research and development of new concepts and new instruments for the production and detection of ionizing radiation and
- Fundamental research of luminescence phenomena and development of new inorganic compounds among others aimed at efficient conversion of ionization energy into light.

R³-PNR: PHYSICS OF NUCLEAR REACTORS

Head: Prof Tim van der Hagen,
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Secretariat: room 1.01.080
tel. +31 (0)15 27 83877
E-mail: C.E.M.Olsthoorn-Kok@tudelft.nl
Web site: www.rrr.tudelft.nl/
Information and guided tour: Dr Jan Leen Kloosterman,
Tel. +31 (0)15 27 81191,
E-mail: j.l.kloosterman@tudelft.nl
The Physics of Nuclear Reactors (PNR) section focuses on the design and analysis of innovative nuclear reactor systems aimed at improved efficiency, a high degree of safety, flexibility and user-friendliness, combined with a reduction in radioactive waste production. The main emphasis of the research is on dynamics of Boiling Water Reactors with natural circulation and analysis of so-called generation-IV reactors with a view to increase the sustainability of nuclear energy.

R³-FAME: FUNDAMENTAL ASPECTS OF MATERIALS AND ENERGY

Head: Prof. Ekkes Brück
Tel. +31 (0) 15 278 3158
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Tel. +31 (0)15 27 86814
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Web site: www.rrr.tudelft.nl
Information and guided tour:
Prof. dr. F.M. Mulder
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At present the focus is on energy storage materials and structural transitions in aluminium and steels. These topics are linked by our expertise in the structure/dynamics/function relations at a fundamental level. Our principle techniques are neutron scattering, positron annihilation, NMR, synchrotron and modelling at the ab-initio and empirical atomistic levels. Research is performed within a solid cooperation with R^3-NPM^2.

R³-NPM²: NEUTRON AND POSITRON METHODS IN MATERIALS

Head: Prof. dr. C. Pappas
E-mail: c.pappa@tudelft.nl
Secretariat: room 2.01.290
tel. +31 (0)15 27 86814
E-mail: n.p.banga@tudelft.nl
Web site: www.rrr.tudelft.nl/
Information and guided tour: dr.ir. A.A. van Well
Tel. +31 (0)15 27 84738
E-mail: a.a.vanwell@tudelft.nl

The main areas of research are the development of instruments and methods for optimal use of neutrons and positrons, mostly for use within the large, international facilities. Research is performed within a solid cooperation with R3-FAME. The application of the instruments and methods is complemented by fundamental studies of soft condensed matter, moving progressively towards applications in health.

R³-RIH: RADIATION AND ISOTOPES FOR HEALTH
Head: Prof. Bert Wolterbeek,
Tel. +31 (0)15 27 87053
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Secretariat: room: 2.00.390
Tel. +31 (0)15 27 86171
E-mail: Y.W.M.Weijgertse@tudelft.nl
Web site: www.rrr.tudelft.nl/
Information and guided tour: Prof. H.Th. Wolterbeek
Tel. +31 (0)15 27 87053
E-mail: H.T.Wolterbeek@.tudelft.nl
The main areas of research are the innovation and optimization of the use of radiation and radioisotopes in the health sciences. The research focuses on innovative production pathways and applications of radioisotopes, which includes the use of radioactive compounds for radiotherapy and diagnostics, the use of radionuclides in studies into the behaviour, distribution (e.g. targeting) and effects of elements, (radio)nuclides and compounds.

4.5

Affiliated groups in the Faculty of Mechanical, Maritime and Materials Engineering (3mE)

3ME-AHD: AERO AND HYDRODYNAMICS
Laboratory for Aero and Hydrodynamics, Leeghwaterstraat 21,
2628 CA Delft
Head: Prof. J. Westerweel
Secretariat: Ms. H.J. van de Brugge,
tel: +31-278 82904,
e-mail: secrah@wbmt.tudelft.nl
Web site: www.ahd.tudelft.nl/
Information and guided tour: Ask secretariat
The research of this group is centred on turbulence and complex flows, which includes multiphase flows, and microscale flows (i.e., microfluidics). Turbulent flow may be characterized by a chaotic fluctuating flow, and its analytical description is one of the unsolved problems of classical mechanics. Multiphase flow is common in practice in the process and chemical industry

(e.g., the transport of oil-gas mixtures in pipes). In microscale flows surface interactions (i.e., electrical effects, heat transfer) become dominant, while inertial effects (i.e., rapid mixing) no longer dominate the flow. The research is focused on the fundamental physics, but always with a clear link to practical technical applications.

3ME-DCSC: DELFT CENTRE FOR SYSTEMS AND CONTROL

Mekelweg 2 (3Me building) 2628 CD, Delft
Chairman: Prof. Paul Van den Hof,
tel. +31 (0)15 27 84509,
e-mail: p.m.j.vandenhof@tudelft.nl
Secretariat: tel. +31 (0)15 27 82473,
E-mail: info@dcsc.tudelft.nl
Web site: www.dcsc.tudelft.nl/
Information and guided tour: Prof. Paul Van den Hof.
The teaching and research field of the centre encompasses the wide area of modelling, parameter estimation, signal processing, identification, control and optimization of dynamical physical processes. Applications vary from physical measurement systems such as microscopy, radar, nanometer-positioning stages, to complex industrial (petrochemical) production processes.

3ME-SCM: STRUCTURE AND CHANGE IN MATERIALS

Mekelweg 2 (3mE building) 2628 CD, Delft
Head: Prof. Barend Thijsse,
tel. +31 (0)15 27 82221,
e-mail: b.j.thijsse@tudelft.nl
Secretariat: Ms. J.E.M. Kerklaan-Koene, room 8D-4-01,
tel. +31 (0)15 27 82285,
e-mail: j.e.m.kerklaan-koene@tudelft.nl
Web site: www.mse.tudelft.nl/ (section structure & change)
Information and guided tour: Prof. Barend Thijsse

The SCM group conducts a fundamental materials research programme that focuses on the multi-length scale structure of a material which determines its properties and on the non-equilibrium conditions that lead to change. Although fundamental in character, the problems under investigation are directly derived from the applications level. Understanding past and future materials, although perhaps a little too broad when taken literally, would be an excellent motto of the SCM programme. The role of the programme in these two fields, historical and future-oriented, can be summarized as follows.

Past materials. Throughout history, materials processing and usage have been essential for the quality of life and for the development of mankind in general. From hunting to art, and from warfare to kitchen utensils, societies have never stopped striving for better materials. Therefore, studying materials in art and archaeology with the advanced experimental methods of current science offers new answers to questions in art history, past production techniques, and historical societal conditions. Questions focused on recently are:

- What can advanced stratigraphy and elemental mapping of paintings tell us about their authenticity?
- Does the discovery of the earliest use of iron in Jordan lead to a new interpretation of the Jordanese 1200-800 BC society?
- How do phase transitions in pigment affect detrimental discolouration in highly valuable paintings?
- Advanced experimental materials research applied to an 1932 Alfa Romeo racing car: is it the real one?

The main techniques used are advanced imaging, diffraction and stratigraphic techniques. This work is the domain of the subprogramme "Materials in Art and Archaeology", led by Dr. Joris Dik.

Future materials. The purpose of this branch of the programme –and of current materials science in general– is to optimize control over materials properties, and ultimately to propose methods for designing materials according to specification. Modern computational materials science enables us to make substantial progress to this future goal. We apply density functional theory calculations and molecular dynamics simulations to study selected problems in the fields of structural materials, materials for IC fabrication, and energy-related materials. In addition, Monte Carlo techniques, statistical mechanics, cluster Hamiltonians, fluid dynamics, and data mining methods are used. Taken together these techniques cover length scales from femtometres to centimetres. Problems recently under study are:

- Can we find improved methods for the manufacturing of electronic materials?
- How do we predict the effects of energetic beams or severe deformation on a material?
- Which clues does the knowledge about existing materials provide for the properties of new engineering materials?
- In what way can new metal alloys be used to help shaping a global hydrogen-based energy supply?

This work is the domain of the subprogramme "Virtual Materials Laboratory", co-chaired by Dr. Marcel Sluiter, Dr. Amarante Böttger, and Prof. Barend Thijsse.

The X-ray and Thermal Analysis Laboratory, led by Dr. Amarante Böttger, is an integral part of the SCM group, yet it plays an additional role as expertise centre for other research programmes inside and outside the department. Within the current program, the X-ray diffraction and fluorescence facilities provide structural and compositional data on ceramics, pigments, thin films, alloy stability, etc; problems investigated for other programmes are very diverse, varying from residual stress distributions in welds to transport of salt in mortar. In addition, the X-ray facilities serve as prototyping benchmark for synchrotron studies to be carried out, for example, at ESRF Grenoble. The Thermal Analysis Laboratory has a Differential Scanning Calorimeter and a wafer curvature measurement apparatus, used for phase transformation and stress measurements.

Principal research fields:

- Solid state transformations and alloy design
- Structural control of materials
- Interaction of solids with liquids, gases, and energetic beams
- Thin films and materials for the information technology
- Hydrogen in metals
- Stratigraphy of coated art objects
- Elementally and spatially resolved imaging techniques
- Historical usage of materials

5.

Course Descriptions

AP3011 G	*Chaotic Processes*	*ECTS: 6*
Responsible Instructor	Dr. H.J.J. Jonker (H.J.J.Jonker@tudelft.nl)
Instructor	Ir. E. Oldenhof (E.Oldenhof@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/4/4
Education Period	3, 4
Start Education	3
Exam Period	4
Course Language	English
Course Contents	Non-linear differential equations, ill-posed problems, attractors, repellors, limit-cycles, bifurcations, chaos in deterministic systems, strange attractors, Poincare sections, Lyapunov exponents, chaos in discrete maps, routes to chaos, fractal geometries, pattern formation. Many examples from physics, mechanics, chemistry, and biology.
Study Goals	You will learn: * that simple equations can give rise to very complex behaviour. * to recognize the basic conditions for a process to be chaotic. * the potentially sensitive dependence on initial conditions. * about prediction horizons. * about attractors, limit-cycles * about strange attractors * to quantify chaotic processes by means of Lyapunov exponents. * what different chaotic processes have in common, i.e. the universality (or `the hidden order') of chaotic processes. * how one can exploit chaos theory (prediction horizons, early warning, mixing enhancement). * about bifurcations and `the routes to chaos'. * about non-Eucledian (fractal) geometries, pattern formation. * about numerous applications (examples from Physics, Mechanics, Chemistry, Biology, Physiology).
Education Method	The nature of the material is such that it is very suitable for self-exploration, which is why the course is set up according to the learning-by-doing concept. The first part (1hr)of a lecture comprises an introduction into the theory and background, and in the second part (2hr) the students can explore the topic for themselves with the mathematical software package Maple.

Literature and Study Materials	This year handouts will be provided during the lectures. Recommended as background literature: Steven H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry and Engineering. Westview Press, 1994. ISBN 0-7382-0453-6
Assessment	The (computer) exam consists of 4 exercises that need to be solved with the aid of maple. These exercises resemble those practised during the course. At the end of the exam (3 hours), the results are handed in using e-mail. The exam is "open book": you may take all relevant study material (books & handouts) with you. You may also consult previous (worked-out) exercises posted on Blackboard.

AP3021 G | Advanced Statistical Mechanics | ECTS: 6

Responsible Instructor	Dr. J.M. Thijssen (J.M.Thijssen@tudelft.nl)
Instructor	Drs. G.M.M. Wakker (G.M.M.Wakker@tudelft.nl)
Contact Hours / Week x/x/x/x	4/4/0/0
Education Period	1, 2
Start Education	1
Exam Period	2, 4
Course Language	English
Expected prior knowledge	Bachelor (applied) physics or equivalent.
Course Contents	In this module topics in advanced statistical mechanics are covered. After a review of standard statistical mechanics, the course focuses on three areas: interacting systems (classical and quantum), phase transitions and transport phenomena using Boltzmann's equation. Strong emphasis on problem solving.
Study Goals	The student who passes this course should have a working knowledge of statistical mechanics on the intermediate level. The course topics are: ensemble theory, non-interacting particles (quantum and classical), interacting particles (quantum and classical), phase transitions and nonequilibrium phenomena (transport). At the end of the course, the student has a broad overview of the theory and he or she is able to solve problems pertaining to the topics covered in this course.

