Physics MSc

VU University Amsterdam - Faculteit der Exacte Wetenschappen - M Physics - 2015-2016

Structure of the training
In the Master curriculum knowledge of physics in general and in one or more specific areas of physics is deepened. The global structure is:

Part	**O**	**M,C,E**
Courses within specialisation	36	24
Seminar, literature study or project	6	
Research project	54	30
Presentation and Master thesis	6	6
Optional, deficiencies	12	
M, C, E courses or academic skills	6	60
Total	120	120

The programme includes compulsary courses for the chosen specialisation and optional courses that can be chosen from a list. In some specializations there are no optional courses in the M.C ,E-variants.
Furthermore, a student in the research variant can participate in a project or student seminar or can write an essay on a subject not directly related to his field of specialisation. 12 cp can be freely chosen within the university from courses on a 2nd or higher year level.

Research variant
The research variant is meant for students who want to pursue a research career. Students who have chosen to follow this variant will spend most of their time on courses and on their research project, including the Master's thesis in the chosen specialisation. Generally spoken these students may aim at continuing their study with PhD education, in order to obtain an executive job as researcher, group leader, at a university, research institution, government or (industrial) company.

The possible specialisations (research variants) are:

-Particle and Astroparticle Physics
-Theoretical Physics
-Advanced Matter and Energy Physics
-Laser Sciences and Biomolecular Photonics
-Physics of Life and Health

All programmes are together with the UvA. In some specialisations there is also cooperation with Chemistry and with the section Physics and Medical Technology of the VU medical centre.

M, C en E variant
Furthermore, a choice can be made out of three study variants.

-Communication variant (C-variant)
-Education variant (E-variant)

-Society oriented variant (M-variant)

For students wishing to combine a sound background in physics with applications or management in industry or business, the study variant Physics and Business (M) is offered. In the same spirit the Communication and Education programme lines prepare for careers in, e.g., science policy, scientific reporting and publishing, and science education in various settings (schools, museums, educational software). Apart from coursework the curriculum for the Business and Communication and Education lines also includes an internship outside the university, e.g., in a company, government agency, school or museum.

Deficiencies
The examination committee can require that a student follows courses from the Bachelor programme Physics in order to make up for deficiencies, up to a maximum of 12 cp.
Students following the O variant are required to spend 6 cp on an M/C/E subject, or on academic skills, so as to broaden their education. Students who have chosen an M, C or E variant can spend a maximum of 60 cp on subjects within that study variant.

To master co-ordinators

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Specialization Science, Business & Innovation

The MSc-SBI program outlined below features two thematic lines: (1) life science, with an emphasis on drug development, molecular diagnostics and innovative medical instrumentation, and (2) energy science, with an emphasis on sustainable energy development. This program, combining the natural sciences with innovation skill sets from a business and organizational perspective is spread across a two-year MSc-program. The program is full time and taught in English. To obtain an MSc degree in SBI, students must earn 120 credits (EC) in courses according to the scheme below.
1.Natural sciences 36 EC
a. Science courses 12 EC
Compulsory choice:
b1. Science project (incl literature research and research skills)24 EC
or b2. Researching science research 12 EC and Track courses 12 EC
2. Business and Social sciences 24 EC
3. Science, Business and Innovation 42 EC
a. SBI course 6 EC
b. SBI project (internship and master thesis) 36 EC
4. Complementary and/or electives 18 EC
In this program, students will be exposed to mandatory science classes, i.e. life science and/or energy science, to strengthen their background in natural sciences fundamentals. In addition, depending on the background of the students (either SBI BSc or other Bachelor degreed) there will be possibilities to define an appropriate customized MSc program. The chosen core will be complemented with a science project (24 EC) or the combination of Researching science research (12 EC) and Track courses (12 EC) for specialization in an area of interest, in either Life or Energy
science and with 24 EC in social and business sciences. The courses in social and business sciences focus on the processes and organizational context of innovation trajectories in business, industry and on institutional settings of inventions in life science and energy science and sustainability. The MSc-SBI is finalized through a final SBI-project of 36 EC (usually an internship at a company or institute) integrating the science, business and social aspects, leading to a Master's Thesis.

Programme components:

- Compulsory Choice 1 out of 2
- Compulsory Choice of 12 EC
- Compulsory Choice of 24 EC
- Recommended electives
- Compulsory Courses

Compulsory Choice 1 out of 2

Courses:

Name	Period	Credits	Code
Business, Innovation and Value Creation in the Life Science Industry	Period 3	6.0	X_432723

Current Sustainable Energy Technologies	Period 3	6.0	X_422582

Compulsory Choice of 12 EC

Compulsory Choice of 12 EC from 1 of the following Science courses:
L&H:
Biomedical modeling and simulation 6 EC
Principles of Pharmaceutical Sciences/Pharmacochemistry 6 EC
Protein science 6 EC
Innovation in medical technology 6 EC
Chemical biology 6 EC
Green chemistry 6 EC

E&S:
Biosolar cells 6 EC
Chemical biology 6 EC
Green chemistry 6 EC
Photovoltaics 6 EC
Project sustainable future 6 EC
Materials for energy and environmental sustainability 12 EC

Courses:

Name	Period	Credits	Code
Biomedical Modelling and Simulation	Period 1	6.0	X_430112
BioSolar Cells	Period 1	6.0	X_428531
Chemical Biology	Period 1	6.0	X_432538
Green Chemistry	Period 1	6.0	X_430557
Innovation in Medical Technology to Improve the Health Care System	Period 6	6.0	X_430602
Organic Photovoltaics	Period 5	6.0	X_422590
Principles of Pharmaceutical Sciences / Pharmacochemistry	Period 1	6.0	X_435675
Project Sustainable Future	Period 6	6.0	X_432784
Protein Science	Period 1	6.0	AM_470145

Compulsory Choice of 24 EC

Courses:

Name	Period	Credits	Code
Business & Innovation Project	Ac. Year (September)	24.0	X_432845
Materials for energy and environmental sustainability	Period 4+5	12.0	X_432850

Researching science research	Period 4+5	12.0	X_432849
Science project	Ac. Year (September)	24.0	X_422591

Recommended electives

The students have to choose elective courses of 18 EC at the MSc level which have to be approved by the Examination Committee.

Courses:

Name	Period	Credits	Code
Science and Society in Historical Perspective	Period 4+5	6.0	X_400424
Technology and Innovation Processes	Period 2	6.0	E_BA_TIP

Compulsory Courses

Courses:

Name	Period	Credits	Code
Management of Sustainable Innovation	Period 2	6.0	X_432739
Networked Organizations and Communication	Period 2	6.0	S_NOC
SBI Project & Master Thesis	Ac. Year (September)	36.0	X_432735
SBI Research Methodology	Ac. Year (September)	6.0	X_432846
Transdisciplinarity and Transition	Period 2	6.0	X_430604

Communication Variant

This specialization is intended for students with a BSc degree in any of the bèta-studies who want to specialize in communication. The programme focuses on science communication theory, research and practice. The programme of the communication (C) specialization is 1 year (60 credits). This specialization may not be combined with the Societal specialization (M) or the Education specialization (E). C-courses are shared with master students from the Faculty of Earth and Life Sciences.

Programme

For a specialization degree it is required to spend 60 credits on Science Communication components. Two courses, one internship and a thesis are compulsory. The rest of the programme can be filled with optional courses. While science communication research is always a component of a students' internship, students have the opportunity to choose for placement at institutes such as newspapers, museums, science centers, companies, etc. to hone their practical as well as academic

skills. Students' thesis comprise short (9 credits) literature studies on research questions about aspects of science communication.

To complete his or her entire Master programme (120 credits), the student has to choose 60 credits Physics courses.
Before formal enrollment, the students' programme has to be approved by the master coordinator as well as the programme coordinator for the Science Communication.

Programme components:

- Courses for Communication Part

Courses for Communication Part

To complete the Master programme (120 EC) of the Communication Variant, the student has to choose 60 EC Communication courses.

Programme components:

- Optional courses: select at least 12EC
- Internship communication
- Compulsory Courses

Optional courses: select at least 12EC

Courses:

Name	Period	Credits	Code
Communication, Organization and Management	Period 2	6.0	AM_470572
Science in Dialogue	Period 2	6.0	AM_1002
Science Journalism	Period 2	6.0	AM_471014
Science Museology	Period 3	6.0	AM_470590

Internship communication

Courses:

Name	Period	Credits	Code
Reflective Practice Internship Science Communication	Ac. Year (September)	30.0	AM_1163
Research Internship Science Communication	Ac. Year (September)	30.0	AM_1162

Compulsory Courses

Courses:

Name	Period	Credits	Code
Research methods for analyzing complex problems	Period 1	6.0	AM_1182
Science and Communication	Period 1	6.0	AM_470587

Educatie variant

The teaching in these variant is mainly in Dutch. Therefore we also give the requirements in Dutch.

Programma

De opleiding voor het behalen van de eerstegraads lesbevoegdheid start twee keer per jaar, in september en in februari. De opleiding wordt aangeboden in twee semesters. Uitgaande van de start in september duurt semester 1 tot en met januari en semester 2 tot juli. De opleiding is sterk praktijkgericht. De helft van de opleiding bestaat uit praktijk door werkervaring of stage (ook wel schoolpracticum genoemd) op een school voor voortgezet onderwijs. Daarnaast kent de opleiding vier componenten: vakdidactiek, algemene didactiek/pedagogiek, praktijkonderzoek en verdiepingsmodulen.

Naast de educatievakken volgt de student 60 sp Physics vakken, in overleg met de mastercoördinator van de gekozen specialisatie. Hierbij zijn de twee vakken Literature thesis and Colloquium Physics Education Variant en Master Research Project Physics-Education Variant verplicht.

Studenten die bij de Communicatie variant de vakken 'interpersoonlijke communicatie' en 'museologie en buitenschoolse educatie' volgen, krijgen bij de lerarenopleiding een vrijstelling voor verdiepingsmodulen, een deel van het praktijkonderzoek en een deel van algemene didactiek.

Programme components:

- Master Leraar VHO Natuurkunde, vanaf 2015
- Leraar voorbereidend hoger onderwijs in Natuurkunde verplicht
- LVHO Natuurkunde, overgangsregeling

Master Leraar VHO Natuurkunde, vanaf 2015

Courses:

Name	Period	Credits	Code
Didactiek 1	Period 1, Period 4	6.0	O_MLDIDAC_1
Didactiek 2	Period 2+3, Period 5+6	6.0	O_MLDIDAC_2
Didactiek 3	Period 4+5+6	9.0	O_MLDIDAC_3

Peergroup 1	Period 1+2+3, Period 4+5+6	0.0	O_MLPEERGR_1
Peergroup 2	Period 3+4+5	0.0	O_MLPEERGR_2
Praktijk 1	Period 1, Period 4	6.0	O_MLPRAK_1
Praktijk 2	Period 2+3, Period 5+6	9.0	O_MLPRAK_2
Praktijk 3	Period 4+5+6	15.0	O_MLPRAK_3
Praktijk onderzoek 1	Period 3, Period 6	3.0	O_MLPROZ_1
Praktijk onderzoek 2	Period 4+5+6	6.0	O_MLPROZ_2

Leraar voorbereidend hoger onderwijs in Natuurkunde verplicht

Courses:

Name	Period	Credits	Code
Educational and Pedagogical Studies II	Period 1+2	3.0	O_MLADEPII
Research II	Period 1+2+3	6.0	O_MLVPOOII
Specialisation	Period 2+3	3.0	O_MLVERD
Teaching Methodology Physics II	Period 1+2	6.0	O_MLVDNAII
Teaching Practice II	Period 1+2+3	15.0	O_MLPRAKII

LVHO Natuurkunde, overgangsregeling

Courses:

Name	Period	Credits	Code
Educational and Pedagogical Studies I	Period 1+2	6.0	O_MLADEPI
Research I	Period 1+2+3	3.0	O_MLVPOOI
Teaching Methodology Physics I	Period 1+2	3.0	O_MLVDNAI
Teaching Practice I	Period 1+2+3	15.0	O_MLPRAKI

Research Variant Particle Physics and Astroparticle Physics

What are the smallest building blocks ("particles") of the universe? Via which forces do these particles interact? Can one understand the apparently random particle masses? Why do we live in a matter (as opposed to anti-matter) dominated universe? These and many other questions are the context of experiments and theoretical work in (astro) particle physics. In particle accelerator experiments physicists investigate high energy interactions in a controlled environment that is thought to approach the conditions in the universe at a fraction of a second after the Big Bang. In non-accelerator experiments the phycists study the neutrino radiation from the sun, supernova and other speculative sources. Common features of the experiments in this field of physics are the state-of-the-art technology and innovative software

(like distributed computing with the GRID-project).

More Information: http://master.particles.nl/ .

The progamme consists of 120 credits
- compulsory courses 78 credits (including a Master Project of 54 credits and a Colloquium and thesis report of 6 credits about the Master Project)
- compulsory optional choice 24 credits from a list
- optional courses 12 credits (free to choose)
- at least 6 credits Management, Communication or Education courses or academic skills

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Details about research in this master track can be found here
http://www.nat.vu.nl/en/research/astro_particle_physics/index.asp

Master coordinators

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Programme components:

- Optional Courses (24 ec compulsary)
- M, C, E Courses or academic Skills (6 ec)
- Compulsory Courses
- Expired Courses PPAP

Optional Courses (24 ec compulsary)

Students need to select a total of 24 credits or more from the following list.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Astroparticle Physics	Period 4	6.0	X_420005
Beyond the Standard Model	Period 5	3.0	X_420192
CERN Research Project	Period 6	6.0	X_420116

CERN Summer Student Lecture Programme	Summer period	3.0	X_420122
Computational Methods	Period 4	6.0	X_420014
Flavour Physics and CP Violation	Period 4	3.0	X_428539
General Relativity	Period 4	6.0	X_420128
Gravitational Waves (Selected Topics in Gravitation and Cosmology)	Period 5	3.0	X_428506
Mathematical Methods in Theoretical Physics 1	Period 1	6.0	X_428573
Particle Cosmology	Period 2	6.0	X_420560
Particle Detection	Period 2	6.0	X_420051
Particles and Fields	Period 4+5	6.0	X_420112
Programming C++	Period 3	3.0	X_420141
Quantum Field Theory	Period 2	6.0	X_420081
Statistical Data Analysis	Period 1	6.0	X_420067
Strong Interactions 1	Period 4	3.0	X_420233
Strong Interactions 2	Period 5	3.0	X_420234

M, C, E Courses or academic Skills (6 ec)

Students need to select at least 6 credits from the following list or a M, C, E course from the range of the M, C and E variants

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Scientific Writing in English	Period 2, Period 6	3.0	X_400592

Compulsory Courses

Courses:

Name	Period	Credits	Code
Master Project Particle Physics and Astroparticle Physics	Ac. Year (September)	60.0	X_422602
NIKHEF Project	Period 5	6.0	X_420115
Particle Physics I	Period 1	6.0	X_420052
Particle Physics II	Period 2	6.0	X_420053

Expired Courses PPAP

Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder

Only for students who have started the Master Physics on or before September 1, 2012

Courses:

Name	Period	Credits	Code
Colloquium and graduate thesis	Ac. Year (September)	6.0	X_422520
Master Project Particle Physics and Astroparticle Physics	Ac. Year (September)	54.0	X_422512

Research Variant Theoretical Physics

The programme consists of 120 credits
- compulsory courses 78 credits (including a Master Project of 54 credits and a Colloquium and thesis report of 6 credits about the Master Project)
- compulsory optional choice 24 credits from a list
- optional courses 12 credits (free to choose)
- at least 6 credits Management, Communication or Education courses or academic skills

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Details about research in this master track can be found here
http://tinyurl.com/qyk5n6g

Master coordinators

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Programme components:

- M, C, E Courses or academic Skills (6 ec)
- Optional Courses (24 ec compulsary)
- Recommended Choicerecommended elective courses
- Compulsory Courses
- Expired Courses TP

M, C, E Courses or academic Skills (6 ec)

Students need to select at least 6 credits from the following list or a M, C, E course from the range of the M, C and E variants

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Scientific Writing in English	Period 2, Period 6	3.0	X_400592

Optional Courses (24 ec compulsary)

Students need to select a total of 24 credits or more from the following list.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Beyond the Standard Model	Period 5	3.0	X_420192
Computational Methods	Period 4	6.0	X_420014
Flavour Physics and CP Violation	Period 4	3.0	X_428539
General Relativity	Period 4	6.0	X_420128
Mathematical Methods in Theoretical Physics 1	Period 1	6.0	X_428573
Mathematical Methods in Theoretical Physics 2	Period 2	6.0	X_428574
Particle Cosmology	Period 2	6.0	X_420560
Particles and Fields	Period 4+5	6.0	X_420112
Quantum Field Theory - Extension	Period 3	3.0	X_422554
Statistical Physics and Condensed Matter Theory I - Extension	Period 3	3.0	X_428519
Statistical Physics and Condensed Matter Theory II	Period 4+5+6	6.0	X_420100
String Theory	Period 5	6.0	X_400242

Recommended Choicerecommended elective courses

Compulsory courses at the expense of the optional courses unless the content already is covered in the bachelor programme.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Mathematical Methods	Period 4	6.0	X_420105

Compulsory Courses

Courses:

Name	Period	Credits	Code
Master Project Theoretical Physics	Ac. Year (September)	60.0	X_422603
Quantum Field Theory	Period 2	6.0	X_420081
Statistical Physics and Condensed Matter Theory I	Period 1	6.0	X_420083
Student Seminar Theoretical Physics	Period 6	6.0	X_420200

Expired Courses TP

Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder

Only for students who have started the Master Physics on or before September 1, 2012

Courses:

Name	Period	Credits	Code
Colloquium and graduate thesis	Ac. Year (September)	6.0	X_422519
Master Project Theoretical Physics	Ac. Year (September)	54.0	X_422509

Research Variant Advanced Matter and Energy Physics

The programme consists of 120 credits
- compulsory courses 24 credits (including a Colloquium and thesis report of 6 credits about the Master Project)
- compulsory master project 30 - 54 credits
- compulsory minor project if master project [Missing ITEM:]
(the sum of the Master project and Minor project must be at least 54

credits)
- compulsory choice of 24 credits from a list
- optional courses 12 credits (free to choose)
- at least 6 credits Management, Communication or Education courses or academic skills. The compulsory course Survival Guide for scientists (3 ec) is part of this

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Details about research in this master track can be found here
http://www.nat.vu.nl/en/research/condensed-matter-physics/index.asp

Master coordinator

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Programme components:

- Compulsory Choice Master Project
- Minor Project Choice
- M, C, E courses or academic skills (3 ec)
- Optional courses (12 ec compulsary)
- Compulsory Choice (6 ec)
- Compulsory Courses
- Expired Courses AMEP

Compulsory Choice Master Project

Students need to select one of the courses from the following list.

The sum of the Master project and Minor project must be at least 54 credits.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Master Project Advanced Matter and Energy Physics	Ac. Year (September)	36.0	X_422561
Master Project Advanced Matter and Energy Physics	Ac. Year (September)	42.0	X_422562
Master Project Advanced Matter and Energy Physics	Ac. Year (September)	48.0	X_422563
Master Project Advanced Matter and Energy Physics	Ac. Year (September)	54.0	X_422564

Master Project Advanced Matter and Energy Physics	Ac. Year (September)	60.0	X_422565

Minor Project Choice

Students need to select one of the courses from the following list if the Master Project is less than 54 credits.