Study Goals (continued)

Students should also be able to present their solutions to their fellow students in a clear way.

In particular, this course contributes to the following end goals of the Master of Applied Physics:

1. Mastery of Applied Physics at an advanced academic level.
4. Capable of understanding a wide variety of different problems and being able to formulate these at an abstract level.
6. Capable of working in a (possibly interdisciplinary) team of experts
8. Capable of making English language presentations of research activities

Education Method

Lectures and student presentations of problems. Students should be active in
solving problems.

Literature and Study Materials

The two main textbooks for this course are:

M. Kardar:
Statistical Mechanics of Particles || Cambridge University Press, 2007
Statistical Mechanics of Fields || Cambridge University Press, 2007

Further reading:

"Statistical Mechanics" by R. K. Pathria, Butterworth & Heinemann, 1996
ISBN 0750624698
Some topics missing from this book can be found in the lecture notes.

Statistical Mechanics, From First Principles to Macroscopic Phenomena
J. Woods Halley
Cambridge University Press, 2007
ISBN-13 978-0-521-82575-7
ISBN-10 0-521-82575-X

EQUILIBRIUM STATISTICAL PHYSICS
Michael Plischke & Birger Bergersen
World Scientific 2006
ISBN 981-256-155-2(pbk)

Literature and Study Materials (continued)	Further useful books are: Equilibrium and non-equilibrium statistical thermodynamics, by M. Le Bellac, F. Mortessange and C.C. Batrouni, Cambridge, 2004 Contains a large collection of elaborate problems. V. I. Kalikmanov: Statistical Physics of Fluids, Basic concepts & applications Springer, 2001 (primarily for classical, interacting systems) Statistical Mechanics, K. Huang, Wiley, 2nd edition (1987)
Assessment	In this course, there is strong emphasis on problem solving skills. Every week, the students will study at least one problem in some detail. Groups of two students are assigned a full problem set. The solutions should be presented to the class. There will also be a final written examination which should be doable for everybody who has participated properly in the course. The exercises will then be used to round off the mark if necessary. Students who want to pass the course without problem solving can do a separate exam (at the same time) which will be more elaborate than the standard exam. It is not recommended to try passing this course via this elaborate exam :-)
Location	Delft

AP3032 G	*Continuum Physics*	*ECTS: 6*
Responsible Instructor	Dr.ir. M.J. Tummers (M.J.Tummers@tudelft.nl)	
Instructor	Dipl.ing. S. Kenjeres (S.Kenjeres@tudelft.nl), Prof.dr. D.J.E.M. Roekaerts (D.J.E.M.Roekaerts@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/0/4/4	
Education Period	3, 4	
Start Education	3	
Exam Period	4	
Course Language	English	

Course Contents	The continuum description of the mechanics of solids and liquids is discussed in a unified approach based on tensors. Deformations of a body are studied and the concept of the strain tensor and the rate-of-deformation tensor are introduced. This is followed by a discussion of the stress tensor, and the equations of motion of a body are derived based on the balances of linear and angular momentum. For linear elastic solids the following topics are discussed: constitutive equation, plane stress and plane strain, Airy stress function, and energy principles. For Newtonian fluids we discuss the stress tensor, Navier-Stokes equations, and the first and second law of thermodynamics. The lecture series is then continued with a number of special topics: thermal convection, magneto-hydrodynamics (MHD), and combustion.
Study Goals	The objectives of the course are: To apply the basic elements of tensor analysis to derive the equations describing the behavior of various continuous systems mechanics (in particular solids and fluids) using the conservation of mass, momentum and energy as a starting point. To be able to explain the similarities and differences between the solid and fluid mechanics, and to solve simple problems in both fields. To be able to analyze other continuous systems such as those describing magneto-hydrodynamics, turbulent thermal convection and combustion.
Education Method	Lectures
Literature and Study Materials	<>
Assessment	The final exam can be downloaded from Blackboard in June 2009. It consists of a set with approximately seven problems. The deadline for handing in your solutions is August 1.

AP3051 G | Advanced Quantum Mechanics | ECTS: 6

Responsible Instructor	Prof.dr. Y.V. Nazarov (Y.V.Nazarov@tudelft.nl)
Exam Coordinator	A.M. Hriscu (A.M.Hriscu@tudelft.nl)
Contact Hours / Week x/x/x/x	4/4/0/0
Education Period	1, 2
Start Education	1
Exam Period	2
Course Language	English
Expected prior knowledge	Bachelor (applied) physics or equivalent.

Course Contents	Second quantization, creation and annihilation operators, superconductivity and magnetism, quantum electrodynamics, and dissipative quantum mechanics.
Study Goals	To master key concepts of advanced quantum mechanics
Education Method	Lectures and problem-solving sessions
Literature and Study Materials	Hand-outs and sillabullus at the blackboard, J.J. Sakurai, Modern Quantum Mechanics, Addison Wesley Publishing Company, 1967, Ch. 1, 2.U. Weiss, Dissipative Quantum Systems, 2nd edition, World Scientific , 1999, Ch. 1,2, 4.
Assessment	Written examination in default, oral by appointment
Location	Delft

AP3061 G | Advanced Wave Propagation | ECTS: 6

Responsible Instructor	Prof.dr.ir. A. Gisolf (A.Gisolf@tudelft.nl)
Instructor	Prof.dr. H.P. Urbach (H.P.Urbach@tudelft.nl)
Contact Hours / Week x/x/x/x	4/4/0/0
Education Period	1, 2
Start Education	1
Exam Period	Exam by appointment
Course Language	English
Course Contents	Introduction to elasticity theory; acoustic waves in fluids; elastic waves in solids; electromagnetic waves;wave propagation in inhomogeneous media; Fraunhofer diffraction; Fresnel diffraction.
Study Goals	To describe a variety of wave phenomena, notably acoustic waves, elastic waves and electro-magnetic waves, by the same mathematical concept: the wave equation. To obtain insight in phenomena like refraction, diffraction and polarisation, that play a role in imaging systems based on wave propagation. To understand the relationship between observed wave phenomena and the relevant properties of the medium in which the waves are propagating. Once the forward problem is understood, quantitative inversion of recorded wave-fields, to obtain the media properties, can be undertaken. To understand the motivation for approximate descriptions of wave propagation such as the WKB method and the Fraunhofer and Fresnel approximations.
Education Method	Oral lectures

Literature and Study Materials	The course is based on the book: 'Physics of Waves', Elmore and Heald, Dover 0-486-64926-1. Recommended reading: 'Applied seismic wave theory', A.J. Berkhout, Elsevier 1987 'Introduction to Fourier Optics', J. Goodman, (1st or 2nd edition McGraw-Hill, 0-07-024254-2.
Assessment	Oral examination

AP3071 G	*Advanced Electrodynamics*	*ECTS: 6*
Responsible Instructor	Dr. S.W.H. Eijt (S.W.H.Eijt@tudelft.nl)	
Instructor	Dr. A.J.L. Adam (A.J.L.Adam@tudelft.nl)	
Contact Hours / Week x/x/x/x	4/4/0/0	
Education Period	1, 2	
Start Education	1	
Exam Period	2, 4	
Course Language	English	
Expected prior knowledge	Electromagnetism at the level of the book Introduction to Electrodynamics by D.J. Griffiths (BSc physics course TN2053, Elektromagnetisme I)	
Course Contents	Maxwell equations.Time dependent charge and current distributions. Electromagnetic radiation. Electrodynamics and relativity. Finally, the properties of synchrotron radiation will be discussed; examples of its important applications in physics, chemistry and materials research will be exposed.	
Study Goals	The student who passes this course should have a working knowledge in electrodynamics at a graduate level. The student will be able to solve modern problems in classical electrodynamics using its covariant foundation, with topics ranging from electrostatics to radiation by relativistic particles. At the end of the course, the study will have a broad view of the theory and modern applications of electrodynamics, and he or she is able to solve problems pertaining to the topics covered in the course.	
Education Method	Lectures and homework exercises. Students are expected to be active in problem solving. Methods for solving the exercises are subsequently discussed in the lecture sessions.	

Literature and Study Materials

We highly recommend the use of one of the following textbooks as study material for the course (a list of the relevant chapters directly related to the lectures will be available on blackboard):

C.A. Brau, Modern Problems in Classical Electrodynamics, Oxford University Press, Oxford, New York, (2004).
modern exposition of advanced electrodynamics with emphasis on the relativistic framework and radiation phenomena

J.D. Jackson, Classical Electrodynamics, 3rd Edition, John Wiley & Sons, New York, (1999).
classical standard textbook for advanced electrodynamics

Further useful books are:

D.J. Griffiths, Introduction to Electrodynamics, 3rd edition, Prentice Hall, Upper Saddle River, NJ (1999).
excellent and thorough introduction to electrodynamics

George B. Rybicki, Alan P. Lightman, Radiative Processes in Astrophysics, John Wiley & Sons, (1985).
clear exposition of radiation processes in electrodynamics including relativistic particles, examples from astrophysics

At the lectures, handouts of the material covered in the lectures will be distributed.

Assessment

Assessment is based on a final written exam in the 2nd examination period. Exercises are an important part of the course; by handing in solved exercises and further by presenting their solutions in the instruction class meetings, students can earn part of their examination grade.

AP3081TU G	*International Masters Course on Computational Physics*	*ECTS: 6*
Responsible Instructor	Dr. J.M. Thijssen (J.M.Thijssen@tudelft.nl)	
Contact Hours / Week x/x/x/x	Different	
Education Period	Different, to be announced	
Start Education	1, 2, 3, 4, 5	
Exam Period	Different, to be announced	
Course Language	English	

Course Contents	Several computer projects are be executed by Delft students in collaboration with students from Michigan State University (US). There will be exchange visits, collaborative projects and video linked discussion meetings. Projects are on molecular dynamics, (quantum) Monte-Carlo calculations, lattice Boltzmann simulations, finite elements for mechanical deformation, parallel computing, assembling a Beowulf cluster, electronic structure, etc. The course projects are close to the research level
Study Goals	Students completing this course have knowledge about computational schemes for physics problems. In particular, the student is well aware of the theory and implementation of molecular dynamics and Monte Carlo simulation, as well as elementary electronic structure calculations. He or she has experience with setting up simulation codes for scientific problems in physics. The student is able to collaborate in the field of computational physics in an international setting. Students can present the results of their projects in a clear and interesting manner. In particular, the study goals of the applied physics degree course addressed in this course are: 1. Mastery of Applied Physics at an advanced academic level. 3. Thorough experience with research in (applied) physics and complete awareness of the applicability of research in technological developments. 4. Capable of understanding a wide variety of different problems and being able to formulate these at an abstract level. To see, from the abstract level, the relation between diverse problems and to contribute creatively to their solution focused on practical applications. 5. Capable of creating innovative technical designs, taking account of feasibility issues. 6. Capable of working in a (possibly interdisciplinary) team of experts performing the aforementioned activities and communicating easily in both written and oral English. 8. Capable of making English language presentations of one's own research activities to diverse audiences. Being able to adapt to the background and interest of the audience.
Education Method	This course does not contain any formal teaching, but is completely project-based. The student learns all the necessary theoretical knowledge directly from literature and from contact with the lecturers. Videoconferencing and e-mail are the tools used to facilitate the international collaboration.
Literature and Study Materials	Use will be made of the textbook Computational Physics by J.M. Thijssen (2nd edition, Cambridge University Press). In addition, papers from modern research literature are used.
Assessment	Assessment is based in the project results: Paper and oral reports.

Remarks	Limited number of participants. See http://www.cp.tn.tudelft.nl/education.html
Studyload/Week	The first week in Michigan and the last week in Delft are expected to be filled entirely with this course. The remaining 80 hours work load are more or less evenly divided over the three months in between, i.e about 7 hours/week.

AP3091 G	*Elementary Particles*	*ECTS: 6*
Responsible Instructor	Dr.ir. H. van der Graaf (H.vanderGraaf@tudelft.nl), Prof.dr. J.W. van Holten (J.W.vanHolten@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/0/4/4	
Education Period	3, 4	
Start Education	3	
Exam Period	4	
Course Language	English	
Expected prior knowledge	special relativity and quantum mechanics	
Course Contents	Introduction to theory and experiments in particle physics	
Study Goals	To master the basis of the Standard Model of Elementary Pa rticles	
Education Method	Class room lectures and experimental demonstrations	
Literature and Study Materials	lecture notes available via blackboard	
Assessment	homework exercises and written exam	
Permitted Materials during Tests	calculator	

AP3111 D	*Quantum Electronics and Quantum Optics*	*ECTS: 6*
Responsible Instructor	Dr.ir. S.F. Pereira (S.F.Pereira@tudelft.nl)	
Instructor	Dr. N. Bhattacharya (N.Bhattacharya@tudelft.nl)	
Contact Hours / Week x/x/x/x	2/2/0/0	
Education Period	1, 2	
Start Education	1	

Exam Period	2
Course Language	English
Required for	Master students
Expected prior knowledge	Quantum mechanics
Course Contents	Quantization of the electromagnetic field, propagation of optical beams in homogeneous media, optical resonators, laser oscillation, interaction of radiation and atomic systems. The second part is devoted to different kinds of lasers
Study Goals	At the end of this course, the student will have a in depth knowledge of the basic theory of lasers and will have worked out one specific laser system in detail.
Education Method	First half of the course: One 2-hour lecture per week plus assignments, one midterm exam Second half of the course: each group of two students works out one specific laser system and presents to the class. Final assignment is a written project on their specific laser system.
Literature and Study Materials	"Quantum Electronics" by A. Yariv, 3rd edition, Wiley
Assessment	Midterm exam, assignments and end project with oral and written parts
Location	Delft

AP3121 D | Imaging Systems | ECTS: 6

Responsible Instructor	Dr. N. Bhattacharya (N.Bhattacharya@tudelft.nl), Dr.ir. S.F. Pereira (S.F.Pereira@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4
Course Language	English
Required for	Master students
Expected prior knowledge	Undergraduate level mathematics and optics
Course Contents	Basic properties of imaging systems, impulse response, frequency domain analysis, wavefront modulation, holography. There will also be lectures on special imaging topics: lithography, particle optics, terahertz imaging, acoustic imaging, optical recording

Study Goals	By the end of the course the student is able to work out in depth a complete imaging system in terms of Fourier Optical Analysis
Education Method	Weekly 2-hour lectures and assignments. Middterm exam and Final exam
Literature and Study Materials	Introduction to Fourier Optics, J. Goodman, 3rd edition, Roberts&Company. Extra handouts from special lectures
Assessment	Assignments, Middterm and Final exams

AP3131 D | Advanced Signal Analysis and Processing | ECTS: 6

Responsible Instructor	Dr.ir. P.M.T. Broersen (P.M.T.Broersen@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4
Course Language	English
Course Contents	no course in or after 2009/2010
Study Goals	none
Education Method	none
Computer Use	Experience with ARMAsel
Practical Guide	demo's of ARMAsel
Books	Piet M.T. Broersen, "Automatic Autocorrelation and Spectral Analysis", Springer-Verlag, London, 2006. ISBN 1-84628-328
Assessment	oral
Permitted Materials during Tests	book

AP3141 D | Environmental Physics | ECTS: 6

Responsible Instructor	Prof.dr.ir. C.R. Kleijn (C.R.Kleijn@tudelft.nl)
Instructor	Dr. S.R. de Roode (S.R.deRoode@tudelft.nl), Dr.ir. M. Rohde (M.Rohde@tudelft.nl), Dr.ir. M.M. Boone (M.M.Boone@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4, Exam by appointment

Course Language	English
Required for	Applied Physics special track Sustainability in Technology
Expected prior knowledge	Physics at BSc level, including basic Transport Phenomena and Fluid Dynamics, thermodynamics, calculus and differential equations, wave propagation; use of Matlab and/or Maple
Course Contents	Fundamentals of the environmental physics, world climate and the greenhouse-model, durable energy-resources (solar-, wind-, wave-, biomass-energy, nuclear energy, transport of pollution in ecosystems, noise problems.
Study Goals	To provide physicists with the knowledge and tools so that they can contribute to a more sustainable society from their own specific field of expertise
Education Method	lectures (mandatory attention) and mandatory homework
Computer Use	Homework requires computer programming in Matlab and/or Maple (or programming languages such as C, C++, Fortran)
Literature and Study Materials	Egbert Boeker and Rienk van Grondelle, Environmental Physics, 2nd edition, Wiley, 1995, ISBN 0 471 997803 + lecture notes and handouts
Assessment	obligatory homework (50%) and written examination (50%)
Permitted Materials during Tests	Book, handouts and lecture notes
Studyload/Week	2 lecture hours per week (14 weeks), 5 series of homework of 20 hours each, 40 hours of exam preparation

AP3151 D | Advanced Thermodynamics | ECTS: 6

Responsible Instructor	Dr.ir. G.C.J. Bart (G.C.J.Bart@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4, 5
Course Language	English
Course Contents	Thermodynamics of irreversible processes. Exergy loss with fluid flow, heat transfer and heat storage. Liquefaction. Enthalpy and entropy of mixtures. distillation. Absorption refrigerator. Psychrometry. Compressible flow. Combustion. Fuel cells. Thermo-electricity.
Study Goals	To be able to perform an exergy analysis on a variety of thermodynaic processes.

Education Method	Lectures (75%) with embedded tutorials (25%)
Literature and Study Materials	Lecture notes 'ap3151d Advanced Thermodynamics' by G.C.J. Bart M.J. Moran and H.N. Shapiro, 'Fundamentals of Engineering Thermodynamics', sections 9.13 and 9.14, chapter 12 from section 12.6 on, chapter 13.
Assessment	Written, open book
Remarks	After the course year 2009--2010 this course will be stopped.

AP3171 D | Advanced Physical Transport Phenomena | ECTS: 6

Responsible Instructor	Dipl.ing. S. Kenjeres (S.Kenjeres@tudelft.nl)
Instructor	Dr.ir. M.J. Tummers (M.J.Tummers@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/4/0
Education Period	3
Start Education	3
Exam Period	3
Course Language	English
Course Contents	Analytical/Numerical/Modelling Aspects of Advanced Physical Transport Phenomena (Fluid Flow, Heat Transfer and Turbulence): 1.Basic Equations of Transport Phenomena - Field Description; 2.Mathematical Methods for Solving Transport Equations (PDE, separation of variables, eigenfunctions and eigenvalues, Bessel functions, Laplace transformation, Error-Gamma functions, integral methods) 3.Transport in Stagnant Media (diffusion, moving front problems, diffusion with source terms) 4.Momentum Transport (potential flows, creeping flows, boundary layers) 5.Transport in Flowing Media (stationary transport in flows with uniform velocity, heat transfer in laminar pipe flow, natural convection) 6.Numerical Heat and Fluid Flow (discretization methods for heat conduction, convection and diffusion; differencing schemes, numerical diffusion; steady and time-dependent convection and diffusion; calculation of flow field/velocity-pressure coupling, SIMPLE algorithm) 7.Turbulence: Some Features and Rationale for Modelling (some generic types of turbulent flows and convective processes, wall-bounded turbulent flows: velocity and temperature distributions/wall functions, Reynolds decomposition, RANS) 8.Turbulence Modelling (closure problem, eddy viscosity/diffusivity models, k-e model, other two-equation eddy-viscosity models)
Study Goals	<>

Education Method	Combination of Lectures (4 Lectures per week) (covering theoretical aspects) and practical exercises (both analytical and computational/ computer exercises, 3 Hours per week)
Literature and Study Materials	1. Book: "Analysis and Modelling of Physical Transport Phenomena", Hanjalic K.,Kenjeres S.,Tummers M.J.,Jonker H.J.J., VSSD Book, ISBN-13 978-90-6526-165-8, First Edition, December 2007. 2. Book: "Transport Phenomena", Bird R.B.,Stewart W.E.,Lighfoot E.N.,2nd edition,Wiley (2002) 3. Book: "Fysische Transportverschijnselen II", Hoogendoorn C.J. and van der Meer, Th.H., Delftse Uitgevers Maatschappij (1991) 3. Handouts: For computational/computer exercises a reference manual and quick start manuals will be provided.
Assessment	Writen Exam (2 times per year)

AP3181 D	*Applied Multiphase Flow*	*ECTS: 6*
Responsible Instructor	Dr. L. Portela (L.Portela@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/0/2/2	
Education Period	3, 4	
Start Education	3	
Exam Period	4	
Course Language	English	
Course Contents	The course on Multiphase Flow will cover the basic parameters for design and operation of process equipment, flow regime dependent modelling, two-phase pressure gradients and phase hold-ups in pipes for stratified, annular, slug and dispersed bubble gas/liquid flows. It furthermore provides an introduction to dispersed gas/liquid and solid/fluid flows and addresses the two-phase heat transfer aspects of boiling liquids.	
Study Goals	To learn about modern flow-pattern dependent calculation methods for two-phase flows in pipes and equipment	
Education Method	Lectures and exercises	
Literature and Study Materials	Lecture notes: Applied Multiphase Flows	
Assessment	Open book examination	

AP3191 D	*Physics of Semiconductor Nanodevices*	*ECTS: 6*
Responsible Instructor	Dr. S. Rogge (S.Rogge@tudelft.nl), Prof.dr. J.T.M. de Boeck (J.T.M.deBoeck@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/0/0/4	
Education Period	3, 4	
Start Education	3	
Exam Period	3, 4	
Course Language	English	
Course Contents	Low dimensional structures are the key to advanced optoelectronic and nano-electronic device structures. Starting by covering basic semiconductor physics, this course treats the aspects of the realisation of low dimensional structures, their physical properties and their incorporation into devices. These structures are often exactly 'made to measure' in order to provide the desired device functionality. Learn how quantum mechanical principles bring components to live, understand how to engineer their operation and performance and discover how nanotechnology meets the fabrication challenges. The course can provide a benchmark for the engineer/device physicist who intends to wander further in the exiting area of low dimensional structures of either classical or exploratory nature. A topical list includes; Schottky-effect, p-n junction and bipolar transistor, epitaxial heterostructures, transport in heterostructures (e.g. MOSFET, HEMT), resonant tunnelling devices, optoelectronic devices from LED to Quantum Cascade Laser, all with a perspective to the nanotechnology road-map.	
Study Goals	Insight in semiconductor physics and its application to lowdimensional devices	
Education Method	<>	
Literature and Study Materials	"Low-Dimensional semiconductor structures" by Barn & Vvedensky, Cambridge University Press	
Assessment	<>	
Location	Delft	

AP3211 D	*Advanced Solid State Physics*	*ECTS: 6*
Verantwoordelijk Docent	Dr. Y.M. Blanter (Y.M.Blanter@tudelft.nl)	
Contacturen / week x/x/x/x	X/X/0/0	
Tentamenperiode	2	

AP3231TU D	*Medical Imaging*	*ECTS: 6*
Responsible Instructor	Prof.dr. W.J. Niessen (W.J.Niessen@tudelft.nl)	
Instructor	Dr. F.M. Vos (F.M.Vos@tudelft.nl), Dr. K.W.A. van Dongen (K.W.A.vanDongen@tudelft.nl)	
Contact Hours / Week x/x/x/x	re: course contents	
Education Period	3, 4	
Start Education	3	
Exam Period	4, 5	
Course Language	English	
Course Contents	Abstract of Course Content In this course, the most important medical imaging modalities will be covered. The course will treat the physical principles underlying signal generation, scanner hardware, and (3D) image generation and reconstruction. Both anatomical and functional imaging using conventional X-ray, CT, ultrasound, MRI, SPECT and PET will be discussed. The increasing role of medical imaging in biomedical research, diagnosis, treatment, and minimally invasive (image-guided) interventions is explained using state-of-the-art examples. Course Content Introduction (2 hrs): - History of medical imaging - Importance of medical imaging in modern medicine and biomedical research - Principles of energy-matter interaction (overall view of all imaging modalities that will be treated in the course) The basics (2 hrs): Conventional X-ray imaging - Principle of X-ray tube - Characteristics of X-rays - Interaction of X-rays with matter - Applications: Radiography, DSA, Fluorescence imaging	

Course Contents (continued)

CT Imaging (3 hrs)
- Historical development
- CT reconstruction principle
- Electron Beam/ multislice CT
- Applications (trauma, cardiac, vascular)