The sum of the Master project and Minor project must be at least 54 credits.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Minor Project Advanced Matter and Energy Physics	Ac. Year (September)	6.0	X_422572
Minor Project Advanced Matter and Energy Physics	Ac. Year (September)	12.0	X_422573
Minor Project Advanced Matter and Energy Physics	Ac. Year (September)	18.0	X_422574
Minor Project Advanced Matter and Energy Physics	Ac. Year (September)	24.0	X_422575

M, C, E courses or academic skills (3 ec)

Students need to select at least 3 credits:
Scientific Writing in English or a M, C, E course from the range of the M, C and E variants

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Communication, Organization and Management	Period 2	6.0	AM_470572
English Academic Course	Period 2+3, Period 5+6	3.0	X_437028
Entrepreneurship for Physicists	Period 3	6.0	X_422600
Managing Science and Technology in Society	Period 1	6.0	AM_470586

Research methods for analyzing complex problems	Period 1	6.0	AM_1182
Science and Communication	Period 1	6.0	AM_470587
Science Communication for Researchers in Bèta Disciplines	Period 5	6.0	AB_470185
Science in Dialogue	Period 2	6.0	AM_1002
Science in Perspective	Period 4+5	6.0	X_437030
Scientific Writing in English	Period 2, Period 6	3.0	X_400592
Tutoring Students	Period 2	3.0	X_432625

Optional courses (12 ec compulsary)

Students need to select a total of 24 credits or more from the following list.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Fermi Quantum Gases	Period 5	6.0	X_428514
Forensics with complex liquids	Period 6	3.0	X_428538
Mathematica for Physicists	Period 3	3.0	X_428533
Nanophotonics	Period 6	6.0	X_428537
Photosynthesis and Energy	Period 5	6.0	X_422553
Photovoltaics	Period 4	6.0	X_428516
Programming C++	Period 3	3.0	X_420141
Soft Condensed Matter and Biological Physics	Period 2	6.0	X_420167
Superconductivity	Period 2	6.0	X_428522
Ultrafast Laser Physics	Period 4	6.0	X_422556

Compulsory Choice (6 ec)

Courses:

Name	Period	Credits	Code
Statistical Mechanics of Soft Matter	Period 1	6.0	X_422555
Statistical Physics and Condensed Matter Theory I	Period 1	6.0	X_420083

Compulsory Courses

Courses:

Name	Period	Credits	Code
Emergent Energy Materials	Period 1	6.0	X_428571
Hydrodynamics	Period 4	6.0	X_428536
Orientation Project	Period 1, Period 2, Period 3, Period 4, Period 6	6.0	X_422580
Quantum optics	Period 2	6.0	X_428535
Showcase 1	Period 1	0.0	X_428576
Showcase 2	Period 2	0.0	X_422609

Expired Courses AMEP

Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder

Only for students who have started the Master Physics on or before September 1, 2012

Courses:

Name	Period	Credits	Code
Colloquium and graduate thesis	Ac. Year (September)	6.0	X_422536
Master Project Physics: AMEP	Ac. Year (September)	30.0	X_422560

Research Variant Physics of Life and Health

The programme consists of 120 credits
- compulsory courses 12 credits (including a Colloquium and thesis report of 6 credits about the Master Project)
- compulsory master project 30 - 54 credits
- compulsory minor project if master project [Missing ITEM:] (the sum of the Master project and Minor project must be at least 54 credits)
- compulsory optional choice 12 credits
- compulsory optional choice 24 credits
- compulsory optional courses 12 credits (free to choose)
- at least 6 credits Management, Communication or Education courses or academic skills.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Details about research in this master track can be found here:
http://www.nat.vu.nl/en/research/physics-life-health/index.asp

(link to the Physics of Life group)

http://tinyurl.com/qzz9uun
(link to Biophysics and Medical Imaging)

Master coordinators

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Programme components:

- Compulsory Choice Master Project
- Compulsory Choice Minor Project
- Optional courses (12 ec compulsary)
- Compulsory Choice (12 ec)
- M, C, E courses or academic Skills (6 ec)
- Compulsory Courses
- Expired Courses PLH

Compulsory Choice Master Project

Students need to select one of the courses from the following list.

The sum of the Master project and Minor project must be at least 54 credits.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Master Project Physics of Life and Health	Ac. Year (September)	36.0	X_422541
Master Project Physics of Life and Health	Ac. Year (September)	42.0	X_422542
Master Project Physics of Life and Health	Ac. Year (September)	48.0	X_422543
Master Project Physics of Life and Health	Ac. Year (September)	54.0	X_422544
Master Project Physics of Life and Health	Ac. Year (September)	60.0	X_422545

Compulsory Choice Minor Project

Students need to select one of the courses from the following list if the Master Project is less than 54 credits.

The sum of the Master project and Minor project must be at least 54 credits.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Minor Project Physics of Life and Health	Ac. Year (September)	6.0	X_422548
Minor Project Physics of Life and Health	Ac. Year (September)	12.0	X_422549
Minor Project Physics of Life and Health	Ac. Year (September)	18.0	X_422550
Minor Project Physics of Life and Health	Ac. Year (September)	24.0	X_422551

Optional courses (12 ec compulsary)

Students need to select a total of 24 credits or more from the following list.

Note: Every programme, including the choice of optional courses, has to be discussed and agreed upon with the master coordinator or a personal mentor and approved by the Examination Board.

Courses:

Name	Period	Credits	Code
Advanced 3D and 4D Medical Imaging	Period 5	6.0	X_428569
Advanced Medical Image Processing	Period 2	6.0	X_422610
Advanced Medical Technology	Period 5	6.0	X_437026
Biomedical Modelling and Simulation	Period 1	6.0	X_430112
Dynamics of Biomolecules and Cells	Period 4	6.0	X_422583
Hydrodynamics	Period 4	6.0	X_428536
Lasers and Quantum Optics	Period 1	6.0	X_422539
Mathematica for Physicists	Period 3	3.0	X_428533
Nanophotonics	Period 6	6.0	X_428537
Parameter Estimation Applied to Medical and Biological Sciences	Period 4	6.0	X_432631
Physics of Organs 2: Sensory Organs and Bioelectricity	Period 2	6.0	X_428528
Stochastic Simulation	Period 2	6.0	X_428577

Compulsory Choice (12 ec)

Courses:

Name	Period	Credits	Code
Advanced MRI	Period 6	6.0	X_428570
Advanced Spectroscopy	Period 6	6.0	X_432767
From Genome to Physiome	Period 6	6.0	X_420127
Laboratory challenge	Period 6	3.0	X_422601

M, C, E courses or academic Skills (6 ec)

Courses:

Name	Period	Credits	Code
Communication, Organization and Management	Period 2	6.0	AM_470572
English Academic Course	Period 2+3, Period 5+6	3.0	X_437028
Entrepreneurship for Physicists	Period 3	6.0	X_422600
Ethics in Biomedical Research	Period 3	3.0	X_422592
Ethics in Life Sciences	Period 3	3.0	AM_470707
Innovation in Medical Technology to Improve the Health Care System	Period 6	6.0	X_430602
Managing Science and Technology in Society	Period 1	6.0	AM_470586
Research methods for analyzing complex problems	Period 1	6.0	AM_1182
Science and Communication	Period 1	6.0	AM_470587
Science Communication for Researchers in Bèta Disciplines	Period 5	6.0	AB_470185
Science in Dialogue	Period 2	6.0	AM_1002
Science in Perspective	Period 4+5	6.0	X_437030
Scientific Writing in English	Period 2, Period 6	3.0	X_400592
Tutoring Students	Period 2	3.0	X_432625

Compulsory Courses

Courses:

Name	Period	Credits	Code
Light-tissue interaction	Period 1	6.0	X_428572
Literature Study mPhys-PLH	Ac. Year (September)	6.0	X_422585
Soft Condensed Matter and Biological Physics	Period 2	6.0	X_420167

Expired Courses PLH

Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder

Only for students who have started the Master Physics on or before September 1, 2012

Courses:

Name	Period	Credits	Code
Colloquium and graduate thesis	Ac. Year (September)	6.0	X_422538
Master Project Physics of Life and Health	Ac. Year (September)	30.0	X_422540

Specialization Science for Energy and Sustainability

The progamme consists of 120 credits
- compulsory courses 24 credits
- compulsory master project 30 - 60 credits
- compulsory minor project

Master coordinator

Dr. Raoul Frese (VU)
K room T-128
T +31 20 59 87263
E r.n.frese@vu.nl

Programme components:

- Compulsory Choice of at least 24 ec.
- Compulsory Choice Ethics and Portfolio Academic skills
- Compulsory Choice Master Project
- Minor Project Choice
- Compulsory Courses

Compulsory Choice of at least 24 ec.

Courses:

Name	Period	Credits	Code
BioSolar Cells	Period 1	6.0	X_428531
Catalysis for sustainable energy	Period 4	6.0	X_437027
Emergent Energy Materials	Period 1	6.0	X_428571
Energy and Climate Change; Science, Policy and Economics	Period 2	6.0	X_428568
Environmental Chemistry	Period 1	6.0	X_437004
Green Chemistry	Period 1	6.0	X_430557
Homogeneous Catalysis	Period 5	6.0	X_435668
Management of Sustainable Innovation	Period 2	6.0	X_432739
Open Innovation in Science and Sustainability	Period 2	6.0	X_422598
Organic Photovoltaics	Period 5	6.0	X_422590
Photosynthesis and Energy	Period 5	6.0	X_422553
Photovoltaics	Period 4	6.0	X_428516

Compulsory Choice Ethics and Portfolio Academic skills

Courses:

Name	Period	Credits	Code
Communication, Organization and Management	Period 2	6.0	AM_470572
English Academic Course	Period 2+3, Period 5+6	3.0	X_437028
Managing Science and Technology in Society	Period 1	6.0	AM_470586
Research methods for analyzing complex problems	Period 1	6.0	AM_1182
Science and Communication	Period 1	6.0	AM_470587
Science Communication for Researchers in Bèta Disciplines	Period 5	6.0	AB_470185
Science in Dialogue	Period 2	6.0	AM_1002
Science in Perspective	Period 4+5	6.0	X_437030
Scientific Writing in English	Period 2, Period 6	3.0	X_400592
Tutoring Students	Period 2	3.0	X_432625

Compulsory Choice Master Project

Courses:

Name	Period	Credits	Code
Master Project SfES	Ac. Year (September)	36.0	X_422594
Master Project SfES	Ac. Year (September)	42.0	X_422595
Master Project SfES	Ac. Year (September)	48.0	X_422596
Master Project SfES	Ac. Year (September)	54.0	X_422597
Master Project SfES	Ac. Year (September)	60.0	X_422604

Minor Project Choice

Courses:

Name	Period	Credits	Code
Minor Project Physics: SfES	Ac. Year (September)	6.0	X_422605
Minor Project Physics: SfES	Ac. Year (September)	12.0	X_422606
Minor Project Physics: SfES	Ac. Year (September)	18.0	X_422607
Minor Project Physics: SfES	Ac. Year (September)	24.0	X_422608

Compulsory Courses

Courses:

Name	Period	Credits	Code
Current Sustainable Energy Technologies	Period 3	6.0	X_422582
Project Sustainable Future	Period 6	6.0	X_432784

Society Oriented Variant for Natural and Life Sciences

Due to the growing complexity of technological and medical issues and the interaction with society, organisations working in this sector have a growing and urgent need for academic professionals in the natural and life sciences, who have knowledge of policy management and entrepreneurship. The Society oriented variant offers students with a bachelor degree in the natural and life sciences the chance to combine a specialization in this field with a specialization in research.

Programme

The programme of the Society oriented variant is equal to the first year of the master programme Management Policy- Analysis and entrepreneurship (MPA). The programme of the Society oriented variant consists of 60 cp (18 cp compulsory courses; 12 cp optional courses and 30 cp internship) The course language is English, unless all students participating in the course speak Dutch, the course language will be Dutch.

Apart from the communication courses, the student has to choose 60 sp Physics courses. The student has to discuss the programme with the master coordinator of the chosen specialisation.

Programme components:

- Courses for Society Oriented Part

Courses for Society Oriented Part

To complete the Master programme (120 EC) of the Society Oriented Variant, the student has to choose 60 EC Society Oriented courses.

Programme components:

- MSc BIO Science in Society specialisation

MSc BIO Science in Society specialisation

The Master's graduate with a Science in society specialization combines an academic approach with the skills and competences that will allow him or her to perform scientific research at the interface of the biomedical sciences and society. The specialization aims to develop strategies that contribute to an understanding of complex societal problems and strategies to solve complex societal problems through interdisciplinary research. In addition, the programme analyses the social, economic and ethical aspects of new developments in the biological sciences, so as to assess their implications for society. Master's graduates have the necessary skills to collaborate and communicate with researchers from various scientific disciplines (including but not limited to those in the biological sciences) and societal actors, and the ability to use these academic insights.
The Science in Society specialization has a study load of 54 EC.

Programme components:

- Compulsory courses
- Compulsory choice of at least 6 EC

Compulsory courses

Courses:

Name	Period	Credits	Code
Analysis of Governmental Policy	Period 1	6.0	AM_470571
Communication, Organization and Management	Period 2	6.0	AM_470572
Internship Science in Society	Ac. Year (September)	30.0	AM_1134
Research methods for analyzing complex problems	Period 1	6.0	AM_1182

Compulsory choice of at least 6 EC

Courses:

Name	Period	Credits	Code
Business Management in Health and Life Sciences	Period 2	6.0	AM_470584
Clinical Development and Clinical Trials	Period 3	3.0	AM_1180
Disability and Development	Period 2	6.0	AM_470588
Entrepreneurship in Health and Life Sc.	Period 2	6.0	AM_470575
Epidemiology	Period 3	3.0	AM_1179
Health, Globalisation and Human Rights	Period 2	6.0	AM_470818
Policy, Politics and Participation	Period 2	6.0	AM_470589
Science in Dialogue	Period 2	6.0	AM_1002

Advanced 3D and 4D Medical Imaging

Course code	X_428569 ()
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course objective
After the successful completion of this course, the student will, among others:
• understand the physics of the Advanced Medical Imaging techniques
• understand the role of advanced medical imaging in research and patient treatment
• derive expressions for image reconstruction from measured data
• analyze and quantify the influence of image acquisition parameters on image quality and appearance

Course content
This course is intended for students who want to get an in depth knowledge on these state-of-the-art 3D and 4D medical imaging technologies. Medical imaging comprises different imaging modalities and processes to image the human body for diagnostic and treatment purposes. Modern imaging techniques rely heavily on advanced physics and mathematics for image acquisition and reconstruction.
After a general introduction on the basic physics of medical imaging, the course will cover a number of advanced imaging techniques. We will focus on the principal imaging modalities used in the clinic: i.e. MRI, CT, Nuclear Imaging, and Ultrasound. Modern 3D and 4D (3D volume + time) imaging techniques will be discussed. The relevance of these techniques will be illustrated with examples from medical practice, including

applications in cardiology, oncology, and orthopaedics.

Type of assessment
The examination will be a written test. To prepare for the test, there will be lectures and assignments which serve as exercises for the written examination. Demonstrations of Medical Imaging Equipment and hands-on experiments will be given for each modality.

Recommended background knowledge
The course offers a solid background for further study of Medical Imaging and research at the AMC and VUMC. Prior basic knowledge of medical imaging at the bachelor level is recommended.

Target group
mPHY

Advanced Medical Image Processing

Course code	X_422610 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. ir. T.J.C. Faes
Examinator	dr. J.C. de Munck
Teaching staff	dr. ir. T.J.C. Faes
Teaching method(s)	Lecture, Computer lab
Level	400

Course objective
1) To provide students with knowledge and skills to understand the state of the art of modern medical imaging analysis in one or more of the topics: Quantitative aspects of image analysis; Image matching; 4D image processing (motion correction, fMRI-image analysis); Meshing in 2D and 3D (e.g., the marching cube algorithms, Delaunay triangulation, data structures, interpolation, connected component algorithms, geometric modelling, optimized algorithms).
2) To develop from concept to algorithm and code (C++ or MATLAB) image analysis software tools in the form of an evaluated (efficacy) and documented programme code.

Form of tuition
Lectures, literature review, workshops, demonstrations, computer practicles.

Type of assessment
Individual end-of-course assignment on a specific topic in medical image processing, including the development and evaluation of the programme code and its documentation. Moreover, an oral and written presentation on the assignment is included.

Recommended background knowledge
- Medische Beeldvorming (bachelor natuurkunde en bachelor medische natuurwetenschappen)
- Introductie medische beeldbewerking (bachelor natuurkunde en balcelor

medische natuurwetenschappen).

Target group
MNS-master & Master Physcics of Life & Health

Advanced Medical Technology

Course code	X_437026 (437026)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. ir. R.M. Verdaasdonk
Examinator	prof. dr. ir. R.M. Verdaasdonk
Teaching staff	prof. dr. ir. R.M. Verdaasdonk
Teaching method(s)	Lecture
Level	400

Course objective
Understanding the physical principles of medical equipment in view of a safe and effective application.

Course content
The course consists of an overview of various medical devices discussing the physical principles and mechanism of action when used with a patient. The understanding of the physics contributes to the safety of the patient and the way the device can be applied most optimally. Particular devices will be discussed like electro-surgery, lasers, ultrasonic knifes, endoscopes, etc. Also recent research and new developments of instruments will be shown.

Form of tuition
Combination of lectures, practical hands-on with medical equipment, short projects of practical and literature research, oral project presentations.

Remarks
Students should also register in advance for this course on Blackboard.

Advanced MRI

Course code	X_428570 ()
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Advanced Spectroscopy

Course code	X_432767 ()

Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. F. Ariese
Examinator	dr. F. Ariese
Teaching staff	dr. F. Ariese
Teaching method(s)	Lecture
Level	500

Course objective
To acquire a deeper insight into the basic principles and modern developments of molecular spectroscopy in (bio)analytical chemistry, with emphasis on fluorescence/luminescence and Raman techniques.
To become familiar with recent literature on the use of these techniques in a variety of applications.
To acquire practical skills in modern (laser) spectroscopy.

Course content
The topics discussed comprise the basic principles of fluorescence/phosphorescence and Raman spectroscopy. Attention will be given to energy transfer mechanisms and the use of fluorescent probes, high-resolution fluorescence at cryogenic temperatures, single-molecule spectroscopy and coupling to analytical separation techniques. Raman spectroscopic topics will include surface-enhanced Raman, resonance Raman, time-resolved Raman and non-linear Raman techniques. Instrumental aspects, such as laser excitation, time-resolved detection, polarization and imaging will also be covered in this course.
Recent examples of the use of these techniques in a chemistry, medical, environmental, industrial, forensic or space research context will be discussed on the basis of literature presentations by the students. The course also includes a set of fluorescence and Raman experiments at VU LaserLaB

Form of tuition
Lectures, tutorials
In small groups the students will carry out a set of experiments, of which the results will be laid down in a report and an oral presentation.
The students will also prepare a presentation on a recent literature article, to be given and discussed in class.

Type of assessment
The final grade will be determined based on
Experiment report (1/6)
Experiment presentation (1/6)
Literature presentation (1/6)
Written exam (3/6)

Course reading
Handouts and literature articles will be provided by the lecturer

Recommended background knowledge
Background knowledge of molecular spectroscopic techniques, in particular fluorescence and Raman, is expected (for instance MSc Chem course (bio)molecular spectroscopy or 3MNW/2N course Microscopy and

Spectroscopy). When in doubt please contact the lecturer.

Target group
MSc Chemistry, MSc Medical Natural Sciences

Analysis of Governmental Policy

Course code	AM_470571 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	M.J. Kishna
Examinator	prof. dr. J.T. de Cock Buning
Teaching staff	prof. dr. J.T. de Cock Buning
Teaching method(s)	Lecture, Study Group, Computer lab
Level	500

Course objective
- To acquire critical knowledge regarding different policy models and theories
- To master the correct use of central concepts in political and policy discourses.
- To further deepen your analytic skills with respect to the critical assessment of a complex societal question or dilemma in the health and life science;
- To learn to integrate science- specific knowledge with the knowledge and skills of other disciplines of the social sciences
- To practice skills in data collection and analysis
- To learn to set up valid lines of argumentation;
- To learn to translate research findings into policy recommendations;
- To get experienced in writing a policy advisory report;
- To improve your communication skills;
- To improve your skills in working effectively in a project team, through team building, team analysis and feedback.

Course content
Governmental policy affects millions of people and is thus object of intensive debate and target of strong societal forces, like political parties, media and interest groups. Being an advisor or policy maker requires a thorough understanding of the dynamics of policy making, as well as from the psychologal side as from the more social structures and their influence on a deliberative democracy.
The course contains several lectures on theoretical concepts and models concerning policy analysis. Furthermore you will be challenged, under supervision, to apply and practice these concepts and models in the project assignment. From the very first day, you will be part of a project team of about ten students. You are confronted with a real policy problem from an external commissioning institution (e. g. a non-governmental organization, a Ministry, an advisory council). Within those 4 weeks you will collect data by literature review and interviews and conduct an interdisciplinary analysis on the basis of which you provide an advice. Specific attention is paid to working in a project team and team building. At the end of the course, you prepare an advisory report. On the last day of the course you present the report to

the representative of the external institution who commissioned the project. In that presentation your team will highlight the main results of your analysis and defend the recommendations you propose.

Form of tuition
Analysis of Governmental Policy is a fulltime course of four weeks (6 ECTS). The most recent course schedule is to be found on Blackboard. Tuition methods include lectures, training workshops, and self-study. The different elements have the following study time:
- lectures: 15 hours
- project and self-study: remaining hours (within the project: 18x 1 hour coach meeting)
- examination: 2 hours

Please note that attendance to the project meetings is compulsory. Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to pass the exam

Type of assessment
Written exam (25%) and individual evaluation based on personal performance in the project team (50%), and assessment of various group products (report and presentation (25%)). All parts have to be passed successfully.

Course reading
Buse, Mays and Walt: "Making Health Policy" McGrawHill/Open University press. (at least 2nd edition 2012).

Recommended background knowledge
The project integrates the learned lessons from the first compulsory MPA courses: Qualitative & Quantitative Methods.\

Target group
Compulsory course within the Masterprogramme Management, Policy Analysis and entrepreneurship for the health and life sciences (MPA) and the Societal differentiation of Health, Life and Natural Sciences Masters programmes.

Remarks
The case is policy analysis and advice, but the exercised methods and skills are equally applicable to strategic marketing advice or evaluation studies. The teams will be coached by workgroup leaders.

Astroparticle Physics

Course code	X_420005 (420005)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/19839

Target group
mPhys

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Beyond the Standard Model

Course code	X_420192 (420192)
Period	Period 5
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
The course description is available on http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/9640

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Biomedical Modelling and Simulation

Course code	X_430112 (430112)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. I.H.M. van Stokkum
Examinator	dr. I.H.M. van Stokkum
Teaching staff	dr. I.H.M. van Stokkum, dr. ir. T.J.C. Faes, dr. J.C. de Munck, prof. dr. G.J.M. Stienen
Teaching method(s)	Lecture, Seminar, Practical, Study Group
Level	400

Course objective
To gain knowledge of the most important theoretical and practical concepts in modelling and simulation of biomedical processes at different scales, ranging from macroscopic organ function, cellular function down to biochemical interactions and signaling pathways within cells.

To gain experience with and to apply MatLab and Mathematica to acquire, analyse and evaluate biomedical signals and to model and simulate biomedical processes.

Course content
This course will start with a general overview the various types of models used to describe biomedical processes by parametric and non-parametric models using linear and non linear (differential) equations. Basic knowledge of vector and matrix calculations and differential equations is required but will be refreshed.

During the course, attention will be paid to viscoelastic models, spectral analysis, compartment models, geometric modelling used in image analysis and models to describe molecular structures and their dynamic behaviour.

Examples will concentrate on cardiovascular function: linear and nonlinear
viscoelastic models of pressure volume relations, compartment models of the interaction between contractile proteins to simulate force and pressure development and a description of an ion pump for instance to import Ca-ions into the cell during an action potential.

The introductory lectures will be combined and followed by practical courses in which, through exercises, experience will be gained of MatLab and Mathematica (4th generation computer languages). Finally students will be offered a choice of 1 out of 5 modelling problems to be solved in small groups, guided by a supervisor. At
the end of the course each group will present and discuss their work with all participants and supervisors of the course.

Form of tuition
Lectures, working groups, assignments.

Type of assessment
Assignments (20%), report and presentation on modelling problem (40%) and written exam (40%).

Course reading
Syllabus.
Book (recommended): Gilat, A., MatLab: An Introduction with Applications, 5th ed, Wiley.

Target group
mCh-SBI, mMNS-MPs, mMNS-PoL, mMNS-MPy, mPhys-PLH, mPhys-SBI

BioSolar Cells

Course code	X_428531 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.P. Dekker
Examinator	dr. J.P. Dekker
Teaching staff	dr. J.P. Dekker, dr. R.N. Frese

Teaching method(s)	Lecture
Level	400

Course objective
To obtain insight in the three main themes of BioSolar Cells (in short research to improve the efficiency of photosynthesis in plants, research to produce biofuel or other products from algae on a semi-industrial scale and research to convert solar energy directly into a fuel in an artificial leaf with very high efficiency), and to perform a literature study on one of the themes from BioSolar Cells.

Course content
BioSolar Cells is a Dutch national research programme with the aim to optimize the photosynthesis process in plants, algae and bacteria, and to develop ‘artificial leaves’ that combine physical and chemical components. The course will start with interactive lectures by experts on each of the three themes from BioSolar Cells. The students will have to read one or two papers before each lecture and formulate research questions, after which the lecturer gives his/her lecture and the questions are discussed. In the second stage of this course, the students choose a research topic, conduct a literature study, prepare a scientific review paper and present their work in a session with all participating students and staff.

Form of tuition
Interactive lectures and literature study.

Type of assessment
Assessment of scientific review article and of a presentation.

Course reading
Scientific papers

Target group
mCh-SES, mPhys, mPhys-SBI, mCh-SBI

Business & Innovation Project

Course code	X_432845 ()
Period	Ac. Year (September)
Credits	24.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.P. Dekker
Examinator	dr. J.P. Dekker
Level	400

Course objective
This project is an alternative for the Science Project (X-422591), but only for those students who have performed a science-based project during their bachelor program, like students with completed chemistry, physics or related bachelors programs.

Course objective is similar to that of the Science Project, but a

science base is not required.

Course content
See Science Project, except that this project is based on business and innovation instead of science.

Type of assessment
Report and presentation

Business Management in Health and Life Sciences

Course code	AM_470584 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. H.J.H.M. Claassen
Examinator	prof. dr. H.J.H.M. Claassen
Teaching staff	prof. dr. H.J.H.M. Claassen
Teaching method(s)	Lecture, Computer lab
Level	500

Course objective
To acquire knowledge and understanding into theory of knowledge valorisation in health and life sciences
To acquire knowledge and insight in how to organise, protect and finance a business in health and life sciences
3To acquire knowledge and understanding into the pharmaceutical industry's business model and business processes
To acquire knowledge and understanding into the challenges that face the pharmaceutical industry
To apply newly acquired knowledge and understanding in writing a business plan
To apply newly acquired knowledge and understanding by solving case examples
To reflect on and critically evaluate the role of the pharmaceutical industry in the healthcare system
To learn to autonomously write a business plan

Course content
As a result of external factors (for example ageing of the population), it is being stated that our healthcare system is under pressure. As a central stakeholder in this healthcare system, the pharmaceutical industry is facing significant challenges the coming years and more than ever, the pharmaceutical industry is challenged to survive. Business Management in the Health and Life Sciences focuses on gaining insight in the pharmaceutical industry, its business model, business processes, challenges, as well as strategies and actions to overcome these challenges.

During the course, prof.dr. Eric Claassen (http://www.falw.vu.nl/en/research/athena-institute/staff/claassen.asp) together with highly experienced guest lecturers from the field will teach theoretical and practical knowledge during lectures and seminars. Tangible subjects that will be discussed during the lectures and

seminars include the pharmaceutical industry's business model and business processes, intellectual property, portfolio management, finance, risk capital, grants and subsidies, team building and people management, different legal entities, fiscal and legal aspects when starting a new company, SWOT analysis in the life sciences and clinical trials.

The newly acquired knowledge is tested via an assignment (during which students will write either a personal career business plan or a 'real' business plan) and a written exam, both counting for 50% of the final grade.

Form of tuition
Lectures:35h
Assignment: 4h
Work on assignment (self study): 40h
Self-study: remaining hours

Type of assessment
Written exam: 50%
Personal Business Plan: 50%
Both have to be passed

Course reading
• Osterwalder, A. & Pigneur, Y. (2009). Business model generation. Self-published.
• Kubr, Marchesi & Ilar (McKinsey & company). (1998). Starting up. Achieving success with professional business planning. McKinsey & Company, Inc. The Netherlands, Amstel 344, 1017 AS Amsterdam.

Target group
Optional course for Master students Management, Policy Analysis and Entrepreneurship in Health and Life Sciences (MPA), Societal differentiation of the Health, Life & Natural Sciences.

Remarks
Guest lecturers/organisations:
• Robert Al, TU Eindhoven
• Tamar Weenen, VU university
• Esther Pronker, VU university
• Patrick de Boer & Jochem Bosschenbroek, Ttopstart BV
• Bart van Weezenbeek
• Bart Bergstein, Forbion Capital partners
• Michael Mellink & Majorie Soeter, Odgersberndtson
• Marga Janse, innovatief LerenLeren BV
• NL Octrooicenrtum
• Price Waterhouse Coopers
• AsjesBisseling Belastingadviseurs
• And others to be announced

Business, Innovation and Value Creation in the Life Science Industry

Course code	X_432723 ()
Period	Period 3
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen

Coordinator	drs. P. van Hoorn
Examinator	drs. P. van Hoorn
Teaching staff	prof. dr. I.J.P. de Esch, drs. P. van Hoorn
Teaching method(s)	Lecture
Level	500

Course objective
Business Innovation and Value Creation in the Life Sciences Industry aims to provide two distinct goals:
a. To provide in depth and comprehensive insight in current business , innovation and entrepreneurship trends, approaches and state-of-the-art practice in the LSI through theory, literature and case analysis.
b. To utilize and apply insights and experiences gained under a. in a personal live entrepreneurship case in which each individual student elects a
case. And develops a business plan according to a set methodology. Essential parts of this process include: building strategy, business modeling, transactional modelling, building a value proposition, leveraging
IP, marketing and commercialization planning.

Course content
The LSI landscape is shown in several ways:
1. Understanding the Pharma Biotech and Health Care sectors and its primary and secondary drivers, including the contributing sciences
2. Understanding relevant business, value chain and innovation models that are common in these industries and sectors
3. Understanding typical product life-cycle dynamics in the Pharma and Biotech and related Health sectors
4. Understanding the relative contribution and position of Genomics, Proteomics and other scientific specialization areas in the future of Health and Life Sciences
5. Understanding current product categories and the future of diagnosis, therapy and prevention
In addition to lectures on the above topics, students will be handed certain texts and articles that illustrate the `State of the Art' in the LSI sector from both a product development as well as from a business development standpoint.
As a result the student will get insight into the business decisions and dynamic that are linked to basic bio-scientific research from inception through to product development and commercialization. The course thus aims to provide a general overview of how life science and business are interwoven in everyday industrial practice.

Two `real-life' cases will be discussed and students will get a group assignment in which the cases will have to be analyzed and certain questions will have to be answered. Each group writes a short analysis and subsequently presents this in front of the whole group. Subsequently, each student will engage in a personal assignment as described above. The outputs will consist of a presentation before the whole group. The aim is to provide as real life a setting as is possible.

Form of tuition
A mix of lectures, guest lectures, Pharma sector casework and related assignments. Individual coaching on the business planning excercise. Outputs include report and oral presentations and a final

written exam.

Type of assessment
In order to receive 6 credits for this course, the following criteria must be met:
- the written exam must be passed with a grade 6 or more (50% of final grade)
- the assignment must be completed with a written document and short presentation before the group (50% of final grade)

Course reading
Selected scientific publications
Harvard Business Cases as posted on blackboard.
New World Drug Development by R Robert M. Rydzewski 2008
Business Model Generation – Osterwalder 2010

Entry requirements
Completed Bachelor SBI or comparible

Target group
M Chem -SBI or M Physics - SBI

Remarks
In case you have any questions about this course, please contact the coordinator at <p.van.hoorn@vu.nl$gt;

Catalysis for sustainable energy

Course code	X_437027 ()
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/20734

Remarks
Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

CERN Research Project

Course code	X_420116 (420116)
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14986

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

CERN Summer Student Lecture Programme

Course code	X_420122 (420122)
Period	Summer period
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14985

Target group
mPhys

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Chemical Biology

Course code	X_432538 (432538)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. R. Leurs
Examinator	prof. dr. R. Leurs
Teaching staff	prof. dr. R. Leurs
Teaching method(s)	Lecture, Computer lab
Level	400

Course objective
To get students acquainted with modern chemical biology techniques to study proteins and the modulation of their function, with a specific emphasis on drug discovery

Course content
In this course emphasis will be given on the interface between Chemistry and Biology. How can one understand biological processes using small molecules? How can one identify small molecules targeting new biochemical pathways, either by using modern biochemical or cellular assays (e.g. SPR, FRET, BRET, High-content & High resolution analysis), or in silico using the wealth of new information from structural biology? How to detect and/or modulate DNA, RNA and protein expression and/or function with chemical probes? These are the questions that are central to this course.

Form of tuition
lectures, tutorial, consultancy sessions and case study/presentation

Type of assessment
Students will work in small groups on an integrated case study. Based on primary literature, background information from Comprehensive Medicinal Chemistry, interaction with “Protein Champions”, students will work on a “Chemical Biology Protein Report” and oral presentation. Finally, there will be a written examination at the end of the course on the various topics presented in the course.

Final grades will be based on results of the case study (35%), case presentation and discussion (15%) and final exam (50%). Each part must at least be satisfactory (mark “6 out of 10” or higher).

Course reading
Selected book chapters from Comprehensive Medicinal Chemistry II, 2007, Elsevier, Editors-in-Chief: John B. Taylor and David J. Triggle (available at VU library as e-book) and primary literature.

Entry requirements
Bachelor Pharmaceutical Sciences, Medical Natural Science, Science, Business and Innovation or Chemistry. Portal course MSc Biomolecular Science or Principles of Pharmaceutical Sciences, Signal Transduction in Health and Disease, or equivalent for mBMS students and students with Bsc SBI of Chemistry.

Target group
mBMS-BC, mCh-SBI (2nd year), mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DDTF,
mDDS-C-var, mDDS-E-var, mDDS-M-var, mPhys-SBI (2nd year)

Registration procedure
Please register as soon as possible online.

Remarks
Presence is obliged at predefined moments of the course (e.g. kick-off meeting, computer practical, presentation session, examination) for finishing the course successfully.

Clinical Development and Clinical Trials

Course code	AM_1180 ()
Period	Period 3
Credits	3.0

Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. H.J.H.M. Claassen
Examinator	prof. dr. H.J.H.M. Claassen
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
- to gain knowledge and insight into the function of clinical trials
- to gain knowledge and insight into the design of clinical trials
- to gain knowledge and insight into the conduct of clinical trials, including the applying rules and regulations (including ICH-GCP)
- to gain knowledge and insight into and reflect on the roles, tasks and responsibilities of the stakeholders involved in clinical trials
- to reflect on the role of golden standard in our healthcare system
- to learn where and how to look up rules and regulations.

Course content
In today's healthcare system, clinical trials have gained the status of golden standard to test the safety and efficacy of newly developed drugs. For new drugs to enter the market, clinical trials must be passed and as a consequence, clinical trial outcomes have major effects on our healthcare system. While our healthcare system currently is under pressure to remain affordable and available to all, at the same time, clinical trial regulations are increasingly tightened and the prominence of clinical trials in our healthcare system is being criticized. For that matter, it is of great importance to learn about and reflect on the role of clinical trials in today's healthcare system.

The Clinical Development & Clinical Trials course will elaborate on the function, design and conduct of clinical trials, as well as the relevant stakeholders involved. The course consists of a theoretical part and an important practical part (e.g. gaining knowledge on clinical trial regulations). Classes include for example: 'Life Cycle of a Clinical Trial', 'Clinical Trial Methodology', 'ICH-GCP Principles', 'The Ethics Committee', 'Safety Considerations in Clinical Trials', 'Quality Control & Quality Assurance', 'Compliance, Misconduct & Fraud'.

The gained knowledge and skills will be evaluated by means of a written exam at the end of the course.

Form of tuition
Lectures: 35 h.
Self study: remaining hours

Type of assessment
Written exam: 100%.

Course reading
Will be announced on Blackboard 1 month before the start of the course.

Target group
Optional course for Master students Management, Policy Analysis and Entrepreneurship in Health and Life Sciences (MPA), Societal differentiation of the Health, Life & Natural Sciences.

Remarks
Guest lecturers/organisations:
• Eric Klaver
• DOCS
• Others to be announced.

Colloquium and graduate thesis

Course code	X_422520 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	600

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder
Only for students who have started the Master Physics on or before September 1, 2012

Colloquium and graduate thesis

Course code	X_422519 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. R.J.C. Spreeuw
Examinator	dr. R.J.C. Spreeuw
Level	600

Course content
A Master Project is supervised by a staff member of VU or UvA. The project spans a full year (60 Credits including Colloquium and Master Thesis). There is a second person involved, preferably from a different research group, who judges the colloquium and the (more general aspects of the) Master Thesis.
See: Master Project Physics (X_422509)

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder
Only for students who have started the Master Physics on or before September 1, 2012

Colloquium and graduate thesis

Course code	X_422536 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	600

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder
Only for students who have started the Master Physics on or before September 1, 2012

Colloquium and graduate thesis

Course code	X_422538 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Course objective
Literature study on a subject decided by the student after approval of the coordinator.

Form of tuition
Zelfstudie - Supervision by group members of the hosting group.

Type of assessment
The exam consists of a written report and an oral presentation.

Course reading
To be found by the student in collaboration with the supervisors.

Target group
mPhys

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder
Only for students who have started the Master Physics on or before September 1, 2012

Communication, Organization and Management

Course code	AM_470572 ()
Period	Period 2

Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	M.J. Kishna
Examinator	M.J. Kishna
Teaching staff	dr. H. Wels, prof. dr. F. Scheele, dr. M.B.M. Zweekhorst
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
To get acquainted with theories on organisational behaviour
To obtain a deeper understanding of communication from the perspective of sharing and influencing results
To acquire knowledge on organisational structures and designs
To get acquainted with important theories on organisational transitions and change management
To acquire insight into different management practices in the health and life sciences sector
To gain insight in leadership and interpersonal behaviour
To obtain insight in methods for motivation and conflict management
To improve communication skills
To practise analytical and advisory skills

Course content
Organisations in the health and life science sector are changing fast, a phenomenon driven by newly emerging technologies and increasing societal complexity. A growing number of students with a beta degree will hold professional and managerial functions in these organisations. During this course students will learn how to be effective performers within these environments, both individually and in teams. This requires an understanding of the macro aspects of organisational behaviour, including designing organisations, managerial skills and ways of strategic thinking. Several speakers conduct lecturers on aspects as motivation, managing interpersonal behaviour, leadership, communication and developing and changing organisations. The speakers explain theories from literature and relate them to their practical experiences. In addition, the students interview managers in health organisations and analyse these interviews using the newly acquired theoretical concepts. Also, practical cases of health care companies will be analysed and discussed, resulting in advisory reports for management. With the other students you discuss your experiences and a coach helps you relate the experiences to theory.

Form of tuition
Lectures: approximately 22 hours
Response lectures: 4 hours
Training workshops 12 hours
Self-study and writing project assignment: remaining hours.

Type of assessment
Written exam (60%;) and assessment of the interviews, case study analysis, and reports (40%). Grades of both parts must at least be 6 or higher.

Course reading

To be announced on Blackboard

Target group
Compulsory course within the Master programme Management, Policy Analysis and Entrepreneurship for the Health and Life Sciences (MPA) and the Societal differentiation of Health, Life and Natural Sciences Masters programmes

Remarks
Attendance to training, workshops, interviews and discussions is indispensable

Computational Methods

Course code	X_420014 (420014)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Teaching staff	dr. H.J. Bulten
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
- Acquaintance with popular numerical methods in physics
- Critical assessment of numerical approaches
- Hands-on experience with the solution of problems in computational physics

Course content
In this course, numerical techniques will be discussed that can be applied to computational problems that cannot be solved analytically. The student should gain understanding of the source of numerical errors and how they can be minimized via the selection and tuning of numerical algorithms. Various topics will be addressed, including integration, Fourier Analysis, Monte Carlo techniques, Eigensystems and evolution of coupled differential equations. During the course routines from the book Numerical Recipes in C++ Press et al. are used. These routines are also available in C and Fortran77. Although a short tutorial is given on coding, compiling and debugging, some prior experience in programming in C++ (or C) is expected and highly recommended..

Form of tuition
Oral presentation and tutoring of pairs of students working on projects.

Type of assessment
Exercises given during the course determine the grade.

Course reading
Press, Teukolsky, Vetterling, and Flannery, Numerical Recipes. The version of this book for the programming language C is available on the web at https://www.fizyka.umk.pl/nrbook/bookcpdf.html .

Target group
mPhys-TP, mPhys-PPAP

Current Sustainable Energy Technologies

Course code	X_422582 ()
Period	Period 3
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.P. Dekker
Examinator	dr. J.P. Dekker
Teaching staff	dr. J.P. Dekker, dr. R.N. Frese
Teaching method(s)	Lecture, Seminar
Level	500

Course objective
To obtain a complete overview of the technical, economic and societal feasibilities of all possible forms of sustainable energy, including relevance and positive and negative effects. The students should be able to explain the basic features of these technologies and should also be able to make quantitative predictions for each of these technologies.

Course content
In week 1, students read all chapters of the book and formulate for each chapter a technological and/or economic/societal question. The question will be accompanied with hypothetical answers or estimations or working hypotheses. Answers must be as quantitative as possible. In week 2, students will present and discuss their questions and hypotheses with their group. Then, participants will be handed specific assignments for further research. In week 3, students will present the results of their further research, and will receive feedback from the other participants in their group. In week 4, students will give their final presentations to all participants of the course and will hand in the final report of their work.

Form of tuition
Introductory lecture in week 1, five discussion meetings in weeks 1, 2 and 3 in groups of about 10 students, final meeting with all participants in week 4 in which students present their most important worked-out question.

Type of assessment
Initial questions, hypothetical answers and participation in the discussion result in 50% of the grade. The final document constitutes also 50% of the grade. All documents will be graded by two independent lecturers, their marks will be averaged. Both parts need to have a mark of 6.0 or higher.