Nuclear Imaging (3 hrs)
- Refresher course on radioactive decay
- Principles of PET and SPECT imaging
- Frequently used radionuclides and their application (brain studies, cardiac studies, metabolism)

Ultrasound: (4 hrs)
- Piezoelectric effect
- Acoustic impedance, reflection and refraction
- Ultrasound probe characteristics
- Image quality and interpretation
- Doppler imaging
- 3D Ultrasound
- Contrast agents (bubbles)
- Applications (Cardiac, vascular)

MRI: Basics (2 hrs)
- Historical development
- Spin, Larmor frequency
- MR imaging hardware

MRI: Image formation (6 hrs)
- Basic mathematical principles revisited (sampling, Fourier analysis)
- Slice selection, frequency and phase encoding
- K-space. Basics and advanced sampling strategies
- Free induction decay, T1, T2, T2* relaxation
- Gradient echo, spin echo
- More advanced MR scan sequences

MRI: Techniques (2 hrs)
- Angiography
- Functional MRI
- MR spectroscopy
- Diffusion/perfusion MRI

MRI: Applications (2 hrs)
- Neuro
- Cardiovascular
- Abdominal
- Interventional
- Musculoskeletal

Course Contents (continued)	New developments: molecular imaging (2 hrs) - show how various imaging modalities can visualize processes at the molecular and cellular level Image guided interventions (2 hrs) - Image guided surgery - Interventional radiology and cardiology Visit to Radiology and Nuclear Medicine Department, Erasmus MC (one morning, 2 hrs)
Study Goals	Understand the principles, possibilities and limitations of the various diagnostic imaging modalities in medicine, based on emission, transmission, reflection and resonance of waves and particles: Various modalities of optical and electron microscopy, X-ray, Computed Tomography, Magnetic Resonance Imaging, ultrasound imaging, isotope imaging (PET, SPECT, etc.). Understand and employ methods from digital signal and image analysis. Attainment levels: 1. be capable of being analytical in their work, on the basis of a broad and deep scientific knowledge: 15% 2. be able to synthesise knowledge and solve problems in a creative way when dealing with complex issues: 20% 6. have an awareness of possible ethical, social, environmental, aesthetic and econmic implications of their work and the insight to act accordingly: 20% 7. have an awareness of the need to update their knowledge and skills: 5% 11. advanced knowledge of specific area: 20% 13. awareness of connections with other disciplines and ability to engag in interdisciplinary work: 20%
Education Method	Lectures, assignments; following several lecture, assignments will be handed out, that should be made as they aid in understanding the material. In the middle of the course an assignment should be made, in which a number of non-trivial questions should be answered in-depth, e.g. related to the (intrinsic) limitations of a medical imaging modality, the comparison of different imaging modalities for different tasks, etc. All assignment will be graded and will be part of the final grade (25%).
Literature and Study Materials	Book: "Medical Imaging Signals & Systems", Jerry L. Prince, Jonathan Links. Upper Saddle River NJ: Prentice Hall, 2005, 496 pp. ISBN: 0-13-065353-5 Additional handouts wherever necessary

Assessment	Assignments and written exam; Durin the course home work will be handed out, and in the middle of the course an assignment should be made, in which a number of non-trivial questions should be answered in-depth, e.g. related to the (intrinsic) limitations of a medical imaging modality, the comparison of different imaging modalities for different tasks, etc. The assignment is obligatory, and will be part of the final grade (25%). The course will be concluded with a written exam.

AP3241TU D	*Particle Therapy Holland PTC - General & technical Aspects*	*ECTS: 6*

Responsible Instructor	Dr. J. Zoetelief (J.Zoetelief@tudelft.nl), Prof.dr.ir. C.W.E. van Eijk (C.W.E.vanEijk@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4, 5
Course Language	English
Course Contents	1 Introduction - principles - protons/ions versus bremsstrahlung - SOBP - some examples 2 Radiobiology 3 Cases: Lung, Head & Neck, Prostate, Neurology, Pediatrics 4 Production of particle beams - cyclotron - synchrotron - other methods 5 Beam transport, fixed beams and gantries 6 Scattered beam versus scanning beam, nozzles 7 Treatment planning 8 Patient immobilization, organ motion, gating 9 Dosimetry 10 Quality Assurance - Patient - Machine 11 ICT 12 The facility, patient flow 13 Shielding
Study Goals	Main learning objectives The student can describe the basic ideas of particle therapy in comparison with radiation therapy. The student can describe the facilities that produce the above-mentioned particles.

Study Goals (continued)	The student can describe the main aspects of patient treatment. The student can describe the main aspects of dosimetry and quality asuurance. Specific learning objectives The student can formulate the main differences in interaction with matter of on the one hand (heavy) charged particles and on the other hand radiation (bremsstrahlung). The student can describe the consequences for therapy. The student can describe a number of specific medical cases for which particle therapy is relevant. The student can describe the different methods of irradiation - scattered beam & pencil beam scanning. The student can describe the methods of beam delivery - accelerator, beam line, gantry. The student can describe treatment planning procedures and actual beam delivery. The student can describe methods of patient immobilization, consequences of target motion and gating. The student can describe methods of treatment verification and dosimetry. The student can describe quality assurance procedures. The student can describe ICT aspects of the complete system. The student can describe the complete facility and patient flow in relation to diagnostics and participating hospitals. The student has full understanding of radiation shielding problems.
Education Method	lectures and assignments
Assessment	written exam

AP3311 D	*Condensed Matter: Scattering, Structure and Dynamics*	*ECTS: 6*

Responsible Instructor	Dr.ir. A.A. van Well (A.A.vanWell@tudelft.nl)
Instructor	Dr. E. Jimenez-Melero (E.Jimenez-Melero@tudelft.nl), Dr. H. Schut (H.Schut@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/2/2
Education Period	3, 4
Start Education	3
Exam Period	4, 5
Course Language	English
Course Contents	The structure and dynamics of condensed matter in physics, chemistry and biology is obtained by a wide variety of scattering techniques. Here we discuss the most common ones on a level available to a broad audience. First we show how diffraction works in theory and practice (either by X-rays or neutrons) to find the composition of solids and powders (up to complicated unit cells). Then we explain how small angle scattering (SAXS and SANS) reveals the shape and arrangement of colloidal systems, dendrimers, micelles or polymers in a solvent. Reflectometry is used to find the composition of layered structures like proteins adsorbed at surfaces or magnetic layers in recording materials. Polarized neutrons are applied to determine magnetic domains in metals and (in 'Spin-Echo') the motion of polymeric chains. With inelastic scattering one measures phonons in crystals diffusion in liquids and the vibrational spectrum of large molecules. An introduction to positron annihilation (PA) will be given. Positron annihilation lifetime, Doppler Broadening techniques are particularly suited for the detection and characterisation of (open volume) defects such as vacancies, vacancy clusters and voids in e.g. metals, alloys, semiconductors and polymers. The main application of the Angular Correlation of Annihilation Radiation (ACAR) technique is the study of the electronic structure of solids, and that of defects, precipitates and nano crystals. A visit to the neutron and positron experimental facilities at the Reactor Institute Delft will be part of the course.
Study Goals	Introduction, both theoretical and practical, into various experiental techniques to investigate condensed matter
Education Method	lectures

Literature and Study Materials	lecture notes
Assessment	oral examination

AP3341 D	*Nuclear Reactor Physics*	*ECTS: 6*
Verantwoordelijk Docent	Dr.ir. J.L. Kloosterman (J.L.Kloosterman@tudelft.nl)	
Docent	Dr.ir. D. Lathouwers (D.Lathouwers@tudelft.nl), Dr.ir. J.L. Kloosterman (J.L.Kloosterman@tudelft.nl)	
Contacturen / week x/x/x/x	2/2/0/0	
Onderwijsperiode	1, 2	
Start onderwijs	1	
Tentamenperiode	Tentamen op afspraak	
Cursustaal	Nederlands (op verzoek Engels)	
Vakinhoud	<>	
Leerdoelen	<>	
Onderwijsvorm	<>	
Literatuur en studie-materiaal	<>	
Wijze van toetsen	<>	

AP3351TU D	*Radiation Technology and Radiation Detection Principles*	*ECTS: 6*
Responsible Instructor	Ir. V.R. Bom (V.R.Bom@tudelft.nl), sProf.dr. P. Dorenbos (P.Dorenbos@tudelft.nl)	
Contact Hours / Week x/x/x/x	2/2/0/0	
Education Period	1	
Start Education	1	
Exam Period	Different, to be announced	
Course Language	English	

Course Contents	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.The mainstream of detectors like scintillation detectors, semiconductor detectors and gas-filled proportional chambers is studied. New developments in detector technology and detection methods are treated. Instrumentation for radiation detection is the main issue of this course.
Study Goals	Main learning objectives: The student can describe the processes of interaction with matter of (i) X-rays and gamma rays, (ii) heavy charged particles like protons and alpha particles, (III) electrons and positrons, (iV) neutrons. The student can describe the main mechanisms of production of the above mentioned radiation. The student can describe the main methods of detection of the above mentioned radiation. The student can describe the relevance of the above-mentioned medical diagnostics and therapy.
Education Method	Lectures
Literature and Study Materials	Radiation Detection and Measurement by Glenn F. Knoll Powerpoint sheets
Assessment	Written examination. A selection of 25 questions is made out of about 150 questions which are distributed during the course.

AP3371TU D | Radiological Health Physics | ECTS: 6

Responsible Instructor	Dr. A.J.J. Bos (A.J.J.Bos@tudelft.nl), M. Schouwenburg (M.Schouwenburg@tudelft.nl)
Contact Hours / Week x/x/x/x	0/0/1dg/1dg vrijdag
Education Period	Different, to be announced
Start Education	1, 2, 3, 4, 5
Exam Period	Different, to be announced
Course Language	English

Course Contents	Radiation, radioactivity, decay. Radiation sources. Interaction of radiation with matter. Methods of radiation detection. Radiation dosimetry. Radiation shielding. Biological effects of radiation. Internal dosimetry. Natural and man-made sources. Radiation protection philosophy. Rules and regulations. Safety measures. Radiation protection of open sources. Passing the examination gives right on the expert level 3 diploma (acknowledged by the Dutch government).To obtain the diploma students has to pay ¨150. In 2009/2010 the course will be given in the third semester on Friday and will start in the second half of January. The exam training is in the first week of May and the examination on May 10, 2010
Study Goals	How to handle safely with ionizing radiation
Education Method	classes, instructions, labs
Literature and Study Materials	J.E. Turner, Atoms, Radiation, and Radiation Protection, John Wiley, New York, 3rd completely revised edition.
Assessment	two parts part1: Multiple Choice (written closed book exam) (max 33 points) Part2: 4 problems (written open book exam) > (max 67 points) To pass the exam part1 > = 18 points AND part2 > = 37 points
Exam Hours	May 10, 2010: 11:00 h - 12:00 h and 13:30 h -16:30 h
Studyload/Week	1 day/week classes + 0.5 day/week preparation
Location	Reactor Institute, Mekelweg 15

CH3771	*Nuclear Chemistry*	*ECTS: 6*
Responsible Instructor	Dr.ir. P. Bode (P.Bode@tudelft.nl), Prof.dr. H.T. Wolterbeek (H.T.Wolterbeek@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/8/0/0	
Education Period	1	
Start Education	2	
Exam Period	2	
Course Language	English	

Course Contents

The demand for radio- and nuclear chemistry expertise is increasing. Nuclear scientists are needed to cover the application of radio-isotopes in medial diagnostics and therapy, the use of isotopes and ionizing radiation in food and safety technology, in industrial technology, in agriculture, hydrology or energy production.

Nuclear Chemistry addresses fundamental aspects of nuclear and radiochemistry, the role of radiochemistry in chemical technology and non-destructive testing, in life sciences and technology, in civil engineering, hydrology and other disciplines. In addition, opportunities for undergraduate and graduate research will be presented.