Course reading
David J.C. Mackay (2008) Sustainable energy – without the hot air, available free online at http://www.withouthotair.com

Entry requirements
Basic knowledge of thermodynamics and sustainable energy

Target group
mCh-SBI, mPhys-SBI, mCh-SES, mPhys-SES

Didactiek 1

Course code	O_MLDIDAC_1 ()
Period	Period 1, Period 4
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	C.L. Geraedts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, drs. L.J. van Well-van Grootheest, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Lecture, Study Group
Level	400

Didactiek 2

Course code	O_MLDIDAC_2 ()
Period	Period 2+3, Period 5+6
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	drs. B. Klein
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, drs. L.J. van Well-van Grootheest, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Study Group, Lecture
Level	400

Didactiek 3

Course code	O_MLDIDAC_3 ()
Period	Period 4+5+6
Credits	9.0

Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	drs. K.L. Schaap
Examinator	drs. K.L. Schaap
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, drs. L.J. van Well-van Grootheest, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Lecture, Study Group
Level	400

Disability and Development

Course code	AM_470588 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. R.M.H. Peters
Examinator	dr. R.M.H. Peters
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
• To develop an understanding of disability and the issues faced by people with disabilities
• To develop knowledge and skills for disability research, policy development and management related to disability, rehabilitation and development
• To acquire insight into the epidemiology of disability, with separate attention for important determinants like gender, poverty and HIV/AIDS
• To learn how to use relevant models of disability and the conceptual framework of the International Classification of Functioning, Disability and Health (ICF)
• To understand the importance of human rights in relation to disability and to learn to use the UN Convention for the Rights of Persons with Disabilities for advocacy and other rights-based interventions
• To acquire skills and knowledge in measurement and research methods relevant to disability
• To understand the importance of inter-sectoral collaboration
• To gain insight in participatory approaches

Course content
The Disability and Development (D&D) course focuses on a broad range of issues related to disability and rehabilitation in the context of development. This means that the focus is on people with disabilities in low and middle-income countries. Disability affects an estimated 1

billion people worldwide, the majority of whom live in low and middle-income countries. The large majority are poor and have no access to rehabilitation services; neither are facilities in place to allow them to be included in the mainstream of society.

To date, very few services and programmes are available to address these needs. The realisation that the Millennium Development Goals cannot be met without addressing the needs of people with disability has brought a new impetus to the field of disability and development. Another major recent development was the adoption of the UN Convention on the Rights of Persons with Disabilities in December 2006. It is expected that there will be a substantial increase in demand for training of a large variety of professionals (e.g. researchers, managers, architects, lawyers, health professionals) with formal training and qualifications in the field of disability-inclusive development.

This rapidly increasing interest in disability, as a development and human rights issue, means that this emerging field of study will rapidly gain in importance and should become part of any serious higher education programme in social and development studies and in international public health. The course will cover essential knowledge and skills in this subject.

The 4-week course programme will include the following subjects:
• Disability models and stereotypes,
• Frequencies and distribution of disability,
• Experience of having a disability,
• ICF conceptual framework,
• Disability rights, including the UN Convention on the Rights of Persons with Disabilities,
• Culture and disability,
• Determinants of disability, including stigma and discrimination, poverty, gender and HIV/AIDS,
• Disability-relevant research methods, including examples of disability research
• An introduction to community-based rehabilitation and disability inclusive development.

Form of tuition
Problem-based learning supported by lectures and an article writing assignment.

• Lectures: 36 hours
• Tutorial groups: 18 hours
• Other events: 12 hours
• Self-study: remaining hours

Type of assessment
Participation in tutorial groups: 10%
Take-home examination, submitted electronically: 60%
Scientific article/essay: 30%

For all parts a pass grade (> 5.5) needs to be obtained in order to receive a final mark.

Course reading
See e-reader

Entry requirements
Bachelor-level education; any subject

Target group
The Disability & Development module is an optional course for Master students Management, Policy Analysis and Entrepreneurship in Health and Life Sciences (MPA), International Public Health and Biomedical Sciences; external students from low and middle-income countries are strongly encouraged to apply. We encourage the participation of students with disabilities, especially from low and middle-income countries.

Remarks
For more information contact Ruth Peters (r.m.h.peters@vu.nl)

Dynamics of Biomolecules and Cells

Course code	X_422583 ()
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Teaching staff	dr. J.T.M. Kennis
Teaching method(s)	Lecture
Level	400

Course objective
Life is, by its very definition, a dynamic quantity. In this course an overview is given of dynamic processes that take place in biomolecules, membranes and cells in relation to biological functionality, and the biophysical methods that are applied to study them.

Course content
The significance of small movements to large-scale and slow reorganizations are being discussed as well the experimental techniques employed.
- DNA processing and dynamics (techniques: optical tweezers, AFM, tethered particle motion, magnetic tweezers). DNA structure and stability, DNA/RNA polymerase, DNA architectural proteins, DNA repair.
- Protein dynamics (techniques: ultrafast spectroscopy, Infrared and Raman spectroscopy, single-molecule fluorescence). Photoactive proteins, light-driven enzymes, Motor proteins, optogenetics.
- Membrane dynamics and remodeling (techniques AFM, single molecule, electron microscopy). Photosynthesis, crowding and membrane protein diffusion, Neuroimaging.
-superresolution microscopy

Form of tuition
Lectures, guest lectures, literature essay, oral literature presentation

Type of assessment
- Essay (literature or research proposal)
- Oral literature presentation

- written Exam

Course reading
Notes, handouts and papers.

Entry requirements
BSc. Physics, BSc. Medical Natural Sciences, BSc Chemistry or comparable

Target group
mMNS-PoL, mPhys-LSBP, mPhys-PLH

Educational and Pedagogical Studies I

Course code	O_MLADEPI ()
Period	Period 1+2
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Lecture
Level	500

Educational and Pedagogical Studies II

Course code	O_MLADEPII ()
Period	Period 1+2
Credits	3.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, dr. T. Bosma, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Lecture, Seminar
Level	500

Emergent Energy Materials

Course code	X_428571 ()

Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/1132205

Registration procedure
Registration is required via https://www.sis.uva.nl during the registration term before the start of the semester.

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Energy and Climate Change; Science, Policy and Economics

Course code	X_428568 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/17937

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

English Academic Course

Course code	X_437028 ()
Period	Period 2+3, Period 5+6
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/20616

Target group

mCh, mPhys

Remarks
Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

Entrepreneurship for Physicists

Course code	X_422600 ()
Period	Period 3
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Teaching staff	prof. dr. D. Iannuzzi, prof. dr. E. Masurel, dr. M.W. van Gelderen
Teaching method(s)	Lecture, Seminar
Level	500

Course objective
After the successful completion of this course, the student will, among others:
- Be familiar with an innovation outlook on entrepreneurship;
- Be aware that value-adding opportunities not only contain financial aspects but also social and ecological aspects (sustainable entrepreneurship);
- Have developed insight into, and actual developed, one's own enterprising competencies;
- Have learned about the processes involved in the recognition and exploitation of opportunities, about creating societal value and about the nature and role of networks;
- Have gained the ability to write a feasibility plan on how to bring an innovation to the market;
- Have gained knowledge of different entrepreneurial processes and the importance of valorization of scientific findings and business ideas for a knowledge-based economy.

Course content
Entrepreneurship, defined here as 'creation, discovery and exploitation of value-adding opportunities', is an increasingly important subject for students and professionals, also in the discipline of physics. The growing complexity and accelerating dynamics of the technologies that lie behind life sciences pre-clinical studies, medical treatments, alternative and sustainable energy sources, innovative materials, micro- and nanodevices, and complex research projects in the high energy particle physics and astrophysics sectors often urge professionals to think, act, and communicate in an entrepreneurial way. In this course, students will learn the ropes of this emerging field via three educational pillars:
1) Students will be learning modern theories of entrepreneurship, with focus on the relationship between entrepreneurship and innovation, sustainable entrepreneurship, life cycle of the firm, valorization of knowledge, entrepreneurial competences;

2) They will familiarize with a set of entrepreneurial soft skills, which they will put into practice when they will be asked to approach different stakeholders to further their projects to gain commitments or to obtain important information. For this purpose, the students will receive training in taking action, networking and network utilization, and influence processes;

3) They will be introduced to business planning. For this purpose, the students, supported by guest lecturers and coaching sessions, will write (in small groups) a Business Model Canvas (BMC 3.0) around an innovative idea that they deem interesting for entrance into the market.

All projects and initiatives will of course revolve around innovative ideas emerging from physics research activities.

Entrepreneurship in Health and Life Sc.

Course code	AM_470575 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. E. Masurel
Examinator	prof. dr. E. Masurel
Teaching staff	prof. dr. E. Masurel
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
Students obtain knowledge about and insight in the relevance of entrepreneurship and innovation for their own discipline. Students learn about the processes which are involved in the recognition and exploitation of opportunities, about creating economic and social value and about the nature and role of networks. In addition students gain knowledge of different entrepreneurial processes and the importance of valorisation of (bio)medical findings and business ideas for a knowledge-based economy.
Learning objectives

- Become familiar with an innovation outlook on entrepreneurship.
- Become aware that value-adding opportunities not only contain financial aspects but also social and ecological aspects (sustainable entrepreneurship).
- Gain the ability to write a feasibility plan on how to bring an innovation to the market.
- Obtain knowledge about and insight in the relevance of entrepreneurship and innovation for science disciplines.
- Learn about the processes which are involved in the recognition and exploitation of opportunities, about creating economic and social value and about the nature and role of networks.
- Gain knowledge of different entrepreneurial processes and the importance of valorisation of (bio)medical findings and business ideas for a knowledge-based economy.

Course content
This course consists of two tracks: a theoretical track and a practical track. These two tracks run simultaneously. In the first track you learn about entrepreneurship. Answers are found on questions such as: What is entrepreneurship? What defines an entrepreneur? What are entrepreneurial opportunities? What is the role of innovation in entrepreneurship? What is corporate social responsibility (CSR)? How can we judge the feasibility of entrepreneurial ambitions? Simultaneously you work on an assignment (second track). In the first week of this course you search for an innovation in your own discipline (product, service, process etc). Your choice must be approved by the lecturers. The first part of the assignment consists of a description of the innovation which you have chosen. Subsequently, you make a SWOT-analysis and a network analysis of the innovation. Also a paragraph on CSR aspect should be added. The final part of the assignment is your own feasibility study: how would you valorize the innovation to the market?

Form of tuition
Lectures, personal meetings. Each week scientific lectures are given (on entrepreneurship, SWOT-analysis, innovation, CSR etc). These lectures are both the basis for the exam and for the assignment. Each week the student has a short meeting with his / her supervisor, in order to discuss the progress of his/her assignment.

Schedule and study time
The total study time is 160 hours.
Tuition methods include lectures, consultancies and self-study.
The different elements have the following study time:
- lectures 18 hours
- consultancies 8 hours
- writing feasibility plan 65 hours
- examination 4 hours
- self study remaining hours

Type of assessment
You conduct a written exam and an assignment. Both the exam and the assignment determine 50% of the grade. The exam and the assignment must be of sufficient quality.

Course reading
To be announced on Blackboard

Target group
Optional course for Master students Management, Policy Analysis and Entrepreneurship in Health and Life sciences (MPA), M-differentiation of the Health, Life & Natural Sciences, Biology, Biomedical Sciences.

Remarks
Attendance is compulsory. Prior knowledge: Business Management in Health and Life sciences.

Environmental Chemistry

Course code	X_437004 (437004)
Period	Period 1
Credits	6.0
Language of tuition	English

Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/21184

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Epidemiology

Course code	AM_1179 ()
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. R.M.H. Peters
Examinator	dr. R.M.H. Peters
Teaching method(s)	Lecture, Study Group, Computer lab
Level	500

Course objective
• To gain an understanding of the principles of different study designs
• To gain an understanding of issues concerning measures of disease and association
• To gain an understanding of principles of bias and confounding
• To gain an understanding of the principles of screening and critically appraise its use in public health
• To learn how to calculate and interpret sensitivity, specificity, positive and negative predictive values
• To acquire skills to perform statistical analyses using a database (during the computer-based sessions) and interpret, describe and present the results critically

Course content
This two week course will help you to obtain an understanding of the principles of study designs (cross-sectional, longitudinal, case-control, clinical trails). Issues concerning exposure and disease measurement and exposure-disease relationships will be discussed in detail, and examples will be provided. Together with your colleagues, you will learn how to apply this knowledge first by hand (during the lectures), then to an epidemiologic database (during the computer-based sessions) and how to interpret the results critically.

Form of tuition
• Lectures (12 hours)
• Work groups (12 hours)
• Computer practicum (12 hours)
• Self-study (remaining time)

Type of assessment
• Exam
• Assignment
Both elements need to be passed.

Course reading
To be announced

Target group
Students without a background in epidemiology

Registration procedure
n/a

Remarks
Maximum 25 students

For more information contact Ruth Peters (r.m.h.peters@vu.nl)

Ethics in Biomedical Research

Course code	X_422592 ()
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. J.T. de Cock Buning
Examinator	prof. dr. J.T. de Cock Buning
Teaching staff	prof. dr. J.T. de Cock Buning
Teaching method(s)	Lecture, Seminar, Study Group
Level	400

Course objective
The objectives of this course are:

- To acquire insight in and understanding of the central concepts and theories in applied philosophy and professional ethics,
- To understand the instrumental role of professional codes of conduct, the role of ethical review committees in medical research, ethical aspects of translational research and the challenges of being an ethically responsible researcher;
- To interpret and reflect on relevant key concepts in ethics, including moral dilemmas;
- Being able to have an open and respectful attitude with respect to different value patterns;
- To acquire insights into various methods and analytical tools to identify and analyse ethical dilemmas in order to formulate proper justifications;
- Being able to apply these various methods and analytical tools in the context of medical natural science and to facilitate constructive discussions about ethical aspects.

Course content
Researchers in medical natural sciences generate knowledge and applications that, for example, offer new and improved options for

prevention, diagnosis, treatment and enhancement, which can profoundly change people's lives. It is therefore important that researchers take responsibility for the decisions they make when designing and implementing applications. In this course you will acquire and apply theoretical knowledge and skills to critically analyse complex case studies in order to formulated proper justifications and establish fair decision-making. Relevant case studies in the field of medical natural sciences will be used as illustration. In small work groups, you are encouraged to critically analyse and deal with ethical dilemmas.

Form of tuition
Ethics in Medical Research is a halftime course of four weeks (3 EC). The total study time is 80 hours. The different course elements have the following study time:
Lectures: 9 hours; Work groups: 19 hours; Exam: 2 hours; Self-study: 50 hours.

Attendance to the work group meetings is compulsory. Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

Type of assessment
- Degree of intellectual participation in the workgroups (10%)
- Exam (50%) has to be passed
- written and verbal execution of the moral dialogue: assignment 'position' (20%) and assignment 'middle ground' (20%)

Course reading
Available on Blackboard

Entry requirements
BSc Medical Natural science or equivalent BSc
Research experience

Target group
Students of master Medical Natural Sciences

Registration procedure
VUnet

Remarks
Lectures in English, part of the workgroups are in Dutch when appropriate. All presentations and plenary discussions in English. Attendance to work groups is compulsory.

Ethics in Life Sciences

Course code	AM_470707 ()
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	prof. dr. J.T. de Cock Buning
Examinator	prof. dr. J.T. de Cock Buning
Teaching staff	prof. dr. J.T. de Cock Buning, dr. J.F.H. Kupper

Teaching method(s)	Lecture, Study Group
Level	400

Course objective
To provide a toolbox of ethical instruments to analyze properly moral problems related (to one's own) research in the life sciences
• To acquire conceptual knowledge of the central concepts in applied philosophy and professional ethics
• To challenge an ethical reflection on one owns life science specialization and to open it for an impartial and constructive discussion
• To exercise a team based project to enter prepare and execute a moral dialogue
• To acquire the necessary skills to handle ethical issues in an accountable manner, as a professional academic beyond one's own inclinations and prejudgments

Course content
Researchers in life sciences generate the knowledge that builds the future of our society. Therefore, professional academics should be accountable for their decisions, experimental designs and presentation of results. In this short course, the principles of justification will be illustrated with cases of technology ethics and medical ethics. The way an ethical review committee on animal research works, is simulated by a role play exercise on an actual research protocol. Finally, as a small group training project, an ethical dialogue is prepared and executed together with another team.

Form of tuition
Ethics in the Life Sciences is a fulltime course of four weeks (3 ECTS). The total study time is 80 hours.
The different elements have the following study time:
• Lectures: 13 hours
• Work groups: 17 hours
• Group assignment: 24 hours
• Exam: 2 hour
• Presentation : 4 hours
• Self working (reading in the first week): 20 hours
Please note that attendance to the work group meetings is compulsory. Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

Type of assessment
• Degree of intellectual participation in the workgroups (10%)
• exam (50%) has to be passed
• written and verbal execution of the ethical dialogue (40%)

Course reading
Available on Blackboard

Entry requirements
Bsc Biology, Biomedical Sciences, Psychology with profile Biological Psychology or Neuropsychology

Target group
Compulsory course in all FALW Master programmes, except Health Sciences and Neuro Sciences

Remarks
Lectures in English, part of the workgroups are in Dutch. All presentations and plenary discussions in English.
In order to maximize the experience of differences in values and preferences, and this increase meaningful ethical inquiry we will place you randomly in the workgroups. Placement will be communicated after the introduction lecture.

Fermi Quantum Gases

Course code	X_428514 (428514)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
The course description is available on http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/11045

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Flavour Physics and CP Violation

Course code	X_428539 ()
Period	Period 4
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. R. Fleischer
Examinator	prof. dr. R. Fleischer
Teaching staff	prof. dr. R. Fleischer
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
This course will give a detailed discussion of the quark-flavour sector of the Standard Model and the theoretical framework to describe CP-violating phenomena and rare decays. The students will encounter calculations of specific meson decays and of low-energy effective Hamiltonians, including a discussion of QCD corrections. The main objective is that the students should after the course be in a position to understand the main challenges in quark-flavour physics, should be able to write down the Feynman diagrams for any given meson decay and should be able to calculate general expressions for the corresponding transitions amplitudes and observables.

Course content
Symmetries and their violation play an outstanding role in particle physics. A key example is CP violation, where C and P denote the charge-conjugation and parity transformations, respectively. In the Standard Model, this phenomenon is closely connected with the quark-flavour sector, which is still a big mystery. A particularly interesting laboratory to explore CP violation and ``quark-flavour mixing'' is given by B mesons, which are composed of a heavy b quark and a light anti-quark. After a general introduction and motivation, we shall discuss the quark-flavour sector of the Standard Model, classify B-meson decays, introduce the theoretical tools to deal with them (such as low-energy effective Hamiltonians), investigate the requirements for non-vanishing CP-violating asymmetries, and discuss the most important benchmark decays, which include some of the rarest processes Nature has to offer. We will also confront theory with experiment by addressing the picture emerging from the most recent data of the Large Hadron Collider at CERN.

Form of tuition
To be decided depending on the number of participants.

Type of assessment
Oral or written (depending on the number of participants).

Course reading
See: http://arXiv.org/abs/arXiv:0802.2882

Target group
mPhys-PPAP, mPhys-TP

Registration procedure
Registration for this course via https://vunet.vu.nl

Remarks
Location Nikhef. This course requires elementary familiarity with Particle Physics and Quantum Field Theory.

Forensics with complex liquids

Course code	X_428538 ()
Period	Period 6
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/22375

Registration procedure
Registration is required via https://www.sis.uva.nl during the registration term before the start of the semester.

From Genome to Physiome

Course code	X_420127 (420127)
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14929

Target group
mPhys-PLH

Remarks
Opgave via https://www.sis.uva.nl tot 4 weken voor aanvang van het semester is verplicht

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

UvA coordinator: dr. N.T.P. Bakker

General Relativity

Course code	X_420128 (420128)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/22392

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Gravitational Waves (Selected Topics in Gravitation and Cosmology)

Course code	X_428506 (428506)
Period	Period 5
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten

Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/18230

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Green Chemistry

Course code	X_430557 (430557)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.C. Slootweg
Examinator	dr. J.C. Slootweg
Teaching method(s)	Lecture
Level	400

Course objective
Acquiring knowledge of the general ideas of green chemistry and their importance in the development of sustainable chemical technology.

Course content
Sustainability and green chemistry focuses on 12 principles. Aspects like atom efficiency, chemical waste and manufacturing processes will be highlighted as well as catalysis, solvents, biomass, solar energy, alternative feedstock, energy consumption, and safety, all in the context of chemical sustainability. Important ingredients in the course are student presentations on these topics, and assignments on selected topics.

Form of tuition
Lectures, Group/Individual Assignments and Presentations

Type of assessment
Written/oral examination, assignments

Course reading
Various e-books (VU license) will be used, such as:
-Handbook of Green Chemistry, part 7: Green Synthesis, http://onlinelibrary.wiley.com/book/10.1002/9783527628698/toc
-Green Chemistry and Engineering: A Pathway to Sustainability, http://onlinelibrary.wiley.com/book/10.1002/9781118720011
-Sustainable Industrial Chemistry, http://onlinelibrary.wiley.com/book/10.1002/9783527629114
-Management Principles of Sustainable Industrial Chemistry, http://onlinelibrary.wiley.com/book/10.1002/9783527649488t.

Target group
mCh-SBI, mPhys-SBI, mCh-SES, mPhys-SES

Health, Globalisation and Human Rights

Course code	AM_470818 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	A. van Luijn MSc
Examinator	dr. C.W.M. Dedding
Teaching staff	prof. dr. P. Heutink
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
The student;

- Is able to describe, understand and apply human rights concepts in a global context
- Develops a deeper understanding and A critical attitude towards scientific literature in the field of health, globalization and human rights in order to formulate soundly argued positions
- Is able to create his/her own vision with regard to the socio-cultural dimensions of human rights values in relation to public health
- Is able to apply methods of human rights assessment in relation to innovations in health care
- Demonstrates the ability to write and present according to academic standards

Course content
This course focuses on the human rights issues that are raised around the globe in connection with public health concerns. The course introduces the students to the effects of globalization on health issues, to the relevant UN human rights instruments on health and to the mechanisms to promote and protect these rights. Attention is given to a wide range of human rights topics in which health and well being play a crucial role. Examples are situations of armed conflict, reproductive rights, migration and refugee issues and childrens rights. Within the context of current globalisation processes the importance of local cultural insights into the human rights & public health interaction will be discussed. During the course students will prepare and participate in a simulation on a human rights assessment of innovations in health technology and discuss relevant scientific literature in study groups. In the exam students will show their creative problem-solving skills applying them to human rights dilemmas in public health.

Form of tuition
Contact hours

Lectures: 33 hours
Work groups: 12 hours
Group project, simulation and exam: 11 hours

Self study and preparing: remaining hours

Type of assessment
Group project (10%), Simulation (20%), exam (70%). All parts need to be passed (6.0)

Course reading
To be announced at the start of the first work group/lecture

Target group
Optional course for students in all differentiations of the Masters Health Sciences, Biomedical Sciences and Management, Policy Analysis and Entrepreneurship in Health and Life Sciences.

Remarks
(Guest) Lectures and guest organisations (under reservation):
Cees Hamelink
Christine Dedding (Children and rights)
Fiona Budge (Culture and Health)
Bert Keizer (Elderly Rights)
Els Mons (Rights and disabled persons)
Women on Waves
Doctors without Borders
And more to be announced.

For more information contact Wanda Konijn (w.s.konijn@vu.nl) or Anna van Luijn (a.van.luijn@vu.nl)

Homogeneous Catalysis

Course code	X_435668 (435668)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/15031

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Hydrodynamics

Course code	X_428536 ()
Period	Period 4
Credits	6.0
Language of tuition	English

Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14984

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Innovation in Medical Technology to Improve the Health Care System

Course code	X_430602 ()
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. ir. T.J.C. Faes
Examinator	dr. ir. T.J.C. Faes
Teaching staff	dr. ir. T.J.C. Faes
Teaching method(s)	Lecture, Seminar
Level	500

Course objective
In innovative development of medical devices the Dutch Health Care System is the natural environment where medical devices need to demonstrate their quality. The aim of the course is to acquire knowledge of the Dutch Health Care System from the perspective of medical devices.

Course content
To be successful in innovation of medical devices one needs knowledge of the 1) Dutch Health Care System, 2) use and users of medical devices, 3) standards and legislation for medical devices, 4) measures of quality of medical devices, and 5) best practice in assurance of quality and safety of medical devices.

Form of tuition
Lectures and working groups.

Type of assessment
Short written report & oral presentation on a specific medical device.

Course reading
Reader

Internship Science in Society

Course code	AM_1134 ()
Period	Ac. Year (September)
Credits	30.0

Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. T.J. Schuitmaker-Warnaar
Examinator	dr. T.J. Schuitmaker-Warnaar

Course objective
The aim of the internship as part of the Major Science in Society (societal specialisation) is to apply the competences acquired during the previous courses in a research project in order to ground the knowledge, attitudes and skills of interdisciplinary research. More specifically, the aims of the internships are:
• The student learns to independently conduct scientific research.
• The student is able to independently find scientific information and to evaluate this for the benefit of his or her own research question.
• The student is able to apply scientific methods and knowledge, to answer research questions and to generate evidencebased knowledge.
• The student is able to formulate a research question, to choose, to implement and to evaluate the (appropriate) research method, and to phrase the obtained results in report.
• The student is able to cooperate with researchers of various disciplines.
• The student is able to orally present the research results and to discuss the findings.
• The student obtains a good impression of a potential future field of career.

Course content
The internship is a compulsory part of the one year specialisation as part of the regular master. The duration of the internship is 5 months (30 EC). An internship placement must provide the student with the opportunity to learn how to conduct research under supervision. The onsite supervisor of the internship is linked to an academic or research institution.

Internships can be done at various locations such as the Ministry of Health, Welfare and Sports, the Public Health Inspectorate, the Health Council, medical organizations such as the municipality health service (GGD), consultancies, the (pharmaceutical) industry and several research institutes, such as universities or e.g. the National Institute for Public Health and the Environment (RIVM).

An internship typically has three phases

• In the first phase, you write your research proposal consisting of an introduction, background, theoretical/conceptual framework, research questions and your research methodology.
• In the second phase, you collect your (qualitative and/or quantitative) data.
• In the third phase, you do your final analysis and present your findings both orally and in a report. The presentation seminar is a compulsory part of this third phase.

Form of tuition
Research internship

Type of assessment
Report (55%), Oral presentation (15%), Execution (30%) and Attitude (Pass/fail)

Within six weeks after the start of the master internship, an interim evaluation will take place to assess whether there is a reasonable chance of the placement being brought to a successful completion.

The internship is supervised and assessed by two lecturers. Both lecturers are members of the academic staff at VU University Amsterdam. The onsite supervision can be carried out by a trainee research assistant (AIO), postdoc or researcher.

Entry requirements
To ensure that students do have enough background knowledge, it is required that you have passed the three compulsory courses: ‘Qualitative and Qualitative Research Methods’, ‘Communication Organization and Management’, and ‘Analysis of Governmental Policy’ (grade at least 6).

Target group
Students Major Science in Society

Registration procedure
Internships can only start when the draft research proposal and application and agreement form is approved and signed by the specialization coordinator.

Remarks
The placement may be extended by 6 EC, subject to conditions that can be found in the FALW document "Student placement (internship) and literature regulations". The student must send a request for extension to the Examination Board.

Information on internships is made available on Blackboard.

Laboratory challenge

Course code	X_422601 ()
Period	Period 6
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Teaching staff	prof. dr. D. Iannuzzi
Teaching method(s)	Lecture
Level	400

Course objective
After the successful completion of this course, the student will, among others:
- Better understand the challenges that are common to most experimental research projects;
- Acquire specific hands-on skills;
- Develop themselves in time management, critical scientific

thinking, problem analysis, problem solving, and teamwork in a real scientific research setting.

Course content
Working on an applied physics research assignment is no easy task. It requires deep, yet timely, analysis of the problem, hands-on skills, organization abilities, scientific know-hows, and critical thinking, to name a few. It also entails a good dose of confidence, which is needed to overcome the reverential hesitation in front of expensive delicate instruments and that sense of frustration that mature scientists are so used to live with. All physics students who are considering to continue a career in either academic or industrial research should be given the chance to confront themselves against this not only to nurture their experimental skills but also to understand whether the life of a scientific laboratory is what they wish to dedicate their career to. The goal of "Laboratory challenge" is to give our students this opportunity, providing a setting that, in four weeks, can put them in front of the typical problems of real life experimental research activity.

Form of tuition
Students will be divided into groups, each of which will receive a set of instruments and an experimental question. (For example, they may be given a laser, and optical fiber, a mirror, and a motor, and asked to build and measure the noise of a Fabry-Perot interferometer in quadrature). Each group has three weeks to answer the question, using all the resources they may wish to use. They may ask questions to the teacher, but the teacher may refuse to answer the question if, by doing that, he/she thinks that they would receive a kind of help that, in real life experimental research, none would be able to give them.

Type of assessment
The teacher will be observing their way of working. At the end of the three weeks, the group will prepare a presentation to report their findings. At the end of the presentation, the teacher will give feedback on the four weeks spent together, making clear suggestions on which strengths each student should keep nurturing and which weaknesses need particular attentions.

Target group
Master Physics

Registration procedure
Because this course is new and will require the purchase and the preparation of laboratory equipment, for this year the number of students admitted to the course is limited to maximum 9, who will be chosen on the a "first-come-first-served" base.”

Remarks
TENTATIVE:
1. Type of assessment. Prac (75%), Pres (25%). No compensation possible.
Re-examination:
Prac: students failing this part will be asked to write a detailed report of their work;
Pres: repeat presentation.
2. Form of tuition. Write down (if applicable) the:
- h, Pra
- Number of contact hours per type per student: TBD
- Teachers
D. Iannuzzi (may change or other may add)

Lasers and Quantum Optics

Course code	X_422539 (422539)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Teaching staff	dr. W. Vassen, dr. H.L. Bethlem
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
To provide insight into the theory of light, light-matter interactions and lasers.

Course content
- Classical Optics (Maxwell's equations, diffraction and interference)
- Nonlinear Optics
- First- and second order coherence
- Radiative transitions in atoms, Einstein coefficients, transition rates, width of spectral lines
- Lasers
- Photon statistics, shot noise
- Photon antibunching
- Coherent states
- Photon number states
- Atom-photon interactions; density matrix, Rabi oscillations, Bloch sphere
- Laser cooling and trapping

Form of tuition
Lectures, exercises.

Type of assessment
Written exam.

Course reading
Mark Fox, Quantum Optics (Oxford university Press 2006).

Target group
mMNS-PoL, mPhys-PLH, mCh-MSP

Light-tissue interaction

Course code	X_428572 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture

Level	500

Course objective
After the successful completion of this course, the student will, among others:
- Be familiar with physical foundation of elastic and in-elastic interaction of light with biological materials and with biological material model systems.
- Be familiar with the most prominent dynamic light scattering techniques and their physical background
- Be familiar with state-of-the art measurement technologies and the underlying physics.

Course content
In this course students focus on the physical background of the interaction of light with biological materials and biologic material model systems. The course rests on 3 pillars:
I: Fundaments of light-tissue interaction. Topics include:
- Physical origin of optical contrast in biologic materials; complex refractive index, dispersion relations and Kramers-Kronig equations; complex refractive index of water and blood.
- Absorption and the ‘fate of light in tissue’; Absorption by molecules in dilutions and suspensions; absorption flattening due to packing of hemoglobin in red blood cells; and of red blood cells in vessels.
- -Elastic scattering (Dipole/Rayleigh scattering, Mie scattering); physical properties of discrete random media (DRM) and continuous random media and their consequences for light scattering (structure factor).
- Propagation of light in tissue: Radiative Transport Equation (RTE), the light-Diffusion approximation to the RTE in 1 and 3 dimensions; Monte Carlo methods for simulating light transport.
- Light scattering of small particles in water, light scattering in dilute and turbid media.
II: Dynamic Light scattering: scattering of light from particles in motion. Topics include:
- Dynamic light scattering (DLS) for quantification of dynamics (Brownian motion, Diffusion, flow)
- Diffusing Wave Spectroscopy (DLS in the multiple scattering regime)
- Laser Speckle Contrast Imaging for quantitative blood flow velocity imaging
- Laser Doppler Flowmetry.
III: Specialized topics in Light-tissue interaction: state-of-the art techniques and hot topics in light-tissue interaction. Topics include:
- Vesicle detection, flow cytometry
- Low coherence interferometry (Optical Coherence Tomography, Low Coherence Spectroscopy, Low Coherent Enhanced Backscattering)
- Multiphoton microscopy (multi-photon fluorescence, second harmonic generation).

Type of assessment
written test after pillar 1 and 2, literature assignment after pillar 3.

Target group
mPHY

Literature Study mPhys-PLH

Course code	X_422585 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Management of Sustainable Innovation

Course code	X_432739 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. R.J.A. Klein Woolthuis
Examinator	dr. R.J.A. Klein Woolthuis
Teaching staff	dr. R.J.A. Klein Woolthuis
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
Sustainable innovation is crucial to counter the challenges our societies are facing: energy without CO2 emissions, access to water and food, reliable banks, affordable elderly care, climate resilient cities. All fields require a structural rethink of existing systems, and introduction of new products, services, and structures to make a sustainable future possible.

This course has the objective to:
1. Learn to conceive sustainable business innovations that create shared value: cars without emissions, houses that produce their own energy, technologies that make clean drinking water for the poor.
2. Increase understanding of how companies, public and government are interrelated in making these innovations a success
3. Show the ability to 'connect the dots' between environmental, social and economic challenges and concrete business opportunities.

This last learning goal has to be made explicit in the assignment: Making a business pitch of a sustainable innovation to a professional Dragon's Den.

For the course much use will be made of film and documentaries. The business pitch will also have to be made as a you-tube film. The best pitches will be selected through voting on-line, and presented to the Dragon's Den.

Course content
A paradigm shift is happening at this moment. Where over the past decades firms were focused on creating shareholder value, the creation of ‘shared value’ is now gaining terrain: leading management scholars

like Peter Senge and Michael Porter are describing how companies from Nike to Tesco create value by including all stakeholders in their firm's strategies. New strategies are centered around respect for the environment, employees, and other stakeholders as to create positive self-reinforcing cycles of value creation. This requires fundamentally different management models in which collaboration with a wide array of stakeholders in key.

Sustainability is hence no longer a story of wishful thinking or environmental activists, it is at the core of corporate strategy and decision making. Moreover, growth in sustainable markets as renewable energy, organic food, and e.g. fair trade products is double digit year after year. Sustainability is not a fashion or an attempt of firms to 'look good', empirical evidence suggest that proper sustainability management improves firm performance and creates new entrepreneurial opportunities in rapidly growing markets. One only has to think of the successes of the Body Shop, Ben and Jerry's and Fair Trade coffee and chocolate.

Form of tuition
Thursday week 1-6: Tutorial
Friday week 3,5: Guest lectures
Friday week 2,4: Feedback on assignments
Friday week 6: Dragon's Den for presentation selected Sustainable innovation business pitches.

Sustainable innovation business pitches:
Students write a strategic business plan for a sustainable innovation. Examples could be membranes for water cleaning, solar technologies for developing countries, organic catering services, bicycles for polluted cities in India.

In the assignment students use the literature offered in the course to develop a coherent insight into how they can make this innovation a success. Connecting the dots is key: What are external developments / problems? Which innovation can help solve this? Which stakeholders have a stake in this problem? And how can the interaction between innovation and stakeholders be orchestrated to make the innovation a success?

Type of assessment
The final grade of the course is determined by the assignment and a written exam. To pass the course, students must at least score 5.0 for the assignment and the exam, and score an average of at least 5.5 on average. The assignment (25%) and written exam (75%) determine the end grade

Course reading
Senge, Peter M., Bryan Smith, Nina Kruschwitz, Joe Laur, Sara Schley, 2008, The Necessary Revolution: How Individuals and Organizations Are Working Together to Create a Sustainable World, Doubleday. (or later edition)

Several articles which will be placed on Blackboard.

Recommended background knowledge
Students should have a enthusiastic and entrepreneurial take on sustainability. The course requires the students to work very independently on their business assignment.
This assignment can be seen as a preparation of setting up an own

company after graduation or proposing innovative changes in existing organizations.

Target group
mCh-SBI, mCH-SES, mPhys-SBI, mPhys-SES,
Master students Business Administration of the specializations: Entrepreneurship, Human Resource Management, Information and Knowledge Management, Management Consulting, Strategy and Organization and Transport and Supply Chain Management.

Managing Science and Technology in Society

Course code	AM_470586 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. T.J. Schuitmaker-Warnaar
Examinator	dr. T.J. Schuitmaker-Warnaar
Teaching staff	dr. B.J. Regeer, dr. J.F.H. Kupper, dr. C.W.M. Dedding, dr. T.J. Schuitmaker-Warnaar, prof. dr. J.E.W. Broerse
Teaching method(s)	Lecture, Study Group
Level	600

Course objective
In this course, students:
• acquire knowledge and understanding of philosophical and social science theories on science and technology development.
• gain insight into the mutual shaping of science & technology and society.
• acquire knowledge and understanding of the basic concepts and issues in the field of science and technology studies.
• acquire knowledge and understanding of technological development through Responsible Research and Innovation
• acquire knowledge and understanding of interactive methods for directing and guiding developments in science and technology.
• gain insight into the need for democratization of science and technology.
• learn to recognize and operate the central STS concepts in their own life worlds.
• learn to communicate verbally and in scientific writing about their knowledge and understanding and to critically reflect on that.

Course content
The ‘Managing Science and Technology in Society’ course offers an advanced introduction into the academic field of ‘Science Technology & Society Studies’.
As an MPA student you are trained to operate at the interface of your natural science discipline and society, thereby making a contribution to answering the complex social problems arising in these areas. At the dawn of the 21st century, technology and science have an enormous potential for transforming life on earth. At the same time, the dimensions of our human culture shape the directions in which science and technology develop. The production of scientific knowledge and technological artefacts can solve some of our problems, but at the same

time they give rise to new problems. During this course you will study the interactions of science and technology with society, and the various ways in which they mutually shape one another. These interactions invoke a lot of questions. Should we embrace genetically modified food? How do new human reproductive technologies interfere with the way we deal with sexuality and social responsibilities?
In this course you will get acquainted with a conceptual framework to critically assess these kinds of questions. It aims at understanding the intertwinement of science, technology and society, and the importance of a broad concern with these interactions, in order to shape our future in the way that we want it.

Form of tuition
'Managing Science and Technology in Society' is a fulltime course of four weeks (6 ECTS). The course schedule is available on blackboard. Tuition methods include lectures, work
groups, a group project and self-study.
The different elements have the following study time:

- lectures: 22 hours
- work groups: 12 hours
- group project: 32 hours
- examination (take-home: 14 hours
- self study (including mini-essays): remaining hours

Type of assessment
The examination consists of:
- Mini-essay 1 (20%)
- Mini-essay 2 (20%)
- Final essay (take-home essay exam) (40%)
- SCOB-project (20%)

All parts need to be passed.

Course reading
The literature of this course consists of selected chapters from the book An introduction to science and technology studies, Sergio Sismondo 2010, which can be purchased at the VU book shop. Complementary articles are provided for via blackboard, august 2015.

Target group
Compulsory course within the second year of the Master Management, Policy Analysis and Entrepreneurship for the Health and Life Sciences (MPA)

Remarks
Guest Lecturers:
- Wouter Mensink (SCP, UvA)
- Harro van Lente (UU)
- Steven Flipse (TU Delft, De Proeffabriek)

and others

More information: T.J.Schuitmaker@vu.nl

Master Project Advanced Matter and Energy Physics

Course code	X_422561 (422561)

Period	Ac. Year (September)
Credits	36.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	600

Master Project Advanced Matter and Energy Physics

Course code	X_422562 (422562)
Period	Ac. Year (September)
Credits	42.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	600

Master Project Advanced Matter and Energy Physics

Course code	X_422563 (422563)
Period	Ac. Year (September)
Credits	48.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	600

Master Project Advanced Matter and Energy Physics

Course code	X_422564 (422564)
Period	Ac. Year (September)
Credits	54.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. R.J. Wijngaarden
Level	600

Master Project Advanced Matter and Energy Physics

Course code	X_422565 ()

Period	Ac. Year (September)
Credits	60.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	600

Master Project Particle Physics and Astroparticle Physics

Course code	X_422602 ()
Period	Ac. Year (September)
Credits	60.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	600

Master Project Particle Physics and Astroparticle Physics

Course code	X_422512 ()
Period	Ac. Year (September)
Credits	54.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	600

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012
of eerder
Only for students who have started the Master Physics on or before
September 1, 2012

Master Project Physics of Life and Health

Course code	X_422541 (422541)
Period	Ac. Year (September)
Credits	36.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Master Project Physics of Life and Health

Course code	X_422542 (422542)
Period	Ac. Year (September)
Credits	42.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Master Project Physics of Life and Health

Course code	X_422543 (422543)
Period	Ac. Year (September)
Credits	48.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Master Project Physics of Life and Health

Course code	X_422544 (422544)
Period	Ac. Year (September)
Credits	54.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Master Project Physics of Life and Health

Course code	X_422545 (422545)
Period	Ac. Year (September)
Credits	60.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	600

Master Project Physics of Life and Health

Course code	X_422540 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. S.M. Witte
Examinator	dr. S.M. Witte
Level	600

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012
of eerder
Only for students who have started the Master Physics on or before
September 1, 2012

Master Project Physics: AMEP

Course code	X_422560 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	600

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012
of eerder
Only for students who have started the Master Physics on or before
September 1, 2012

Master Project SfES

Course code	X_422594 ()
Period	Ac. Year (September)
Credits	36.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	600

Master Project SfES

Course code	X_422595 ()

Period	Ac. Year (September)
Credits	42.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	600

Master Project SfES

Course code	X_422596 ()
Period	Ac. Year (September)
Credits	48.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	600

Master Project SfES

Course code	X_422597 ()
Period	Ac. Year (September)
Credits	54.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	600

Master Project SfES

Course code	X_422604 ()
Period	Ac. Year (September)
Credits	60.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	600

Master Project Theoretical Physics

Course code	X_422603 ()

Period	Ac. Year (September)
Credits	60.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. P.J.G. Mulders
Examinator	prof. dr. P.J.G. Mulders
Level	600

Master Project Theoretical Physics

Course code	X_422509 ()
Period	Ac. Year (September)
Credits	54.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. P.J.G. Mulders
Examinator	prof. dr. P.J.G. Mulders
Level	600

Course content
A Master Project is supervised by a staff member of VU or UvA. The project spans a full year (60 Credits including Colloquium and Master Thesis). There is a second person involved, preferably from a different research group, who judges the colloquium and the (more general aspects of the) Master Thesis.