Lectures comprise:
- Nuclear Decay, reactions and types of radiation
- Sources, accelerators, reactors
- Natural radioactivity, nuclear dating
- Interaction with matter and detection
- Radiotracers, industrial applications, gauging
- Autoradiography, Imaging techniques

Theory and Practise
Every afternoon, the course gives theory and ends with practical demonstrations and exercise. These include
- Determination of half-thickness of materials for alpha, beta, and gamma rays
- Assessment of the half-life of radioactive isotopes
- Assessment of gold or silver content of jewelry by XRF
- Gauging experiment to judge irregularities in pipe walls
- Measuring natural 40K in potasssium
- A visit to the HOR reactor
- A visit to the RID accelerator

Study Goals

After studying the lecture notes the student should have gained.
1. Insight in the nature of radioactivity c.q. nuclear (ionizing) radiation, it's interaction with matter.
2. insight and knowledge of the various possibilities to detect various neclear radiation.
3. an overview of the possible applications of closed and open radiation sources in technological, chemical and medical fields.
4. insight in principles and definitions within the radiation hygiene.
5. The expertise to do calculations on basis of specific nuclear cq radiochemical data and parameters.
6. The knowledge to analyse the strengths and weaknesses of the use of nuclear and radiochemical methods.

Education Method

Oral lectures

Literature and Study Materials	Lecture hand-outs serve as dictate, together with a general booklet on nuclear chemistry: both can be taken also from blackboard
Assessment	Written exam

NS3501 | Nanotechnology | ECTS: 6

Responsible Instructor	Prof.dr. H.W.M. Salemink (H.W.M.Salemink@tudelft.nl)
Instructor	T. schmidt (schmidt@physics.leidenuniv.nl)
Contact Hours / Week x/x/x/x	x/x/0/0
Education Period	1, 2
Start Education	1
Exam Period	1, 2
Course Language	English
Course Contents	Material deposition methods, pattern definition, pattern transfer, atomic and molecular manipulation, scanning probe techniques, single molecule techniques, methods of inspection, analysis and characterization, applications. The course aims to impart the nanoscientist with the awareness required to make him/her an effective technologist for his/her own nanostructures.
Study Goals	Knowledge of, and insight in fabrication and analysis methods of nano-objects of electronic materials.
Education Method	Lectures, student presentation & discussion sessions
Literature and Study Materials	"Nanoelectronics and Information technology", edited by R. Waser; BlackBoard: articles to be prepared for working groups, powerpoint presentation of the lectures, student presentations and other supplementary information is posted on BlackBoard (blackboard.tudelft.nl)
Assessment	Written exam
Location	Leiden & Delft

NS3511TU | Biophysics | ECTS: 6

Responsible Instructor	Dr. J.E. Keymer Vergara (J.E.KeymerVergara@tudelft.nl)
Instructor	Dr. S.G. Lemay (S.G.Lemay@tudelft.nl), Prof.dr. C. Dekker (C.Dekker@tudelft.nl)
Contact Hours / Week x/x/x/x	14/14/0/0
Education Period	1, 2
Start Education	1

Exam Period	2
Course Language	English
Expected prior knowledge	Knowledge of mechanics, thermodynamics and electromagnetism at the 2nd year undergraduate physics level.
Course Contents	This course explores the fundamental physical principles (heat, hydrodynamics, electrostatics) that underlie the cell's functioning. The primary focus is on phenomena at the scale of individual molecules, currently a very active area of research. Both theoretical concepts and modern single-molecule experimental techniques are discussed.
Study Goals	To provide the participants with a firm foundation in the fundamentals of molecular biophysics and an overview of the areas of current active research.
Education Method	Lecture Reading of pre-selected scientific articles Homework
Literature and Study Materials	The textbook "Biological physics: Energy, Information, Life" by Philip Nelson (W.H. Freeman, New York, 2004).
Assessment	Written examination (60%), problem sets (40%). Examination date: January 30th (14:00-17:00)
Enrolment / Application	not later than September 15 via Black Board Delft (courses > Master > LS&T)
Schedule	1st and 2nd period Thursday5/6
Location	Delft

NS3521TU | Mesoscopic Physics | ECTS: 6

Responsible Instructor	Dr.ir. H.S.J. van der Zant (H.S.J.vanderZant@tudelft.nl)
Contact Hours / Week x/x/x/x	2/2/0/0
Education Period	1, 2
Start Education	1
Exam Period	2
Course Language	English
Expected prior knowledge	Knowledge of Solid state physics (electrons in metals, Pauli/Bose statistics, energy bands, scattering, conductance); Quantum mechanics (wavefunctions, eigenstates, transmission); Electrodynamics; Elementary Statistical Physics and Thermodynamics.

Course Contents	Mesoscopic physics is the area of Solid State physics that covers the transition regime between macroscopic objects and the microscopic, atomic world. It concentrates on questions related to the roles of classical and quantum mechanics in these intermediate-sized systems.The main goal of the course is to introduce the physical concepts underlying the phenomena in this field.This is facilitated by the introduction and use of transparent physical models.These models are extensively complemented by (usually very recent) experimental results, highlighting the main aspects contained in the model, but at the same time, stressing the limitations by identifying deviations found in such experiments. While thoroughly discussing the formalisms essential for understanding the subject, it avoids lengthy and highly technical theoretical derivations.Where possible, suggestions for further reading are given, providing convenient paths for an in-depth study.
Study Goals	Reach understanding of electronic properties of meso-size conductors, appreciate/recognize the role of classical and quantum processes, being able to explain electronic transport phenomena using simple physical concepts.
Education Method	<>
Literature and Study Materials	Syllabus.
Assessment	<>
Location	Delft

TN2881 | *Speciale en algemene relativiteits-theorie* | *ECTS: 6*

Responsible Instructor	Prof. Dr. J. de Boer (UvA)
Contact Hours / Week x/x/x/x	4/4/0/0
Education Period	1, 2
Start Education	1
Exam Period	2
Course Language	English
Course Contents	This course introduces the student to the theory of special and general relativity. Further details will be announced The instructor of this course is: J. de Boer, J.deBoer@uva.nl

WB1422ATU	*Advanced Fluid Dynamics A*	*ECTS: 6*
Responsible Instructor	Prof.dr.ir. J. Westerweel (J.Westerweel@tudelft.nl)
Assistent	Dr. R. Delfos (R.Delfos@tudelft.nl)
Contact Hours / Week x/x/x/x	2/2/0/0
Education Period	1, 2
Start Education	1
Exam Period	2, 3
Course Language	English
Required for	wb1424ATU, 1424BTU
Course Contents	In this course the fundamental and mathematical principles of fluid mechanics are treated. Point of departure is the conservation equations for mass and momentum. Based on these equations the equations of motion for a incompressible flow are derived. In order to close the equation of conservation of momentum a relationship must be prescribed between the stress tensor and the deformation-rate tensor leading to the constitutive equation for a Newtonian fluid. The result is known as the Navier-Stokes equations. First these equations are simplified for the case of an inviscid fluid which are known as the Euler equations. The solution of these equations for the case of a irrotational flow leads to a treatment of potential flow theory and the law of Bernoulli. This theory and law are applied to the flow around a sphere and around a cylinder. The flow around a cylinder is two dimensional and it is shown that in this case potential flow theory can be described in terms of complex function theory. This theory is applied to the flow around a cylinder in combination with a line vortex and by means of conformal transformations a relationship is derived with the lift force on a airfoil. In the remaining of the course the full Navier-Stokes equations, i.e. including the viscosity terms, are considered and the Reynolds number is defined. The effect of viscosity is coupled to dissipation of energy and diffusion of vorticity. As example of a very viscous flow, we discuss the Stokes flow in particular the flow around a sphere. For large Reynolds numbers the boundary-layer theory is derived and the Blasius solution for the boundary layer over a flat plate is discussed.

Study Goals (continued)

The student is able to describe the basic fundamentals of classical, incompressible fluid mechanics and to apply the fundamental and mathematical principles of fluid mechanics.

More specifically, the student must be able to:

1. formulate the conservation equations for mass and momentum
2 derive the equations of motion for an incompressible flow, based on the conservation equations for mass and momentum
3. derive the constitutive equation for a Newtonian fluid (the Navier-Stokes equations)
4. simplify the Navier-Stokes equations for the case of an in viscid fluid (the Euler equations)
5. solve the Euler equations for the case of an irrotational flow, leading to a treatment of potential flow theory and the law of Bernoulli
6. apply the potential flow theory and the law of Bernoulli to the flow around a sphere and around a cylinder
7. derive that in the case of a flow around a cylinder, the flow is two dimensional, and the potential flow theory can be described in terms of complex function theory
8. derive a relation with the lift force on a airfoil by applying the complex function theory to the flow around a cylinder in combination with a line vortex and by means of conformal transformations
9. consider the full Navier-Stokes equations, i.e. including the viscosity terms, and to define the Reynolds number
10. couple the effect of viscosity to dissipation of energy and diffusion of vorticity
11. discuss the Stokes flow, in particular the flow around a sphere, as example of a very viscous flow
12. drive the boundary-layer theory for large Reynolds numbers and discuss the Blasius solution for the boundary layer over a flat plate

Education Method: Lectures (2 hours per week), computer demonstration

Computer Use: Computers are used for demonstrations of the lecture material during the course on the basis of home-made software and on the basis of the symbolic manipulation program Maple.

Literature and Study Materials: Course material:
Lecture Notes "Advanced Fluid Mechanics A" in downloadable PDF-format.
Book: Fluid Mechanics by Cohen & Kundu, Elsevier Academic Press (3rd edition)

Assessment: Written exam

WB1424ATU	*Turbulence A*	*ECTS: 6*
Responsible Instructor	Prof.dr.ir. B.J. Boersma (B.J.Boersma@tudelft.nl)	
Contact Hours / Week x/x/x/x	0/0/2/2	
Education Period	3, 4	
Start Education	3	
Exam Period	4, 5	
Course Language	English	
Required for	wb1424B	
Summary	Turbulence, Stability theory, Chaos, Turbulence models, Turbelent kinetic Energy, Vorticity, Correlation function, Spectrum, Dispersion	
Course Contents	In this course an introduction is given in the theory of turbulence. The point of departure is the treatment of linear stability theory applied to Kelvin-Helmholtz instability, the inflection criterion of Rayleigh and the Orr-Sommerfeld equation. Following the results of linear theory new insights in the generation of turbulence are considered, i.e. the routes to chaos. Next follows a phenomenological treatment of turbulence, based on the solution of the Burgers equation. The statistical treament of stochastic processes is discussed and with it the Reynolds equations are derived from the Navier-Stoker equations. This leads to a discussion of the closure problem and the introduction of turbulence modeling. The results are then applied to a one-dimensional channel flow in which we introduce the logarithmic velocity profile. The turbulence energy equation is discussed and we introduce the cascade process. At the same time the one-equation model for turbulence is discussed and the Rotta hypothesis for the exchange of energy between coordinate directions. The next equation to be treated is the vorticity equation and with this equation the role of vorticity stretching in turbulence is discussed. The equation for enstrophy is derived and this leads to a two-equation model of turbulence such as the k-e model. De disadvantages of K-theory are discussed and attention is given to second-order closure models. The next step is to introduce two-points correlations and their Fourier transform: spectra. By means of scaling the 5/3 spectrum in the inertial sub-range is derived. The last topics are isotropic turbulence and dispersion.	

Study Goals	The student must be able to: 1. formulate the difference between laminar and turbulent flows 2. apply the Reynolds decomposition to a turbulent flow 3. describe the different scales in a turbulent flow, macroscopic and microscopic scales including Taylor and Kolmogorov scales 4. describe the background of turbulence closure theory and the ability to apply it to simple flow problems 5. use the k-e model to calculate turbulent flow problems, and to learn its limitations 6. describe wall bounded turbulent flow, buffer and logarithmic region in the flow 7. solve free turbulent shear flows using similarity solution 8. describe vortex dynamics in turbulent flows, the effect of vortex stretching on turbulence 9. tell about modern numerical and experimental techniques used for turbulent flows 10. describe the behavior of one dimensional energy spectra and (auto)correlations in a turbulent flow
Education Method	Lecture 0/0/2/2
Computer Use	Computers are used for demonstrations of the lecture material during the course on the basis of commercial software.
Literature and Study Materials	Course material: P.A Davidson, Turbulence and introduction for scientists and engineers, Oxford University Press References from literature: H. Tennekes and J.L. Lumley, A First Course in Turbulence, The MIT Press. ISBN 0 262 20019 19 8 S.B. Pope, 'Turbulent Flows' Cambridge University Press. ISBN 0 521 59886 9.
Prerequisites	wb1422A
Assessment	Written exam
Special Information	During the lecture some demonstrations are carried out to explain and support the course material.
Remarks	Extra credit for assessment can be gained via homework.