Remarks
Alleen voor studenten die de master Physics begonnen zijn op 01-09-2012 of eerder
Only for students who have started the Master Physics on or before September 1, 2012

Materials for energy and environmental sustainability

Course code	X_432850 ()
Period	Period 4+5
Credits	12.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.P. Dekker
Examinator	dr. J.P. Dekker
Teaching staff	dr. J.P. Dekker
Teaching method(s)	Lecture
Level	500

Course content
This course will help you understand critical relationships between the environment, energy and sustainability. The course will provide comprehensive coverage of each topic, bringing together diverse subject

matter by integrating theory with engaging insights. It includes helpful features to aid understanding, including a historical overview and suggested questions for discussion.

Course reading
Book 'Fundamentals of Materials for Energy and Environmental Sustainability' by D.S. Ginley and D. Cahen (MRS, Cambridgre University Press)

Target group
Master SBI, track Life & Health and Energy & Sustainability

Mathematica for Physicists

Course code	X_428533 ()
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/12391

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Mathematical Methods

Course code	X_420105 (420105)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. F.C. Mac Kintosh
Examinator	prof. dr. F.C. Mac Kintosh
Teaching staff	B.L.G. Bakker
Teaching method(s)	Lecture, Seminar
Level	300

Course objective
Introduction to mathematical techniques that are particularly useful in theoretical physics.

Course content
Calculus of variations; Classical field theories; Greens functions and applications; Linear spaces and orthogonal functions.

Form of tuition
Lectures and working classes.

Type of assessment
Written exam and homework.

Course reading
Mathematics of Classical and Quantum Physics, Byron and Fuller.

Theoretical Mechanics of Particles and Continua, Fetter and Walecka.

Target group
3N, 3WN, mPhys

Remarks
Gezien het accent dat gelegd wordt op praktische vaardigheden is het noodzakelijk regelmatig tijd te besteden aan de vraagstukken.

Mathematical Methods in Theoretical Physics 1

Course code	X_428573 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. P.J.G. Mulders
Examinator	prof. dr. P.J.G. Mulders
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/1132310

Mathematical Methods in Theoretical Physics 2

Course code	X_428574 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. P.J.G. Mulders
Examinator	prof. dr. P.J.G. Mulders
Teaching method(s)	Lecture
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/1132311

Registration procedure
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Remarks

This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.

Minor Project Advanced Matter and Energy Physics

Course code	X_422572 (422572)
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	500

Minor Project Advanced Matter and Energy Physics

Course code	X_422573 (422573)
Period	Ac. Year (September)
Credits	12.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	500

Minor Project Advanced Matter and Energy Physics

Course code	X_422574 (422574)
Period	Ac. Year (September)
Credits	18.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	500

Minor Project Advanced Matter and Energy Physics

Course code	X_422575 (422575)
Period	Ac. Year (September)
Credits	24.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem

Examinator	dr. H.L. Bethlem
Level	500

Minor Project Physics of Life and Health

Course code	X_422548 (422548)
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	500

Minor Project Physics of Life and Health

Course code	X_422549 (422549)
Period	Ac. Year (September)
Credits	12.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	500

Minor Project Physics of Life and Health

Course code	X_422550 (422550)
Period	Ac. Year (September)
Credits	18.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi
Examinator	prof. dr. D. Iannuzzi
Level	500

Minor Project Physics of Life and Health

Course code	X_422551 (422551)
Period	Ac. Year (September)
Credits	24.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. D. Iannuzzi

Examinator	prof. dr. D. Iannuzzi
Level	500

Minor Project Physics: SfES

Course code	X_422605 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	500

Minor Project Physics: SfES

Course code	X_422606 ()
Period	Ac. Year (September)
Credits	12.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	500

Minor Project Physics: SfES

Course code	X_422607 ()
Period	Ac. Year (September)
Credits	18.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis
Examinator	dr. J.T.M. Kennis
Level	500

Minor Project Physics: SfES

Course code	X_422608 ()
Period	Ac. Year (September)
Credits	24.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.T.M. Kennis

Examinator	dr. J.T.M. Kennis
Level	500

Nanophotonics

Course code	X_428537 ()
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/1132211

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Networked Organizations and Communication

Course code	S_NOC ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Sociale Wetenschappen
Coordinator	dr. I.R. Hellsten
Examinator	dr. I.R. Hellsten
Teaching staff	dr. I.R. Hellsten
Teaching method(s)	Lecture, Practical, Study Group
Level	500

Course objective
Students who have completed the seminar will be able to critically approach, interpret, and compare theories and literature on social networks, semantic networks, and networked organizations. They can write a literature review or about the developing field of networked organizations and communication. Moreover, they can carry out a small-scale research project (in groups) using a software tool ORA/Automap to conduct social and semantic network analysis on text documents, and reflect on the results.

Course content
The seminar Networked Organizations and Communication aims at gaining in-depth insight into networks and network analysis. The seminar begins with an introduction to network theory, general terms, and concepts. On the basis of recent network literature, the seminar then focuses on how organizations and organizational members become more connected to each other (e.g., through actor similarity, communication patterns, etc.). A

particular focus will thus be on gaining insights into social and semantic networks and on the software program with which one can analyze and visualize social or semantic networks. This course addresses three aspects of organizational networks: structure, content and meaning.

Form of tuition
Lectures combined with workshops about two different network analysis methods. Active participation in the lectures and method workshops is required.

Type of assessment
Possibly small tests during class, individual literature review, group assignment (research project), and an individual reflection assignment.

Course reading
Series of articles to be announced on Blackboard.

Entry requirements
All students are recommended to study chapters 1, 2, 3, 7, and 10 of Kadushi, C., 2012: Understanding social networks. Oxford University Press: New York.

Recommended background knowledge
All students are recommended to study chapters 1, 2, 3, 7, and 10 of Kadushi, C., 2012: Understanding social networks. Oxford University Press: New York.

Target group
MSc BCO track Strategie en identiteit, exchange students, and students SBI.

NIKHEF Project

Course code	X_420115 (420115)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Teaching method(s)	Lecture
Level	600

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/16784

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Open Innovation in Science and Sustainability

Course code	X_422598 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	drs. P. van Hoorn
Examinator	drs. P. van Hoorn
Teaching staff	drs. P. van Hoorn
Teaching method(s)	Lecture
Level	400

Course objective
In this final course in the Business and Innovation course series across the Bachelor SBI program, the challenges involved in 'Open Innovation' (OI) are the central theme. Classes cover the dominant OI theoretical insights and crucial aspects of OI based on various pieces of literature, relevant book chapters and casework on the subject. Students will gain insight in the emergence, distribution, application and marketing of scientific knowledge in a complex network of stakeholders. Through the case work assignments, teams will learn to apply OI principles and aim to take on inherent OI challenges in transitions that are taking place in both the Energy and Life sciences sectors in society. OI in S is fully taught in English, spoken, written and read.

Course content
1. Theories, trends and practice of OI through literature study which also will be presented and discussed in class. These materials are the subject of a final written exam.
2. Assigments based on actual cases, including Harvard Cases.
In this course two cases will be presented with the purpose of demonstrating the dilemma’s that open innovation practices inevitably lead to. And to subsequently apply the theoretical OI principles to both cases through executing a team assignment.
Case A: Vertex and the CF Foundation have developed a novel drug. The R&D trajectory breaks the mold of the fully-integrated pharma approach to development through aspects like: advocacy group financing of research, end-user driven innovation, ownership position of developers, R&D within a heterogeneous network and last but not least, patient benefit as the primary driver. (two Harvard cases: a: Vertex and b: Bob Beale and the CFF)
Case B: Alliander, an energy supply and network company drives an international network of innovator start-ups collectively playing in the smart grid space. Also here, the setting provides many challenges that test the OI framework.

Form of tuition
Lectures, guest lectures, casework, presentations and reports.
OI in S is fully taught in English e.g. spoken, written and read.

Type of assessment
The final course grade is composed of a grade on casework per team (50%) and individual written exam (50%).
The assignment outputs include a final report and a presentation per team, where individual group member contribution is identified for

grading.

M Phys students will work in tandem with SBI students on assignment execution. M Phys students will work on specific detail questions and assignment components that are aligned with their level of education and training.

Course reading
Selected chapters from :
- Open Innovation, Researching a New Paradigm. By Henry Chesbrough et al. (2008)
- Open Innovation Research Management and Practice by Tidd et al (2014)
- Higgens et al - Vertex Ph and the CFF: Venture Philantropy Funding for Biotech (by Harvard Business School)
- Kaplan et al – Bob Beall at the CFF (2009) (by Harvard Business School).

Entry requirements
Natural sciences courses, including Physics and (Bio)Chemistry (level 100 - 200) as well as basics in Innovation sciences. On a per case basis, additional pre-reading materials are available for students who have a gap in one of the above areas.

Target group
MPhys

Remarks
Should you have any questions about this course or the enrollment requirements, please send an Email to < p.van.hoorn@vu.nl $gt;

Organic Photovoltaics

Course code	X_422590 ()
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. E.L. von Hauff
Examinator	dr. E.L. von Hauff
Teaching staff	dr. E.L. von Hauff
Teaching method(s)	Lecture
Level	400

Course objective
The aim of this course is introduce students to the emerging topic of organic and hybrid photovoltaics. The concepts presented will build on students' previous basic knowledge of physics and chemistry and extend these towards current research questions pertaining to the design and implementation of organic semiconductors in the field of energy conversion.

The course is successful if students gain insight into the physical and chemical principals of energy conversion with emerging materials. The focus will be placed on relevant questions and issues related to photovoltaics, semiconductor material processing and design, and the

role of low cost and non-toxic material systems for future energy applications.

Course content
The course is comprised of three main topics:
• Properties of organic and hybrid/perovskite semiconductors – The optical, electrical and structural properties, as well as fabrication and characterisation techniques will be introduced.
• Photovoltaic energy conversion – photovoltaic energy conversion is based on the absorption of light, the separation and transport of charge carriers, the collection of photocurrent. These processes will be discussed in terms of the material properties.
• Current research questions in emerging photovoltaics – charge carrier separation and transport is a unique problem in organic semiconductors. Defects and structural attributes of perovskite materials. Correlations between material properties and solar cell efficiency will be established.

Form of tuition
Introductory lectures for each module (with homework). Workshop-style student presentations dealing with research articles.

Type of assessment
Student-presentations during the lectures; Reports; Participation

Course reading
Literature (will be assigned during lectures)

Target group
mPhy
mCh
Part of track Science for Energy and Sustainability

Orientation Project

Course code	X_422580 ()
Period	Period 1, Period 2, Period 3, Period 4, Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.L. Bethlem
Examinator	dr. H.L. Bethlem
Level	400

Course objective
Kennismaking met AMEP research en AMEP researchgroepen.

Course content
Een stage van een maand in een vakgroep met een eigen wetenschappelijke opdracht, leidend tot een kort verslag en een presentatie.

Form of tuition
Stage en/of Literatuurstudie

Target group
mPhys-AMEP, 1e masterjaar

Remarks
Het totaal is 6 studiepunten. Studenten kunnen het deels (3 sp) in periode 3 volgen, gevolgd door 3 sp in periode 5, of in zijn geheel (6 sp) in periode 5.

Parameter Estimation Applied to Medical and Biological Sciences

Course code	X_432631 (432631)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.C. de Munck
Examinator	dr. J.C. de Munck
Teaching staff	dr. J.C. de Munck
Teaching method(s)	Lecture
Level	500

Course objective
The course treats the theory of parameter estimation problems in general, but the theory is illustrated extensively by examples from medical and biological sciences and brain imaging (fMRI and MEG/EEG) in particular. Linear and non-linear regression analysis is treated, as well as confidence intervals and significance testing. The goal of the course is to provide insight into the theory of parameter estimation and to develop a critical attitude towards its application and interpretation in order to avoid inconsistent and improper use of the theory.

Course content
Linear-non linear parameter models, basic matrix-vector algebra, maximum likelihood principle, correlated-uncorrelated noise, OLS, GLS, nuisance parameters, linear (time invariant) filters, t-test, F-test, confidence intervals, fMRI data model, missing data, MEG/EEG source localisation. These topics are treated in the form of a series of lectures alternated with exercises.

Extra topics: L1 en L2 norms.

Form of tuition
Lecture.

Type of assessment
Written exam.

Target group
mMNS

Particle Cosmology

Course code	X_420560 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14319

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Particle Detection

Course code	X_420051 (420051)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Teaching method(s)	Lecture
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14975

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Particle Physics I

Course code	X_420052 (420052)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14921

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Particle Physics II

Course code	X_420053 (420053)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14924

Target group
mPhys-PPAP, mPhys-TP

Remarks
Opgave via https://www.sis.uva.nl tot 4 weken voor aanvang van het semester is verplicht

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

Particles and Fields

Course code	X_420112 (420112)
Period	Period 4+5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Teaching method(s)	Lecture
Level	500

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/16717

Target group
mPhys-TP, mPhys-PPAP

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Peergroup 1

Course code	O_MLPEERGR_1 ()
Period	Period 1+2+3, Period 4+5+6
Credits	0.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching method(s)	Study Group
Level	400

Peergroup 2

Course code	O_MLPEERGR_2 ()
Period	Period 3+4+5
Credits	0.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching method(s)	Study Group

Photosynthesis and Energy

Course code	X_422553 (422553)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. I.H.M. van Stokkum
Examinator	dr. I.H.M. van Stokkum
Teaching staff	prof. dr. R. van Grondelle
Teaching method(s)	Lecture
Level	500

Course objective

Introduce the fundamental aspects of photosynthesis and photosynthetic energy conversion.

Course content
Photosynthesis: an overview of the biological processThe relevant structures: pigments, proteins, the photosynthetic membrane Excitation energy transfer and excitons
Disorder Charge separation by the reaction center and electron transfer Charge stabilisation Proton coupled electron transfer The energetics of photosynthesis Arificial photosynthesis

Form of tuition
Lectures, literature study, presentations

Type of assessment
Scriptie plus presentation of subject related to photosynthesis.

Course reading
Blankenship, R.E., Molecular Mechanisms of Photosynthesis. Blackwell 2002.

Target group
mPhys-PLH, mPhys-AMEP, mCH-SES, mPhys-SES

Photovoltaics

Course code	X_428516 (428516)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/18185

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904,
servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Physics of Organs 2: Sensory Organs and Bioelectricity

Course code	X_428528 (428528)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content

http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14928

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Policy, Politics and Participation

Course code	AM_470589 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. R.M. Edelenbosch MSc
Examinator	dr. R.M. Edelenbosch MSc
Teaching staff	dr. B.J. Regeer, dr. J.F.H. Kupper, prof. dr. J.E.W. Broerse
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
To further deepen your analytic skills with respect to the assessment of a specific societal problem;
To acquire further insight into the practice of interactive research;
To acquire further insights into specific methods and techniques of interactive research;
To strengthen the skills to design an interactive research project
To practice skills in data collection and analysis;
To learn to set up valid lines of argumentation;
To improve your communication skills;
To improve your skills in working effectively in a project team, through team building, team analysis and feedback.

Course content
In this course you get the chance to gain experience in the practical implementation of methodologies for interactive research. In a four week policy project you will both improve your focus group research skills and deepen your understanding of the relevant theoretical concepts in the areas of policy studies, science and technology studies and democracy theory. In a group of about ten students you will participate in a real interactive research project which is executed at the Athena institute. In this project you will be trained in and practice various skills for data collection (such as focus group design and facilitation) and data analysis (such as qualitative content analysis).
Specific attention is paid to your personal interactive research skills.
At the end of the course, you prepare a policy report to present your findings. In an oral presentation your team will highlight the main results of your analysis and defend the recommendations you propose.

Form of tuition
Lectures: 14 hours
Training workshops: 4 hours
Project assignment: 102 hours

focus group execution: 6 hours
Final presentations project results: 4 hours
Self study: remaining hours

Type of assessment
The course does not have an oral or written exam. You will be assessed on the basis of the group assignment, a group presentation and on your individual performance during the course (in the work groups, your facilitation skills in the 'real' focus groups). For all parts a pass grade (> 5.5) needs to be obtained in order to receive a final mark.

Your final mark will be based on: the group report (40%): oral presentation per group(40%): individual performance (20%).

Course reading
To be announced on Blackboard

Entry requirements
Basic knowledge of (interactive) policy processes, policy analysis and relevant research skills are required.

Target group
Optional course for Master students Management, Policy Analysis and Entrepreneurship in Health and Life sciences (MPA), Societal differentiation of the Health, Life & Natural Sciences.

Registration procedure
Registration deadline by VUnet is 4 weeks before the start of the course.

Remarks
As the project depends on team work, attendance is compulsory.

Praktijk 1

Course code	O_MLPRAK_1 ()
Period	Period 1, Period 4
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. L.J. van Well-van Grootheest, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Study Group
Level	400

Praktijk 2

Course code	O_MLPRAK_2 ()
Period	Period 2+3, Period 5+6
Credits	9.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Study Group
Level	400

Praktijk 3

Course code	O_MLPRAK_3 ()
Period	Period 4+5+6
Credits	15.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Level	400

Praktijk onderzoek 1

Course code	O_MLPROZ_1 ()
Period	Period 3, Period 6
Credits	3.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. H.B. Westbroek
Examinator	dr. H.B. Westbroek

Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, prof. dr. M. Meeter, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, drs. L.J. van Well-van Grootheest, dr. T. Bosma, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, dr. J.M.H. Swennen, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Study Group, Lecture
Level	400

Praktijk onderzoek 2

Course code	O_MLPROZ_2 ()
Period	Period 4+5+6
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. H.B. Westbroek
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, ir. E.J.F. Scheringa, prof. dr. M. Meeter, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. B. Klein, drs. W. Jongejan, drs. L.J. van Well-van Grootheest, dr. T. Bosma, dr. H.B. Westbroek, C.L. Geraedts, dr. J.M.H. Swennen, dr. A.A. Kaal, dr. A. Handelzalts, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw
Teaching method(s)	Lecture, Seminar
Level	400

Principles of Pharmaceutical Sciences / Pharmacochemistry

Course code	X_435675 (435675)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. I.J.P. de Esch
Examinator	prof. dr. I.J.P. de Esch
Teaching staff	prof. dr. I.J.P. de Esch
Teaching method(s)	Lecture
Level	400

Course objective
General introduction into and deepening of knowledge of concepts, mechanisms and recent developments in pharmaceutical sciences and the pharmaceutical and biotech industry.

Course content
This course is designed for students with an interest in life sciences and the biotech/pharmaceutical industry but without prior education in this field. A general introduction will be given to the process of drug discovery, drug design and synthesis, drug development and drug safety assessment. Subsequently, potential drug targets, mechanisms of drug actions (including drug-receptor/enzyme Using various drug classes, relationships between chemical structures and biological activities will be derived and illustrated. Finally, various modern developments and tools will be illustrated by recent applications in the field of drug research, medicinal chemistry and toxicology.

Form of tuition
Lectures and tutorials.

Type of assessment
Written examination

Course reading
Patrick, G., An Introduction to Medicinal Chemistry 5th ed.
Oxford: Oxford University Press. 2009, ISBN: 978-0-19-969739-7

Target group
3S, 3MNW, mCh, mPhys.
The course is optional for mDDS students that did not follow the VU University BSc Pharmaceutical sciences and these mDDS students should contact the mDDS coordinator before enrolling.
The course is recommended for SBI (life) mastertrack students, except for students with an bachelor in SBI or pharmaceutical sciences.

Programming C++

Course code	X_420141 (420141)
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. H.J. Bulten
Examinator	dr. H.J. Bulten
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14987

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Project Sustainable Future

Course code	X_432784 ()

Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.C. Slootweg
Examinator	dr. J.C. Slootweg
Teaching method(s)	Lecture, Seminar
Level	500

Course content
Human civilization finds itself at a pivotal point in history. As a result of the growing world population as well as extensive industrial and societal developments that have taken place over the last 150 years, humanity has exploited earth's natural resources up to a point that further developing or even maintaining current levels of prosperity cannot be sustained. In addition, it has become very clear that current fossil fuel based energy technologies have a dramatic adverse effect on the global climate. These issues becomes even more urgent when considering the anticipated elevated prosperity levels in the developing world.

These developments lie at the basis of the concept of 'sustainability': the future has to be radically different from past and present in the sense that human activities must be carried out in such a way that they can be sustained for many generations. To achieve this, many aspects of human activity have to be changed: different technologies for energy production and resource utilization will have to be developed. Choices will have to be made as of which of these new technologies are considered most favorable for society. Such technologies will have to be implemented at large scale, which requires involvement of decisive societal forces, such as governments, markets, producers and consumers. Only if clear, rational and appealing visions are developed can such societal forces be activated and the required changes be realized.

In this course, we will consider a number of acute sustainability themes that humanity faces today. The students' mission of this course will be to define under which conditions new technologies can make a meaningful contribution to a sustainable future of our society in a specific case study. The project will be divided in 4 discrete steps:
1. We will analyze the scientific basis of the issue under consideration. We will analyze the potential, but also the limitations of each technology.
2. We will analyze what 'sustainability' actually means. The term is often used in a loose and informal way. But 'sustainability' only becomes meaningful when it is made quantitative! We will apply these concepts to the chosen theme, and define the conditions that are required to make the new technologies deserve the label 'sustainable'.
3. To assess and potentially quantify the uncertainties and risks with regard to the different technology solutions, how these could affect society now and in the future (through applying scenario planning techniques).
4. We will integrate the knowledge and insights obtained from the above three approaches, to understand how they are interconnected and how they influence one another.

Form of tuition
lectures, guest lectures, werkcolleges, group work, self study

Type of assessment
written exam
project report
presentation of project report
literature exercise

Target group
mCh-SES, mPhys-SES

Protein Science

Course code	AM_470145 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. D. Bald
Examinator	dr. D. Bald
Teaching staff	dr. M.H. Siderius, prof. dr. ir. E.J.G. Peterman, dr. J.N.M. Commandeur, dr. D. Bald, prof. dr. M.J. Smit
Teaching method(s)	Lecture, Study Group
Level	400

Course objective
The student:
1. knows and understands principles of protein structure,, dynamics, regulation, inhibition, interaction and engineering
2. can explain protein function based on protein structure and the proprties of amino acid residues.
3. can predict the function of (parts of) a protein based on undestanding of its molecular properties
4. knows and understands the principle of current methods for protein investigation (e.g. overproduction, purification, interaction, engineering)
5. can analyze the strong and weak points of Protein Science techniques and can correlate an open question with a suitable technique.
6. can analyze experiments in Protein Science and design new experiments.

Course content
We will start with a repetition of protein structure and function. Subsequently, we will focus on methods in protein science and also on more specialized properties of proteins important in fundamental research, biomedicine or biotechnology. Finally we will deal with case studies on selected proteins.
Lecture topics include:
Protein Structure, Protein Function, Protein Dynamics, Molecular Machines, Control of Protein Function, Protein inhibition, Antibiotic action, Development of antibiotics and antibiotic resistance, Protein over-expression and purification, Protein Interaction, Protein Engineering,
Molecular Modeling and docking

Case studies:
GPCRs as drug target, Cytochrome P450, Chaperones as Protein folding machines,
Molecular Modeling/docking.

Form of tuition
Lectures (30 h) accompanied by work (paper) discussions (6 h) and self study
(individual or in small groups) to prepare for the lectures and to discuss the material presented in lectures/accompanying papers.

Type of assessment
Written exam (100%)

Course reading
No special book required. Useful may be "Protein Structure and Function" by Petsko/Ringe. You can also use any Biochemistry textbook (e.g. Voet and Voet) for repetition. You will receive material (reviews and original articles on relevant topics). Examples of scientific literature: Lee et al. Nature 2010, Bax et al. Nature 2010, and Kumar Exp. Opin. Drug Metab 2010.

Target group
Masters students Biomolecular Sciences, Biomedical Sciences, Biology, Pharmaceutical Sciences and Medical Natural Sciences

Remarks
Visiting lecturer: Dr. Anil Koul, Tibotec J&J

Quantum Field Theory

Course code	X_420081 (420081)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching staff	prof. dr. P.J.G. Mulders
Teaching method(s)	Lecture
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/15658

Recommended background knowledge
Advanced Quantum Mechanics (VU) or Quantum 3 (UvA).

Target group
mPhys-PPAP, mPhys-TP

Quantum Field Theory - Extension

Course code	X_422554 (422554)
Period	Period 3
Credits	3.0

Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching staff	prof. dr. P.J.G. Mulders
Teaching method(s)	Lecture
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/15658

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Quantum optics

Course code	X_428535 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/15643

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Reflective Practice Internship Science Communication

Course code	AM_1163 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.F.H. Kupper
Level	600

Course objective
The internship is a compulsory part of the Master's programme. The aims of the internship are:
• Learn to independently apply and expand your practical science communication skills in one particular area of the field (writing, multi-media, facilitation, policy and strategy development, content design, etc.).

• Critical self-assessment and reflection on acquired science communication competencies in the field.
• Conduct scientific research independently: assess scientific information, design a research project, apply scientific methods, collect data, report and discuss findings.
• Present and discuss about internship and research outcomes.
• Learn to cooperate with researchers and practitioners of various disciplines.
• Gain an impression of a potential future field of career.

Course content
When you are enrolled in the VU Science Communication specialization or the UvA Major Science Communication you need to conduct one internship (30 ECTS, 5 months). One of the two possible formats is the Reflective Practice Internship (RPI). The complete and up-to-date information about the internship can be found in the SC internship guide line on blackboard (science communication community).

Form of tuition
Work-based placement

Type of assessment
Written report and oral presentation.
Within six weeks after the start of the master internship, an interim evaluation will take place to assess whether there is a reasonable chance of the placement being brought to a successful completion.
The internship is supervised and assessed by two lecturers. Both lecturers are members of the academic staff at VU University Amsterdam. The day-to-day supervision can be carried out by a trainee research assistant (AIO), postdoc or researcher.

Target group
Students MSc Earth science year 2

Remarks
Participation in this compulsory component is only permitted if the student meets the relevant requirements for admission. These requirements are detailed in the Internship guidelines of Earth science (on
Blackboard) and in the Academic and Examination Regulations.
The work-based placement is subject to the FALW document: “Student placement (internship) and literature regulations”. These regulations require detailed written agreements between supervisors and student that specify the conditions for the Master research project. This agreement should be sent for approval by the science communication co-ordinator at least two weeks before the planned start of the work-based placement.
If the proposal is of sufficient quality, you can start your internship.
If not, you’ll need to adapt your proposal and send it for approval again. You can only start your internship after your research design has been approved.
The placement may be extended by 6 EC, subject to conditions that can be found in the FALW document “Student placement (internship) and literature regulations”. The student must send a request for extension to the Earth science Examination Board.
Information on Master internships is made available on Blackboard.

Research I

Course code	O_MLVPOOI ()
Period	Period 1+2+3
Credits	3.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, drs. I. Pauw, drs. W.S. Hoekstra, drs. C.D.P. van Oeveren, drs. S. Donszelmann, drs. W. Jongejan, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, prof. dr. J.J. Beishuizen, dr. A.A. Kaal, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart
Teaching method(s)	Lecture, Seminar
Level	500

Research II

Course code	O_MLVPOOII ()
Period	Period 1+2+3
Credits	6.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. H.B. Westbroek
Examinator	dr. H.B. Westbroek
Teaching staff	drs. W. Jongejan, dr. T. Bosma, dr. H.B. Westbroek, dr. A.A. Kaal, dr. A. Handelzalts, W. Maas
Teaching method(s)	Lecture, Seminar
Level	500

Research Internship Science Communication

Course code	AM_1162 ()
Period	Ac. Year (September)
Credits	30.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.F.H. Kupper
Level	600

Course objective
The internship is a compulsory part of the Master's programme. The aims of the internship are:
• Learn to independently apply and expand your practical science communication skills in one particular area of the field (writing, multi-media, facilitation, policy and strategy development, content design, etc.).
• Critical self-assessment and reflection on acquired science communication competencies in the field.

• Conduct scientific research independently: assess scientific information, design a research project, apply scientific methods, collect data, report and discuss findings.
• Present and discuss about internship and research outcomes.
• Learn to cooperate with researchers and practitioners of various disciplines.
• Gain an impression of a potential future field of career.

Course content
When you are enrolled in the VU Science Communication specialization or the UvA Major Science Communication you need to conduct one internship (30 ECTS, 5 months). One of the two possible formats is the full Research Internship. The complete and up-to-date information about the internship can be found in the SC internship guide line on blackboard (science communication community).

Form of tuition
Work-baed placement

Type of assessment
Written report and oral presentation.
Within six weeks after the start of the master internship, an interim evaluation will take place to assess whether there is a reasonable chance of the placement being brought to a successful completion.
The internship is supervised and assessed by two lecturers. Both lecturers are members of the academic staff at VU University Amsterdam. The day-to-day supervision can be carried out by a trainee research assistant (AIO), postdoc or researcher.

Target group
Students Earth science year 2

Remarks
Participation in this compulsory component is only permitted if the student meets the relevant requirements for admission. These requirements are detailed in the Internship guideline of science communication (on
Blackboard) and in the Academic and Examination Regulations.
The work-based placement is subject to the FALW document: “Student placement (internship) and literature regulations”. These regulations require detailed written agreements between supervisors and student that specify the conditions for the Master research project. This agreement should be sent for approval by the science communication internship or master co-ordinator
at least two weeks before the planned start of the work-based placement.
If the proposal is of sufficient quality, you can start your internship.
If not, you’ll need to adapt your proposal and send it for approval again. You can only start your internship after your research design has been approved.
The placement may be extended by 6 EC, subject to conditions that can be found in the FALW document “Student placement (internship) and literature regulations”. The student must send a request for extension to the earth science Examination Board.
Information on Master internships is made available on Blackboard.

Research methods for analyzing complex problems

Course code	AM_1182 ()

Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. M.E. Arentshorst MSc
Examinator	dr. M.E. Arentshorst MSc
Teaching method(s)	Lecture, Seminar, Computer lab
Level	400

Course objective
The objectives of this course are:

- To understand the differences between beta- and gamma research;
- To acquire insight in and understanding of a real world research process, including knowledge of the character of complex societal issues and the needs, advantages and disadvantages of real world research;
- To acquire insight into various quantitative and qualitative research methods, their underlying theoretical concepts and their relative strengths and weaknesses;
- Being able to apply these various quantitative and qualitative research methods in a specific societal context;
- To interpret quantitative and qualitative findings;
- Being able to create an adequate research design for the investigation of a specific complex societal problem.

Course content
Contemporary societies increasingly face complex social problems, such as climate change, HIV/ AIDS or ethnic and religious diversity. These complex problems involve a variety of social actors: policy-makers, professionals, NGOs, industries, science and, of course, the public at large. Addressing these complex issues demands an approach that investigates, analyzes and integrates the positions and knowledge of different actors.

This course offers an (advanced) introduction to various research methods used in real world research, including questionnaires, systematic observations, surveys and statistics, semi-structured interviews, and focus groups. These methods are commonly used in research into complex problem contexts, communication and opportunities for intervention. Strengths and weaknesses of each research method and technique will be discussed, as well as its possibility to be applied in different societal contexts.

Form of tuition
Research Methods for Analyzing Complex Problems is a fulltime course of four weeks (6 ECTS). The total study time is 160 hours. Tuition methods include lectures, workgroups, workshops, group project work and self-study.

The different elements have the following study time:
- lectures 20 hours
- workgroups and training 36 hours
- examination 3 hours
- project work & reading (self-study) Remaining hours

Please note that attendance to the workgroup sessions is compulsory. If you miss one workgroup, with a good reason, you will receive an additional assignment. If you miss more than one workgroup session it is no longer possible to pass the project part of the course.

Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

Type of assessment
The course grade is based on the group assignment 'study design' and the exam. Both aspects need to be graded 6.0 or higher.

Exam 50% of total grade
Group assignment 'study Design' 50% of total grade

Course reading
The literature of this course consists of selected scientific articles that are provided on blackboard, and the books:
- Verschuren, D.E. and Doorewaard, H. (2010). Designing a Research Project
(2nd edition)Eleven International Publishing, the Hague. ISBN 978-90-5931-572-3.
- Gray, D.E. (2014) Doing Research in the Real World (3rd edition)Sage Publications Ltd, United Kingdom. ISBN 978-1-4462-6019-7

An overview of the literature per lecture will be provided on blackboard.

Target group
The course ‘Research Methods for Analyzing Complex Problems’ is a compulsory course for first year master students ‘Management, Policy Analysis and Entrepreneurship in Health and Life Sciences’. This course is also a compulsory course within the Science communication- and Societal differentiations of Health, Life and Natural Sciences Master programmes. It is an optional course for other Life Sciences Master program students at the VU University.

Registration procedure
VUnet

Remarks
Lectures are in English, part of the workgroups are in Dutch. The assignments are written in English.

Please note that attendance to the workgroup sessions is compulsory. If you miss one workgroup, with a good reason, you will receive an additional assignment. If you miss more than one workgroup session it is no longer possible to pass the project part of the course.

Attendance to the lectures is highly recommended. In our experience, relying on self-study alone is insufficient to apply the theory of the lectures in the assignments of the workgroups, and to pass the exam.

course coordinator: Marlous Arentshorst - m.e.arentshorst@vu.nl

Researching science research

Course code	X_432849 ()
Period	Period 4+5
Credits	12.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. ir. B.A.G. Bossink
Examinator	prof. dr. ir. B.A.G. Bossink
Teaching staff	prof. dr. ir. B.A.G. Bossink
Teaching method(s)	Seminar
Level	500

Course objective
To study strategy, structure, culture and the environment of a lab research group or R&D group in practice. Students learn how a lab research group or R&D group in life & health practice or energy & sustainability practice functions, on a daily basis, on a yearly basis, related to other commercial functions in its direct environment, and related to the strategy of the organization in which it is situated.

Course content
Road mapping-assignment to study strategy, structure, culture and environment of a lab research group or R&D group in life & health practice or energy & sustainability practice.
- Students learn to develop a case study research plan that enables them to study a lab or R&D group in practice
- Students learn to carry out the planned case study research steps
- Students develop an report in which they describe and discuss strategy, structure, culture of a lab research or R&D group in practice
- Students learn to orally present and discuss their finding with a student-audience.

Form of tuition
- Weekly interactive assignment sessions;
- Plenary presentation sessions;

Type of assessment
Students work on an assignment and write a report on the functioning of a lab group or R&D group they studied by means of a case study research method. The assignment is related to 12 EC of the track courses a student has chosen in his/her personal education plan. To pass a weighted average of 5.5 or higher should be scored for the assignment (60%) and presentations (40%).

Course reading
To be announced on blackboard.

Entry requirements
12 EC of science courses

Target group
Master SBI, track Life & Health and Energy & Sustainability

SBI Project & Master Thesis

Course code	X_432735 ()
Period	Ac. Year (September)
Credits	36.0
Language of tuition	Dutch
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. ir. B.A.G. Bossink
Examinator	prof. dr. ir. B.A.G. Bossink
Teaching method(s)	Lecture
Level	600

Course objective
The aim of the Master project is that the individual student learns to conduct a comprehensive SBI research project.

Course content
Further deepening and application of knowledge and skills that are obtained during the bachelor and master program. The project starts with developing a project plan. The plan consists of: literature study, research questions, research methods and techniques, time schedule and research goals. The project starts when the plan is approved by the supervisors from VU University and the supervisor from the organization in which the student conducts the research project. The research project lasts for five to six months, and is centered around a SBI-related problem that is acknowledged by the student and the supervisors. The student produces two deliverables:
a. A thesis, consisting of scientific research design, results, discussion, and conclusions.
b. A report describing the organization in which the project is conducted.

Form of tuition
For further information see Manual Master project SBI (Blackboard). Student will spend most of his/her time on conducting the research project and writing the thesis. Additionally, some time will also be spent on contributing to practical work in the organization that enables the research project. Internship, thesis, final presentation

Type of assessment
Work execution: 40%
Aptitude test (the thesis): 45%
Final oral presentation: 15%

Course reading
Verschuren, P., Doorewaard, H. (most recent edition) Designing a research project. The Hague: Eleven International Publishing.

Other literature as described in the plan of action.

Entry requirements
Up-to-date PEP signed by the master coordinator and the examination board. Maximum of 12 EC open, master project excluded, at the start of the internship.

Target group
2 M SBI

Remarks
A mandatory part of the Master project is the writing of a reflection report. This reflection consists of two parts: a business analysis and self-reflection. The student has to write the report when the internship is (almost) completed.

SBI Research Methodology

Course code	X_432846 ()
Period	Ac. Year (September)
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. P.C. van der Sijde
Examinator	dr. P.C. van der Sijde
Teaching method(s)	Lecture
Level	500

Course objective
The objective of the course is to learn about the different methodological traditions in science. SBI is a multidisciplinary study in which (natural) sciences, social and business studies are combined. Each with its own pedigree. The students learn about the similarities and differences and how to cope with methodological issues in their research projects.

Course content
The students are introduced to the different methodological traditions (- natural - sciences, social and business studies) and learn about what it means to do research. Students learn to analyze articles, formulate research question, qualitative and quantitative research, setting up research and analyzing data.

Form of tuition
The course has two parts:
Part 1 - classes and workgroups. theory is introduced in the classes and via assignment elaborated in work groups.
Part 2 - the students coach Bachelorstudents in writing their Plan of Action for the Bachelorthesis.

Type of assessment
1. Exam (30%)
2. Research plan for a project (50%)
3. Reflection report of the coaching of Bachelor students (20%)

Course reading
Bhattachjee, A. (2012) Social science research. (Available via Internet)
Selected articles to be announced

Target group
SBI students preparing for their thesisproject

Registration procedure

via the normal procedures

Science and Communication

Course code	AM_470587 ()
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	P. Klaassen MA
Examinator	P. Klaassen MA
Teaching staff	dr. B.J. Regeer, dr. J.F.H. Kupper, drs. ir. M.G. van der Meij, P. Klaassen MA
Teaching method(s)	Lecture, Study Group
Level	500

Course objective
- Gain theoretical insight in the relationship between science and society,
- Gain insight in the role of science communication in this relationship,
- Acquire knowledge of different theories and models of science communication,
- Acquire knowledge of different strategies, media and activities for science communication,
- Learn how to apply theoretical concepts to real-life examples,
- Development of practical skills for science communication (e.g. writing, discussing).

Course content
Science is all around us and shapes our lives in many different ways. From the vaccines you need for travelling abroad, to the technological devices you use on a daily basis. At the same time, society shapes the development of science and technology. Science and society influence each other continuously; they communicate. Students of Science Communication are expected to become experts in understanding and designing interaction between science and society. In order for this interaction to be fruitful and valuable for both science and society, it is important to gain in-depth knowledge about the theoretical basis of the field of science communication and understand communication processes at the core of several interfaces; e.g. the communication between scientists from different disciplines, between different sciences and their stakeholders, and between science and the public. This course provides a broad basis in the field of science communication by addressing the main areas of science communication and by discussing and challenging several core concepts within this field. Students are invited to explore some issues in greater depth and active participation in lectures and workgroups is required.

Form of tuition
Lectures (22 h)
Workgroups (18 h)
Home-study for group assignments (8 h)
Home-study for individual assignments/exam (90h)

Type of assessment
Individual assignments (30%), group assignment (10%), examination (60%).
For all parts a pass grade needs to be obtained.

Course reading
Academic articles. Direct links to articles will be provided on BlackBoard one month before the beginning of the course.

Target group
The course Science and Communication is a compulsory course for students of the Master specialisation Science Communication (Wetenschapscommunicatie) and is a prerequisite for the internship. Science and Communication is an optional course for students from other master programs in the health and life sciences.

Science and Society in Historical Perspective

Course code	X_400424 (400424)
Period	Period 4+5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. D.J. Beckers
Examinator	dr. D.J. Beckers
Teaching staff	dr. D.J. Beckers
Teaching method(s)	Lecture, Seminar
Level	400

Course objective
To increase understanding of the various interactions between mathematics, chemistry, physics, (medical) biology, computer and earth sciences (in general: science) and society during the last two centuries.