WI3150TU | Partial Differential Equations 1 | ECTS: 3

Responsible Instructor	Dr. H.M. Schuttelaars (H.M.Schuttelaars@tudelft.nl)
Contact Hours / Week x/x/x/x	4/0/0/0
Education Period	1
Start Education	1

Exam Period	2
Course Language	English
Course Contents	I: (Wi3150TU) Introduction. Types of second order equations. Initial and initial boundary value problems. Fourier series. Quasi-linear, first order partial differential equations. Waves and reflections of waves. Separation of variables. Sturm-Liouville problems. Parabolic, elliptic and hyperbolic equations. Maximum principle. Diffusion and heat transport problems. Lectures (3 ECTS). II: (Wi4150TU) Boundary value problems. Delta functions and distributions. Green's function for heat, wave and Laplace equations. Fourier and Laplace transform methods. Waves in R2 and in R3. Vibrations of membranes. Bessel functions. Shock waves. Lectures and Maple practical work (3 ECTS).
Study Goals	Many mathematical--physical problems can be formulated using partial differential equations. Therefore it is important to be able to both interpret and solve this type of equations. At the end of the course the student 1- is able to formulate various physical problems (wave--equation, heat--equation, transport--equations) in terms of partial differential equations. 2- has knowledge and understanding of various mathematical techniques which are necessary to solve these problems (Fourier--series, method of separation of variables, Sturm-Liouville problems, Greens' functions, Fourier- and Laplace transformations) and is able to apply these techniques to (simple) problems. 3- is able to interpret the solutions obtained and is able to place them in (a physical) context.
Education Method	Lectures
Literature and Study Materials	R.Haberman, Applied Partial Differential Equations, Fourth edition, Pearson Prentice Hall, New Jersey, 2004, ISBN 0-13-065243-1
Assessment	Takehome exam and oral exam.
Remarks	The contents of WI3150TU + WI4150TU is the same as WI2607.

WI4014TU | Numerical Analysis | ECTS: 6

Responsible Instructor	Dr.ir. F.J. Vermolen (F.J.Vermolen@tudelft.nl), Ir. A. Segal (A.Segal@tudelft.nl)
Contact Hours / Week x/x/x/x	x/x/0/0
Education Period	1, 2
Start Education	1
Exam Period	none

Course Language	English
Course Contents	Numerical methods for partial differenial equations. Discretization methods. Solution techniques for large sparse systems. Nonlinear systems. Applications
Study Goals	The student will be able to discretize partial differential equations with the finite difference, finite volume and finite element methods. He or she will be able to evaluate the solutions in terms of accuracy, consistency and convergence.
Education Method	Lectures in the 1st and 2nd education period. Lab exercises in the 3rd education period which have to be finished before the 1st of February in the form of a written report.
Literature and Study Materials	J.van Kan, A.Segal and F.Vermolen. Numerical methods in scientific computing. VSSD, Delft, 2005, improved 2008, ISBN-13 978-90-71301-50-6
Prerequisites	Numerical Analysis cI, Introduction partial differential equations
Assessment	Take-home assignments, Labexercise with a written report The grades of any take-home assignment has to be minimal a 3.0. If a grades is lower than 3.0, then an oral examination will be obligatory to get a final grade.

WI4143TN | Complex Analysis | ECTS: 6

Responsible Instructor	Dr. K.P. Hart (K.P.Hart@tudelft.nl)
Contact Hours / Week x/x/x/x	2/2/0/0
Education Period	1, 2
Start Education	1
Exam Period	2, 3
Course Language	English
Course Contents	wi4143TN and wi4008TU: Complex numbers; analytic functions; exponential, logarithmic and trigonometric functions, complex integration; Taylor and Laurent series; singularities and calculus of residues; boundary value problems and initial-boundary value problems; conformal mappings and applications. wi4143TN only: Hilbert transform, Kramers-Kronig relations and Green's functions
Study Goals	To acquire a working knowledge of Complex Analysis, its foundations and applications.
Education Method	Lectures

Literature and Study Materials	Yue Kuen Kwok: Applied Complex Variables for Scientists and Engineers, Cambridge University Press, ISBN: 0521004624 On-line available text on the Hilbert Transform and Green's functions.
Assessment	Written exam
Remarks	This course subsumes the course wi4008TU (4 EC); see course contents for differences

WI4150TU | Partial Differential Equations 2 | ECTS: 3

Responsible Instructor	Dr. H.M. Schuttelaars (H.M.Schuttelaars@tudelft.nl)
Contact Hours / Week x/x/x/x	0/4/0/0
Education Period	2
Start Education	2
Exam Period	2
Course Language	English
Course Contents	Boundary value problems. Delta functions and distributions. Green's function for heat, wave and Laplace equations. Fourier and Laplace transform methods. Waves in R2 and in R3. Vibrations of membranes. Bessel functions. Shock waves. Lectures and Maple practical work (3 ECTS).
Study Goals	Many mathematical--physical problems can be formulated using partial differential equations. Therefore it is important to be able to both interpret and solve this type of equations. At the end of the course the student 1- is able to formulate various physical problems (wave--equation, heat--equation, transport--equations) in terms of partial differential equations. 2- has knowledge and understanding of various mathematical techniques which are necessary to solve these problems (Fourier--series, method of separation of variables, Sturm-Liouville problems, Greens' functions, Fourier- and Laplace transformations) and is able to apply these techniques to (simple) problems. 3- is able to interpret the solutions obtained and is able to place them in (a physical) context.
Education Method	Lectures and Maple practical work.
Literature and Study Materials	R.Haberman, Applied Partial Differential Equations, Fourth edition, Pearson Prentice Hall, New Jersey, 2004, ISBN 0-13-065243-1
Assessment	Take-home exam and oral exam.
Remarks	The contents of WI3150TU + WI4150TU is the same as WI2607.

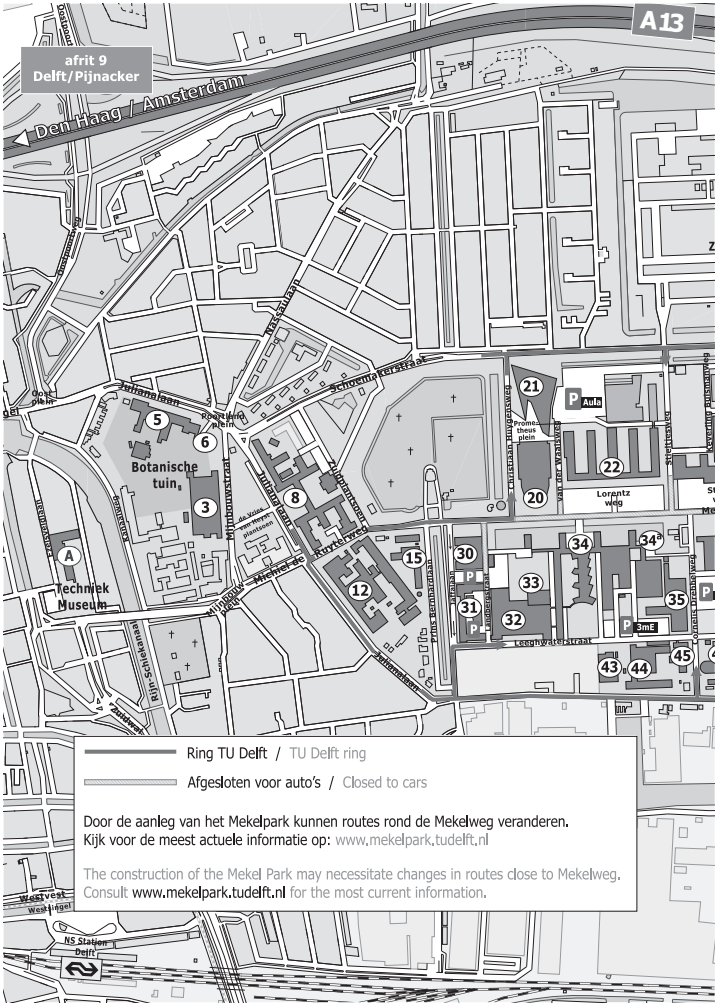
WM0320TU	*Ethics and Engineering*	*ECTS: 3*
Module Manager	Dr. D.R. Koepsell (D.R.Koepsell@tudelft.nl)	
Contact Hours / Week x/x/x/x	4/0/4/0	
Education Period	1, 3	
Start Education	1, 3	
Exam Period	1, 3	
Course Language	English	
Course Contents	This code of this course used to be WM0320TN. This course is identical to the initial part of the course wm0329tu. You will explore the ethical and social aspects and problems related to technology and to your future work as professional or manager in the design, development, management or control of technology. You will be introduced to and make exercises with a range of relevant aspects and concepts, including professional codes, collective reasoning, philosophical ethics, collective decision making (public choice), ethical aspects of technological risks, responsibility within organisations, responsible conduct of companies and the role of law, and game theory as a tool for analyzing ethical problems and solutions. You will analyse legal, political and organisational backgrounds to existing and emerging ethical and social problems of technology, and you will explore possibilities for resolving, diminishing or preventing these problems.	
Study Goals	After having completed the course you: - can better recognise and analyse ethical and social aspects and problems inherent in technology and in the work of professionals and managers active in the design, development, management and control of technology. - have insight into how these ethical and social aspects and problems are related to legal, political and organisational backgrounds. - are able to explore and assess possibilities for solving or diminishing existing and emerging ethical and social problems that attach to technology and the work of professionals and managers. - are better prepared to perform your future work as a professional or manager in the design, development, production and control of technology in an ethical and socially responsible way.	
Education Method	A series of 9 lectures and work sessions (including role playing sessions) concluded with a written test.	
Literature and Study Materials	Reader and exercise book "Ethics and Engineering", available at Nextprint and as PDF files on Blackboard; Powerpoint lecture notes.	
Assessment	Written exam.	

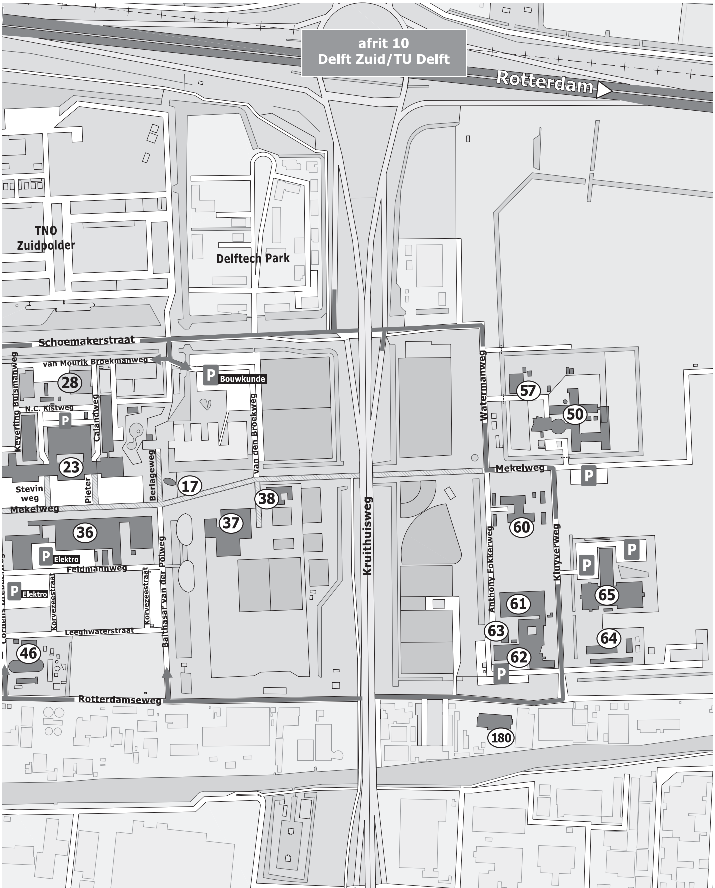
Enrolment / Application: Enrolment via Blackboard is required for this course. This is needed in order to plan the number of workgroups. For participation in the first period you must enrol not later than August 17 2009 and for participation in the third period not later than January 11 2010 via Blackboard.

Remarks: The course is run twice each year in the first and third quarter. The course is identical to the initial part of the course wm0329tu (6 ects). The latter course continues with the writing of an essay in groups of 5 under the guidance of the teachers. Students who take wm0320tn have the possibility to also take the second part of wm0329tu, the writing of an essay. If successful this will render 3 additional ects credit points, which will be administered under the course code wm0323tn (Essay). Students who want to take wm0320tn should enrol on Blackboard both for wm0320tn (for registration purposes) and for wm0329tu (because the latter site is used for all communication purposes).

6.

Map of TU Delft Campus


A13
afrit 9
Delft/Pijnacker
Den Haag / Amsterdam
Botanische tuin
Botanische tuin
Technek Museum
Aula
Lorentz weg
Leeghwaterstraat
Ring TU Delft / TU Delft ring
Afgesloten voor auto's / Closed to cars
Door het mekelpark kunnen routes rond de Mekelweg veranderen.
Kijk voor de meest actuele informatie op: www.mekelpark.tudelft.nl
The construction of the Mekel Park may necessitate changes in routes close to Mekelweg.
Consult www.mekelpark.tudelft.nl for the most current information.


afrit 10
Delft Zuid/TU Delft
Rotterdam
TNO
Zuidpolder
Delftech Park
Schoemakerstraat
van Mourik Broekmanweg
P Bouwkunde
Keverling Buismanweg
N.C. Kistweg
Calandweg
van den Broekweg
Watermanweg
Mekelweg
Stevin weg
Pieter
Berlageweg
Kruithuisweg
Anthony Fokkerweg
Kluyverweg
P Elektro
Feldmannweg
Korvezeestraat
Balthasar van der Polweg
Leeghwaterstraat
Rotterdamseweg
NS Station
Delft Zuid
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180

Legend of map TU Delft

Latest update: May 2008

No.	Address	Name
A	Ezelsveldlaan 61	Delft Technology Museum
3	Mijnbouwstraat 120	Centre for Technical Geoscience
5	Julianalaan 67	Biotechnology (Kluyver laboratory)
6	Poortlandplein 6	Botanic Gardens
8	Julianalaan 132-134	Former main building / Temporary location Faculty of Architecture
12	Julianalaan 136	Delft ChemTech
15	Prins Bernhardlaan 6	Kramerslab. Physical Technology
17	iWeb	Virtual reality pavillion
20	Mekelweg 5	Aula Congress Centre
21	Prometheusplein 1	TU Delft Library / Marketing & Communication
22	Lorentzweg 1	Faculty of Applied Sciences
23	Stevinweg 1	Faculty of Civil Engineering and Geosciences / University Corporate Office
28	Van Mourik Broekmanweg 6	TNO Built Environment and Geosciences
30	Jaffalaan 9	OTB Research Institute
	Jaffalaan 9a	Education & Student Affairs (CSA, International Office)
31	Jaffalaan 5	Faculty of Technology, Policy and Management
32	Landbergstraat 15	Faculty of Industrial Design Engineering / SSC ICT
33	Landbergstraat 19	Composites laboratory / INHOLLAND
34	Mekelweg 2	Faculty of Mechanical, Maritime and Materials Engineering (3mE) / CICAT / NIMR
34a	Cornelis Drebbelweg 9	Executive Board / Supervisory Board
35	Cornelis Drebbelweg 5	EEMCS Examination and Laboratory Class Building 35
36	Mekelweg 4 + 6	Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) / DIMES / IRCTR / MultiMedia Services (MMS)
37	Mekelweg 8	Sports Centre
38	Mekelweg 10	Cultural Centre
43	Leeghwaterstraat 36	Cogeneration plant
44	Rotterdamseweg 145	Technostarter share building, YES!Delft
45	Leeghwaterstraat 42	Low Speed Wind Laboratory & VSSD
46	Leeghwaterstraat 44	Process and Energy Laboratory (API)
50	Mekelweg 15	Reactor Instituut Delft (RID, former IRI) / Radiation Radionuclides & Reactors (RRR)
57	Watermanweg	Datacenter
60	Anthony Fokkerweg 5	Logistics & environment
61	Kluyverweg 3 Delft	Aerospace Structures & Materials Laboratory
62	Kluyverweg 1	Faculty of Aerospace Engineering / Adhesion Institute
63	Anthony Fokkerweg 1	SIMONA Research Flight Simulator
64	Kluyverweg 2	High Speed Wind Laboratory
65	Kluyverweg 4 + 6	SUPAIR / TRAIL / Facility Management & Real Estate
180	Rotterdamseweg 380	Annex Faculty AE & EEMCS / ASTI / ANWB driving simulator

7.

Year planner

Academic Calendar 2009 / 2010

Winter semester

Calendar Week	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	1	2	3	4
Week type	C	C	C	C	C	C	C	CW	CWT	T	C	C	C	C	C	C	V	V	C	CW	CWT	T
Course week	1-01	1-02	1-03	1-04	1-05	1-06	1-07	1-08	1-09	1-10	2-01	2-02	2-03	2-04	2-05	2-06			2-07	2-08	2-09	2-10
Monday	31 Opening	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25
Tuesday	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26
Wednesday	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
Thursday	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28
Friday	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	Christmas holid	New Years day	8	15	22	29
Saturday	05/09	12/09	19/09	26/09	03/10	10/10	17/10	24/10	31/10	07/11	14/11	21/11	28/11	05/12	12/12	19/12	26/12	02/01	09/01	16/01	23/01	30/01
Sunday	06/09	13/09	20/09	27/09	04/10	11/10	18/10	25/10	01/11	08/11	15/11	22/11	29/11	06/12	13/12	20/12	27/12	03/01	10/01	17/01	24/01	31/01

Spring semester

Calendar	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Week type	C	C	C	V	C	C	C	C	CW	CWT	T	C	C	C	C	C	C	C	C	CW	CWT	T
Course	3-01	3-02	3-03		3-04	3-05	3-06	3-07	3-08	3-09	3-10	4-01	4-02	4-03	4-04	4-05	4-06	4-07	4-08	4-09	4-10	4-11
Monday	1	8	15	22	1	8	15	22	29	Easter	12	19	26	3	10	17	Pentecost	31	7	14	21	28
Tuesday	2	9	16	23	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29
Wednesday	3	10	17	24	3	10	17	24	31	7	14	21	28	Liberation Day	12	19	26	2	9	16	23	30
Thursday	4	11	18	25	4	11	18	25	1	8	15	22	29	6	Ascension Day	20	27	3	10	17	24	1
Friday	5	12	19	26	5	12	19	26	Good Friday	9	16	23	Queens Day	7	14	21	28	4	11	18	25	2
Saturday	06/02	13/02	20/02	27/02	06/03	13/03	20/03	27/03	03/04	10/04	17/04	24/04	01/05	08/05	15/05	22/05	29/05	05/06	12/06	19/06	26/06	03/07
Sunday	07/02	14/02	21/02	28/02	07/03	14/03	21/03	28/03	04/04	11/04	18/04	25/04	02/05	09/05	16/05	23/05	30/05	06/06	13/06	20/06	27/06	04/07

Non educational period, Summer spell

Calendar	27	28	29	30	31	32	33	34	35
Week type	V	V	V	V	V	V	V	H	
Monday	5	12	19	26	2	9	16	23	30
Tuesday	6	13	20	27	3	10	17	24	31
Wednesday	7	14	21	28	4	11	18	25	
Thursday	8	15	22	29	5	12	19	26	
Friday	9	16	23	30	6	13	20	27	
Saturday	10/07	17/07	24/07	31/07	07/08	14/08	21/08	28/08	
Sunday	11/07	18/07	25/07	01/08	08/08	15/08	22/08	29/08	

C = courses and other educational activities

CW = courses/non educational week; differs per programme

T = exams

H = retakes

V = no educational activities; due to vacation or official holidays

Public Holidays	
Christmas period	: Dec. 21, 2009 up and until Jan. 1, 2010
Spring Break	: Febr. 22 up and until Febr. 26
Good Friday	: April 2
Easter	: April 4 and 5
Queens Day	: April 30
Liberation Day	: May 5
Ascension Day	: May 13 and 14
Pentecost	: May 24

Directie Onderwijs & Studentenzaken,juni 2009

7.1

Lecture hours

1 8.45 - 9.30
2 9.45 - 10.30
3 10.45 - 11.30
4 11.45 - 12.30
5 13.45 - 14.30
6 14.45 - 15.30
7 15.45 - 16.30
8 16.45 - 17.30
A1 18.45 - 19.30
A2 19.45 - 20.30
A3 20.45 - 21.30

8.

Diary

2009 | Juli - July

27 | Maandag - Monday

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28 | Dinsdag - Tuesday

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29 | Woensdag - Wednesday

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| week 31

30 | Donderdag - Thursday

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31 | Vrijdag - Friday

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1 | Zaterdag - Saturday

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2 | Zondag - Sunday

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2009 | Augustus - August

3 | Maandag - Monday

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4 | Dinsdag - Tuesday

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5 | Woensdag - Wednesday

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| week 32

6 | Donderdag - Thursday

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7 | Vrijdag - Friday

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8 | Zaterdag - Saturday

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9 | Zondag - Sunday

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2009 | Augustus - August

10 | Maandag - Monday

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11 | Dinsdag - Tuesday

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12 | Woensdag - Wednesday

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| week 33

13 | Donderdag - Thursday

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14 | Vrijdag - Friday

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15 | Zaterdag - Saturday

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16 | Zondag - Sunday

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2009 | Augustus - August

17 | Maandag - Monday

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18 | Dinsdag - Tuesday

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19 | Woensdag - Wednesday

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| week 34

20 | Donderdag - Thursday

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21 | Vrijdag - Friday

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22 | Zaterdag - Saturday

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23 | Zondag - Sunday

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2009 | Augustus - August

24 | Maandag - Monday

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25 | Dinsdag - Tuesday

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26 | Woensdag - Wednesday

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| week 35

27 | Donderdag - Thursday

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28 | Vrijdag - Friday

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29 | Zaterdag - Saturday

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30 | Zondag - Sunday

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2009 | September - September

31 | Maandag - Monday

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1 | Dinsdag - Tuesday

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2 | Woensdag - Wednesday

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| week 36

3 | Donderdag - Thursday

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4 | Vrijdag - Friday

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5 | Zaterdag - Saturday

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6 | Zondag - Sunday

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2009 | September - September

7 | Maandag - Monday

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8 | Dinsdag - Tuesday

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9 | Woensdag - Wednesday

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| week 37

10 | Donderdag - Thursday

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11 | Vrijdag - Friday

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12 | Zaterdag - Saturday

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13 | Zondag - Sunday

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14 | Maandag - Monday

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15 | Dinsdag - Tuesday

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16 | Woensdag - Wednesday

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| week 38

17 | Donderdag - Thursday

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18 | Vrijdag - Friday

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19 | Zaterdag - Saturday

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20 | Zondag - Sunday

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2009 | September - September

21 | Maandag - Monday

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22 | Dinsdag - Tuesday

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23 | Woensdag - Wednesday

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| week 39

24 | Donderdag - Thursday

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25 | Vrijdag - Friday

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26 | Zaterdag - Saturday

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27 | Zondag - Sunday

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2009 | September - September

28 | Maandag - Monday

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29 | Dinsdag - Tuesday

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30 | Woensdag - Wednesday

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| week 40

1 | Donderdag - Thursday

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2 | Vrijdag - Friday

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3 | Zaterdag - Saturday

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4 | Zondag - Sunday

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2009 | Oktober - October

5 | Maandag - Monday

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6 | Dinsdag - Tuesday

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7 | Woensdag - Wednesday

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| week 41

8 | Donderdag - Thursday

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9 | Vrijdag - Friday

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10 | Zaterdag - Saturday

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11 | Zondag - Sunday

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2009 | Oktober - October

12 | Maandag - Monday

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13 | Dinsdag - Tuesday

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14 | Woensdag - Wednesday

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| week 42

15 | Donderdag - Thursday

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16 | Vrijdag - Friday

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17 | Zaterdag - Saturday

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18 | Zondag - Sunday

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2009 | Oktober - October

19 | Maandag - Monday

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20 | Dinsdag - Tuesday

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21 | Woensdag - Wednesday

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| week 43

22 | Donderdag - Thursday

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23 | Vrijdag - Friday

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24 | Zaterdag - Saturday

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25 | Zondag - Sunday

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2009 | Oktober - October

26 | Maandag - Monday

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27 | Dinsdag - Tuesday

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28 | Woensdag - Wednesday

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| week 44

29 | Donderdag - Thursday

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30 | Vrijdag - Friday

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31 | Zaterdag - Saturday

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1 | Zondag - Sunday

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2009 | November - November

2 | Maandag - Monday

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3 | Dinsdag - Tuesday

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4 | Woensdag - Wednesday

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| week 45

5 | Donderdag - Thursday

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6 | Vrijdag - Friday

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7 | Zaterdag - Saturday

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8 | Zondag - Sunday

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2009 | November - November

9 | *Maandag - Monday*

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10 | *Dinsdag - Tuesday*

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11 | *Woensdag - Wednesday*

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| week 46

12 | Donderdag - Thursday

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13 | Vrijdag - Friday

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14 | Zaterdag - Saturday

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15 | Zondag - Sunday

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2009 | November - November

16 | Maandag - Monday

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17 | Dinsdag - Tuesday

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18 | Woensdag - Wednesday

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| week 47

19 | Donderdag - Thursday

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20 | Vrijdag - Friday

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21 | Zaterdag - Saturday

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22 | Zondag - Sunday

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2009 | November - November

23 | Maandag - Monday

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24 | Dinsdag - Tuesday

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25 | Woensdag - Wednesday

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| week 48

26 | Donderdag - Thursday

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27 | Vrijdag - Friday

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28 | Zaterdag - Saturday

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29 | Zondag - Sunday

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2009 | December - December

30 | Maandag - Monday

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1 | Dinsdag - Tuesday

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2 | Woensdag - Wednesday

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| week 49

3 | Donderdag - Thursday

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4 | Vrijdag - Friday

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5 | Zaterdag - Saturday

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6 | Zondag - Sunday

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2009 | December - December

7 | Maandag - Monday

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8 | Dinsdag - Tuesday

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9 | Woensdag - Wednesday

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| week 50

10 | Donderdag - Thursday

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11 | Vrijdag - Friday

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12 | Zaterdag - Saturday

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13 | Zondag - Sunday

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2009 | December - December

14 | Maandag - Monday

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15 | Dinsdag - Tuesday

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16 | Woensdag - Wednesday

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| week 51

17 | Donderdag - Thursday

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18 | Vrijdag - Friday

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19 | Zaterdag - Saturday

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20 | Zondag - Sunday

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2009 | December - December

21 | Maandag - Monday

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22 | Dinsdag - Tuesday

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23 | Woensdag - Wednesday

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| week 52

24 | Donderdag - Thursday

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25 | Vrijdag - Friday

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26 | Zaterdag - Saturday

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27 | Zondag - Sunday

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2009 | December - December

28 | Maandag - Monday

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29 | Dinsdag - Tuesday

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30 | Woensdag - Wednesday

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| week 53

31 | Donderdag - Thursday

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1 | Vrijdag - Friday

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2 | Zaterdag - Saturday

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3 | Zondag - Sunday

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2010 | Januari - January

4 | Maandag - Monday

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5 | Dinsdag - Tuesday

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6 | Woensdag - Wednesday

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| week 1

7 | Donderdag - Thursday

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8 | Vrijdag - Friday

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9 | Zaterdag - Saturday

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10 | Zondag - Sunday

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2010 | Januari - January

11 | Maandag - Monday

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12 | Dinsdag - Tuesday

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13 | Woensdag - Wednesday

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| week 2

14 | Donderdag - Thursday

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15 | Vrijdag - Friday

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16 | Zaterdag - Saturday

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17 | Zondag - Sunday

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2010 | Januari - January

18 | Maandag - Monday

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19 | Dinsdag - Tuesday

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20 | Woensdag - Wednesday

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| week 3

21 | Donderdag - Thursday

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22 | Vrijdag - Friday

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23 | Zaterdag - Saturday

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24 | Zondag - Sunday

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2010 | Januari - January

25 | Maandag - Monday

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26 | Dinsdag - Tuesday

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27 | Woensdag - Wednesday

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| week 4

28 | Donderdag - Thursday

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29 | Vrijdag - Friday

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30 | Zaterdag - Saturday

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31 | Zondag - Sunday

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2010 | Februari - February

1 | Maandag - Monday

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2 | Dinsdag - Tuesday

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3 | Woensdag - Wednesday

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| week 5

4 | Donderdag - Thursday

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5 | Vrijdag - Friday

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6 | Zaterdag - Saturday

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7 | Zondag - Sunday

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2010 | Februari - February

8 | Maandag - Monday

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9 | Dinsdag - Tuesday

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10 | Woensdag - Wednesday

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| week 6

11 | Donderdag - Thursday

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12 | Vrijdag - Friday

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13 | Zaterdag - Saturday

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14 | Zondag - Sunday

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2010 | Februari - February

15 | Maandag - Monday

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16 | Dinsdag - Tuesday

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17 | Woensdag - Wednesday

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| week 7

18 | Donderdag - Thursday

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19 | Vrijdag - Friday

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20 | Zaterdag - Saturday

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21 | Zondag - Sunday

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2010 | Februari - February

22 | Maandag - Monday

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23 | Dinsdag - Tuesday

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24 | Woensdag - Wednesday

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| week 8

25 | Donderdag - Thursday

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26 | Vrijdag - Friday

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27 | Zaterdag - Saturday

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28 | Zondag - Sunday

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2010 | Maart - March

1 | Maandag - Monday

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2 | Dinsdag - Tuesday

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3 | Woensdag - Wednesday

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| week 9

4 | Donderdag - Thursday

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5 | Vrijdag - Friday

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6 | Zaterdag - Saturday

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7 | Zondag - Sunday

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2010 | Maart - March

8 | Maandag - Monday

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9 | Dinsdag - Tuesday

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10 | Woensdag - Wednesday

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| week 10

11 | Donderdag - Thursday

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12 | Vrijdag - Friday

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13 | Zaterdag - Saturday

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14 | Zondag - Sunday

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2010 | Maart - March

15 | Maandag - Monday

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16 | Dinsdag - Tuesday

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17 | Woensdag - Wednesday

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| week 11

18 | Donderdag - Thursday

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19 | Vrijdag - Friday

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20 | Zaterdag - Saturday

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21 | Zondag - Sunday

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2010 | Maart - March

22 | Maandag - Monday

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23 | Dinsdag - Tuesday

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24 | Woensdag - Wednesday

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| week 12

25 | Donderdag - Thursday

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26 | Vrijdag - Friday

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27 | Zaterdag - Saturday

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28 | Zondag - Sunday

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2010 | Maart - March

29 | Maandag - Monday

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30 | Dinsdag - Tuesday

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31 | Woensdag - Wednesday

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| week 13

1 | Donderdag - Thursday

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2 | Vrijdag - Friday

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3 | Zaterdag - Saturday

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4 | Zondag - Sunday

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2010 | April - April

5 | Maandag - Monday

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6 | Dinsdag - Tuesday

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7 | Woensdag - Wednesday

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| week 14

8 | Donderdag - Thursday

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9 | Vrijdag - Friday

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10 | Zaterdag - Saturday

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11 | Zondag - Sunday

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2010 | April - April

12 | Maandag - Monday

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13 | Dinsdag - Tuesday

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14 | Woensdag - Wednesday

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| week 15

15 | Donderdag - Thursday

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16 | Vrijdag - Friday

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17 | Zaterdag - Saturday

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18 | Zondag - Sunday

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2010 | April - April

19 | Maandag - Monday

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20 | Dinsdag - Tuesday

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21 | Woensdag - Wednesday

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| week 16

22 | Donderdag - Thursday

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23 | Vrijdag - Friday

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24 | Zaterdag - Saturday

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25 | Zondag - Sunday

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2010 | April - April

26 | Maandag - Monday

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27 | Dinsdag - Tuesday

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28 | Woensdag - Wednesday

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| week 17

1 | Donderdag - Thursday

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2 | Vrijdag - Friday

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1 | Zaterdag - Saturday

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2 | Zondag - Sunday

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2010 | Mei - May

3 | Maandag - Monday

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4 | Dinsdag - Tuesday

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5 | Woensdag - Wednesday

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| week 18

6 | Donderdag - Thursday

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7 | Vrijdag - Friday

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8 | Zaterdag - Saturday

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9 | Zondag - Sunday

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2010 | Mei - May

10 | Maandag - Monday

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11 | Dinsdag - Tuesday

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12 | Woensdag - Wednesday

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| week 19

13 | Donderdag - Thursday

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14 | Vrijdag - Friday

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15 | Zaterdag - Saturday

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16 | Zondag - Sunday

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2010 | Mei - May

17 | Maandag - Monday

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18 | Dinsdag - Tuesday

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19 | Woensdag - Wednesday

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| week 20

20 | Donderdag - Thursday

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21 | Vrijdag - Friday

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22 | Zaterdag - Saturday

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23 | Zondag - Sunday

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2010 | Mei - May

24 | Maandag - Monday

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25 | Dinsdag - Tuesday

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26 | Woensdag - Wednesday

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| week 21

27 | Donderdag - Thursday

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28 | Vrijdag - Friday

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29 | Zaterdag - Saturday

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30 | Zondag - Sunday

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2010 | Juni - June

31 | Maandag - Monday

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1 | Dinsdag - Tuesday

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2 | Woensdag - Wednesday

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| week 22

3 | Donderdag - Thursday

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4 | Vrijdag - Friday

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5 | Zaterdag - Saturday

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6 | Zondag - Sunday

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2010 | Juni - June

7 | Maandag - Monday

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8 | Dinsdag - Tuesday

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9 | Woensdag - Wednesday

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| week 23

10 | Donderdag - Thursday

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11 | Vrijdag - Friday

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12 | Zaterdag - Saturday

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13 | Zondag - Sunday

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2010 | Juni - June

14 | Maandag - Monday

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15 | Dinsdag - Tuesday

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16 | Woensdag - Wednesday

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| week 24

17 | Donderdag - Thursday

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18 | Vrijdag - Friday

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19 | Zaterdag - Saturday

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20 | Zondag - Sunday

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2010 | Juni - June

21 | Maandag - Monday

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22 | Dinsdag - Tuesday

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23 | Woensdag - Wednesday

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| week 25

24 | Donderdag - Thursday

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25 | Vrijdag - Friday

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26 | Zaterdag - Saturday

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27 | Zondag - Sunday

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2010 | Juni - June

28 | Maandag - Monday

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29 | Dinsdag - Tuesday

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30 | Woensdag - Wednesday

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| week 26

1 | Donderdag - Thursday

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2 | Vrijdag - Friday

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3 | Zaterdag - Saturday

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4 | Zondag - Sunday

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2010 | Juli - July

5 | Maandag - Monday

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6 | Dinsdag - Tuesday

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7 | Woensdag - Wednesday

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| week 27

8 | Donderdag - Thursday

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9 | Vrijdag - Friday

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10 | Zaterdag - Saturday

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11 | Zondag - Sunday

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2010 | Juli - July

12 | Maandag - Monday

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13 | Dinsdag - Tuesday

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14 | Woensdag - Wednesday

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| week 28

15 | Donderdag - Thursday

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16 | Vrijdag - Friday

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17 | Zaterdag - Saturday

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18 | Zondag - Sunday

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2010 | Juli - July

19 | Maandag - Monday

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20 | Dinsdag - Tuesday

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21 | Woensdag - Wednesday

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| week 29

22 | Donderdag - Thursday

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23 | Vrijdag - Friday

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24 | Zaterdag - Saturday

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25 | Zondag - Sunday

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2010 | Juli - July

26 | Maandag - Monday

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27 | Dinsdag - Tuesday

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28 | Woensdag - Wednesday

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| week 30

29 | Donderdag - Thursday

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30 | Vrijdag - Friday

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31 | Zaterdag - Saturday

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1 | Zondag - Sunday

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2010 | Augustus - August

2 | Maandag - Monday

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3 | Dinsdag - Tuesday

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4 | Woensdag - Wednesday

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| week 31

5 | Donderdag - Thursday

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6 | Vrijdag - Friday

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7 | Zaterdag - Saturday

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8 | Zondag - Sunday

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Bestelnummer: 06942480004