Course content
In the last two centuries science has become one of the prime agents in the shaping of modern society. In turn social and political concerns have been equally instrumental in the shaping of the modern scientific enterprise. In this course we will study the changing relationship between science and society in this period in various case studies and from several points of view. We will use literature and source material, most notably (journal and film) advertisements, and the cartoon journal Punch to illustrate these cases. The following themes are addressed: professionalization, science and the public (e.g. the public understanding and appreciation of science); Science as product and agent of modernity (e.g. quantification and standardization as applied to nature and society); Science and politics (e.g. science policies, military and commercial interests, science and ideology), science and education.

Form of tuition
seminar.

Type of assessment
Active participation during the seminar, essay and presentation and a short exam on the topics addressed during the classes.

Course reading
available via blackboard.

Entry requirements
Bachelor degree

Target group
mFEW, mFALW, mFGW

Remarks
More information with the course coordinator: Afdeling Algemene Vorming, De Boelelaan 1081, kamer U252, d.j.beckers@vu.nl

Science Communication for Researchers in Bèta Disciplines

Course code	AB_470185 ()
Period	Period 5
Credits	6.0
Language of tuition	Dutch
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.F.H. Kupper
Examinator	dr. J.F.H. Kupper
Teaching staff	dr. B.J. Regeer, dr. J.F.H. Kupper, drs. ir. M.G. van der Meij
Teaching method(s)	Lecture, Study Group
Level	200

Science in Dialogue

Course code	AM_1002 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.F.H. Kupper
Examinator	dr. J.F.H. Kupper
Teaching staff	dr. J.F.H. Kupper
Teaching method(s)	Study Group, Lecture, Seminar
Level	500

Course objective
To gain knowledge of and insight into:
- the basic concepts and issues in the understanding of science-society interactions, both from a science and technology studies and communication science perspective
- the nature and course of interpersonal and group communication processes relevant to the formal and informal dialogue between science

and society
- the nature and form of dialogical science communication, aimed at reflective learning and mutual understanding

To acquire or improve:
- individual skills for effective interpersonal communication
- individual skills for the design and facilitation of the science-society dialogue

Course content
This course examines the public character of scientific controversy and focuses on the communicative aspects of a fruitful science-society dialogue. At the dawn of the 21st century, science, and particularly fields that combine science and engineering such as nanotechnology and synthetic biology, holds a great promise for the progress of our societies. At the same time, these developments are controversial. They lead to a variety of concerns related to risks, benefits and wider moral issues. Nanotechnology creates materials with novel characteristics that help us, but may also contain risks for health and environment. Synthetic biology develops new biological systems that may be very useful, but radically change the nature and meaning of life. Clearly, advances in science do not always match the needs, desires and expectations of society. On the other hand, parts of society might not always appreciate the nature and scope of scientific findings. For a fruitful relationship between science and society, a constructive science-society dialogue is necessary.
This course offers advanced lectures on the basic concepts and issues of dialogical science communication: communication, learning, dialogue, understanding, controversy, democracy. A series of workshops and small group assignments presents communicative tools and spaces such as discussion games, science theatre and multimedia platforms that can be used to design and facilitate science-society interactions. Training workshops will focus on improving the students' individual communication and facilitation skills. The students' individual learning curve as a science communicator and facilitator is self-evaluated by means of a refle ction report.
Every course week is completed with a mini-exam.

Form of tuition
Lectures (14h), Workgroups (28h), Training workshops (24h), Dialogue presentations (12h), Selfstudy
(remaining hours)

Type of assessment
Group assignment (50%), Take home exam (30%), Reflection report (20%). All assignments must be passed (grade > 6).

Course reading
Is announced on blackboard one month before start of the course

Target group
Optional course in the MSc specialization Science Communication

Remarks
Independence and a cooperative attitude is expected. Attendance to training workshops is mandatory.

Science in Perspective

Course code	X_437030 ()
Period	Period 4+5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/19213

Target group
mCh, mPhys

Remarks
Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

Science Journalism

Course code	AM_471014 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. J.F.H. Kupper
Examinator	dr. J.F.H. Kupper
Teaching staff	dr. J.F.H. Kupper
Teaching method(s)	Lecture, Study Group, Computer lab
Level	500

Course objective
To acquire knowledge of and insight into:
- the concepts, models and issues of science journalism according to contemporary scientific literature
- the criteria for effective science journalism with respect to diverse media
- the representation of science in the media
- the role of science journalism in the use of scientific knowledge in society

To acquire skills in:
- writing popular scientific texts for different genres such as news, background and interview
- science reporting using videos
- designing science communication for different media such as newspaper, radio and internet

Orientation to the professional practice of science journalism

Course content
This course teaches the basic principles of science journalism. A series of interactive lectures reviews both the practical as well as the theoretical aspects of science journalism. Topics that are discussed are

the translation of science to a language that is both compelling and understandable, the role of journalism in the interaction between science and society, images of science in the media and the ethics of science journalism. The interactive lectures invite you to take your own defendable position with regard to these issues.
Guest lectures provide insight into the professional practice of science journalists. The guest speakers work as freelancer, editor or producer at diverse science media, such as newspapers (NRC, Volkskrant), magazines (NWT), internet (Noorderlicht) and radio (Labyrint).
Finally, the course trains specific skills that you need as a science journalist, such as popular writing, popular science videos, interviewing, conceptual analysis
and program design.

Form of tuition
Lectures and seminars on theory and practice of science journalism and writing skill training (36h). Considerable time is set aside for performing science journalism in assignments (108h). The assignments are assessed by lecturers and fellow students (peer-review process). Self study (remaining hours).

Type of assessment
Several individual assignments (60%), several small group assignments (40%). All assignments must be passed (grade > 6).

Course reading
Announced on Blackboard one month before start of the course

Target group
All Master students with a Beta-Bachelor degree. Students taking this course as part of their C-specialisation within FALW or FEW will have precedence over other students. Students from other faculties and or universities need to get formal consent from the course coördinator (Frank Kupper) before enrolment.

Remarks
Course is taught in Dutch. More information: f.kupper@vu.nl.

Science Museology

Course code	AM_470590 ()
Period	Period 3
Credits	6.0
Language of tuition	English
Faculty	Fac. der Aard- en Levenswetenschappen
Coordinator	dr. B.J. Regeer
Examinator	dr. B.J. Regeer
Teaching staff	dr. B.J. Regeer, drs. ir. M.G. van der Meij
Teaching method(s)	Lecture, Study Group, Seminar, Fieldwork
Level	500

Course objective
- Gain insight in the role of museum exhibits in the field of science communication.
- Gain insight in the role of science communication concepts in the

context of science museums.
- Apply qualitative research methods to design, conduct, and report on a user research project in museum settings.
- Apply theoretical notions of science communication and exhibit design to advise development of exhibit experience and content design.
- Gain experience in working for an external commissioner.

Course content
This course is about the role of science museums/centers, zoos and natural history museums in science communication. You will get familiar with theories of science communication in museum settings, and will be introduced to different styles of communication, different approaches to exhibit design & development, and different methods of research and evaluation of exhibitions.
Guest speakers and lecturers give insight into their profession (1) as science communicators in museums and science centers, (2) as researchers in the field of museology, and/or (3) as professionals in informal science & technology learning environments.
Through individual and group assignments you are encouraged to combine theory and practice, working step-by-step towards (part of) an exhibition (re-)design. The group assignments are commissioned by museums and science centers, such as NEMO, Museon, Naturalis, Delft Science Centre, and Artis.

Form of tuition
Lectures
Workgroups
Workshops
Home-study for group assignments
Home-study for individual assignments
Field work

Type of assessment
Group assignment (50%), presentation (poster and oral) (10%), and individual exam(s) (40%). For the assignments, presentations and all exams a pass-grade must be obtained.

Course reading
Academic articles. Direct links to articles will be provided on Blackboard one month before the beginning of the course.

Entry requirements
It is possible to follow the course as an elective course outside of one of the science communication master specialisations of FALW/FEW. In that case additional reading may be required depending on the student's background.

Target group
Optional course in the Science Communication master specialisation of most of the two-year master programs of the FALW and FEW faculties. Master students from other universities in any scientific field are welcome as well. Additional reading may be required.

Remarks
Guest lectures from and excursions to for instance Artis, NEMO, Naturalis, NorthernLight, Museon, etc.

Science project

Course code	X_422591 ()
Period	Ac. Year (September)
Credits	24.0
Language of tuition	Dutch
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. J.P. Dekker
Examinator	dr. J.P. Dekker
Level	400

Course objective
The MSc SBI students will follow the Science Project SBI to strengthen their knowledge and experience with natural sciences in order to be able to talk the language of the specialists and to scan and interpret new developments and inventions in the field of life and health and/or energy and sustainability. The student will:
a. actively participate in a research team and is expected to critically follow and discuss research matters that are a subject in meetings as well as present his or her own work to the group on a regular basis. In doing so and through this immersion in faculty research, the student is becoming acquainted with a research process, including its organization, objectives and challenges.
b. design, execute and deliver his or her own research project and be individually responsible for it, under supervision of a senior scientist. A second and independent reviewer will be assigned to assess the final products.
c. deliver a final report, present outcomes on a regular basis including a final presentation and make detailed recommendations for further research with respect to his or her research assignment.

Course content
In this project the student should work closely with laboratory researchers on a project based on modeling and/or experimental lab work. Programs that contain innovation or valorization aspects are ideally suited for participation of SBI students. Once a topic has been agreed upon, the student will agree on a research question. Subsequently the student will draft a research plan in which is addressed: theoretical framework, research methodology and data analysis, experimentation set-up, planning, organization, anticipated outcomes and reporting format. This plan will also include a listing of some relevant literature references pertaining to the particular topic.

The plan may also include a course to provide insight and experience on experimental lab work or modeling. For instance, it is possible to define a drug discovery project that is accompanied by the integrated course Computational Design and Synthesis of Drugs (code 435673). In this course, students will learn step by step about data mining and computer-aided drug design techniques. The study load of these courses will be integrated in the Science Project SBI.

Form of tuition
Research project

Type of assessment
Report and presentation, as explained in the course manual

Course reading
Depending on the project

Entry requirements
Requirements to enter the mSBI program

Target group
mSBI

Scientific Writing in English

Course code	X_400592 (400592)
Period	Period 2, Period 6
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	M. van den Hoorn
Examinator	M. van den Hoorn
Teaching method(s)	Lecture
Level	400

Course objective
The aim of this course is to provide Master's students with the essential linguistic know-how for writing a scientific article in English that is well organized, idiomatically and stylistically appropriate and grammatically correct.

At the end of the course students
- know how to structure a scientific article;
- know what the information elements are in parts of their scientific article;
- know how to produce clear and well-structured texts on complex subjects;
- know how to cite sources effectively;
- know how to write well-structured and coherent paragraphs;
- know how to construct effective sentences;
- know what collocations are and how to use them appropriately;
- know how to adopt the right style (formal style, cohesive style, conciseness, hedging)
- know how to avoid the pitfalls of English grammar;
- know how to use punctuation marks correctly;
- know what their own strengths and weaknesses are in writing;
- know how to give effective peer feedback.

Final texts may contain occasional spelling, grammatical or word choice errors, but these will not distract from the general effectiveness of the text.

Course content
The course will start with a general introduction to scientific writing in English. Taking a top-down approach, we will then analyse the structure of a scientific article in more detail. As we examine each section of an article, we will peel back the layers and discover how paragraphs are structured, what tools are available to ensure coherence within and among paragraphs, how to write effective and grammatically

correct sentences and how to choose words carefully and use them effectively.

Topics addressed during the course include the following:
- Structuring a scientific article
- Considering reading strategies: who is your readership? How do they read your text? What do they expect? How does that affect your writing?
- Writing well-structured and coherent paragraphs
- Composing effective sentences (sophisticated word order, information distribution).
- Arguing convincingly – avoiding logical fallacies
- Academic tone and style: hedging – why, how, where?
- Using the passive effectively
- Understanding grammar (tenses, word order, etc.)
- Understanding punctuation
- Referring to sources: summarising, paraphrasing, quoting (how and when?)
- Avoiding plagiarism
- Vocabulary development: using appropriate vocabulary and collocations

Form of tuition
Scientific Writing in English is an eight-week course and consists of 2 contact hours a week. Students are required to spend at least 6 to 8 hours of homework per week. They will work through a phased series of exercises that conclude with the requirement to write several text parts (Introduction, Methods, Discussion and Abstract). Feedback on the writing assignments is given by the course teacher and by peers.

Type of assessment
Students will receive the three course credits when they meet the following requirements:
- Students hand in three writing assignments (Introduction, Methods, Discussion)
- Students get a pass mark for all writing assignments;
- Students provide elaborate peer feedback (Introduction, Methods, Discussion, Abstract);
- Students attend at least 7 out of 8 sessions;
- Students are well prepared for each session (i.e. do all homework assignments);
- Students participate actively in class;
- Students do not plagiarise or self-plagiarise.

Writing assignments:
1. If students have a BSc thesis in a traditional thesis form (e.g., 20+ pages) and written in English, they may use this for the writing assignments.
2. If students have a BSc thesis in a traditional form (e.g., 20+ pages) written in another language than English, they may use this for the writing assignments.
3. If students have written a paper or report in English that’s not already in article form, they may use this for the writing assignment.
4. If students are working on their MSc thesis or internship report when taking Scientific Writing in English, they may use this for the writing assignments. They will have to notify their supervisor to make sure that they won’t be accused of self-plagiarism.
5. If students cannot or do not wish to use any of the above-mentioned texts for the writing assignments (1-4), they are expected to do a limited Literature Review on a topic in their field of research, using at least 5 articles.

Students are not allowed to use the following texts for the writing assignments:
1. A BSc thesis written in English that’s already in article form.
2. A MSc thesis written in English that’s already in article form (and that has already been marked).
3. An internship report written in English that’s already in article form (and that has already been marked).
4. A paper or report written in English that’s already in article form.

Course reading
Effective Scientific Writing: An Advanced Learner's guide to Better English, 3rd edition (June 2013) (A. Bolt & W. Bruins, ISBN 978 90 8659 617 1). VU bookstore: €27.95.

Target group
This course is only open to students of the two-year Master's programmes Drug Discovery & Safety and Physics of the Faculty of Sciences. These students are only eligible to the course if they have already conducted scientific research (e.g. for their Bachelor’s thesis) or if they will be working on a research project when taking Scientific Writing in English.

Remarks
- To do well, students are expected to attend all lessons. Group schedules are to be found at VUnet and on Blackboard.
- A VUnet registration for this course automatically gives access to the corresponding Blackboard site. Group registration only takes place via Blackboard (general groups: registration by students following FEW programmes offering this course; groups assigned to specific studies: registration through programme and course coordinator).
- Make sure Scientific Writing in English does not overlap with another course.
- If you have registered for a group in Blackboard, you are expected to attend all sessions. If you decide to withdraw from the course, do so in time in VUnet. This all will avoid a 'fail' on your grade list for not taking part in this course and allows other students to fill in a possible very wanted group spot.
- For specific Blackboard matters concerning this course, please contact onderwijsbureau.beta@vu.nl.

Showcase 1

Course code	X_428576 ()
Period	Period 1
Credits	0.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Showcase 2

Course code	X_422609 ()
Period	Period 2

Credits	0.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching staff	dr. H.L. Bethlem
Teaching method(s)	Lecture
Level	400

Soft Condensed Matter and Biological Physics

Course code	X_420167 (420167)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. ir. G.J.L. Wuite
Examinator	prof. dr. ir. G.J.L. Wuite
Teaching staff	prof. dr. ir. G.J.L. Wuite, prof. dr. P.R. ten Wolde
Teaching method(s)	Lecture
Level	400

Course objective
To provide insight into the physics of biological systems and soft condensed matter. In addition we will discuss and illustrate recent examples of the scientific literature in this field.

Course content
- The building blocks of cells.
- Statistical physics applied to soft-condensed matter.
- Random Walks, Friction and Diffusion.
- Life at low Reynolds number.
- Entropic forces at work.
- Chemical forces & self-assembly.
- The cytoskeleton, a semiflexible, crosslinked polymer network.
- Enzymes and molecular machines.
- Molecular motor proteins, the lorrries in our cells.

Form of tuition
Lectures, and self-study.

Type of assessment
Homework, Scientific literature presentations and an exam.

Course reading
Nelson, P., Biological Physics, Energy, Information, Life. New York: W.H. Freeman and Company, 2004 (ISBN 0-7167-4372-8).
Later editions are also fine.

Target group
mMNS, mPhys-AMEP, mPhys-PLH

Specialisation

Course code	O_MLVERD ()
Period	Period 2+3
Credits	3.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. A. Handelzalts
Examinator	dr. A. Handelzalts
Teaching staff	drs. J.K.W. Riksen, drs. H.R. Goudsmit, drs. Y.G. Meindersma, drs. W.S. Hoekstra, drs. S. Donszelmann, dr. H.B. Westbroek, C.L. Geraedts, drs. A. Krijgsman, drs. K.L. Schaap, W. Maas, F.L. de Vries MSc, drs. H. Stouthart, drs. I. Pauw, drs. C.D.P. van Oeveren
Teaching method(s)	Seminar,
Level	500

Statistical Data Analysis

Course code	X_420067 (420067)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14976

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100. Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Statistical Mechanics of Soft Matter

Course code	X_422555 (422555)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. F.C. Mac Kintosh
Examinator	prof. dr. F.C. Mac Kintosh
Teaching method(s)	Lecture
Level	400

Course content
In this course, we begin with an introduction/review of the fundamentals of statistical mechanics. We then develop quantitative approaches to understand fluctuations of systems about thermal equilibrium, as well as the linear response of such systems to external

perturbations. We also introduce and develop theoretical approaches to understand phase transitions and critical phenomena.
These techniques are particularly relevant, but not limited to soft matter systems,
which tend to exhibit rich phase behavior, strong thermal fluctuations and
high sensitivity/responsiveness to external forces/fields.

Type of assessment
Written exam

Course reading
Lecture notes will be provided.

Target group
mPhys-MP, mPhys-PAP, mPhys-TP

Statistical Physics and Condensed Matter Theory I

Course code	X_420083 (420083)
Period	Period 1
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/135

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Statistical Physics and Condensed Matter Theory I - Extension

Course code	X_428519 (428519)
Period	Period 3
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	500

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/22444

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904,
servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Statistical Physics and Condensed Matter Theory II

Course code	X_420100 (420100)
Period	Period 4+5+6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	500

Course content
The course description is available on
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14982

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Stochastic Simulation

Course code	X_428577 ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Level	400

Course content
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/15356

Registration procedure
Registration is required via https://www.sis.uva.nl before the start of the semester. Please visit the website of your programme through http://student.uva.nl and check the A-Z list 'Course and Exam Registration' for more information.

String Theory

Course code	X_400242 (400242)
Period	Period 5
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	500

Course content
The course description is available on:
http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/14988

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Strong Interactions 1

Course code	X_420233 (420233)
Period	Period 4
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	400

Course content
The course description is available on
http://studiegids.uva.nl/web/uva/sgs/en/c/9638.html

Target group
mPhys-PPAP, mPhys-TP

Remarks
This course is scheduled in the first block of semester 2 at the University of Utrecht, room to be announced.

Opgave via https://www.sis.uva.nl tot 4 weken voor aanvang van het semester is verplicht

Course registration at the UVA is compulsory at least 4 weeks before the start of the semester via https://www.sis.uva.nl

Strong Interactions 2

Course code	X_420234 (420234)
Period	Period 5
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	500

Course content
Course description is available on
http://studiegids.uva.nl/web/uva/sgs/en/c/9639.html .

Target group
mPhys-PPAP, mPhys-TP

Remarks
Registration via https://www.sis.uva.nl is mandatory 4 weeks before the start of the Semester.

Location: Utrecht

Student Seminar Theoretical Physics

Course code	X_420200 (420200)
Period	Period 6
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	500

Course content
The course description is available on http://studiegids.uva.nl/web/uva/sgs/en/c/125.html

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Superconductivity

Course code	X_428522 (428522)
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Teaching method(s)	Lecture
Level	500

Course content
The course description is; available on http://studiegids.uva.nl/xmlpages/page/2015-2016/zoek-vak/vak/20497

Remarks
This course is offered at the UvA. For more information contact: FNWI Education Service Centre, Science Park 904, servicedesk-esc-science@uva.nl, +31 (0)20 525 7100.
Enrolment via https://m.sis.uva.nl/vakaanmelden is required.

Teaching Methodology Physics I

Course code	O_MLVDNAI ()
Period	Period 1+2
Credits	3.0
Language of tuition	Dutch
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. E. van den Berg
Examinator	dr. E. van den Berg
Teaching staff	dr. H.B. Westbroek, F.L. de Vries MSc
Teaching method(s)	Seminar
Level	500

Teaching Methodology Physics II

Course code	O_MLVDNAII ()
Period	Period 1+2
Credits	6.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	dr. E. van den Berg
Examinator	dr. E. van den Berg
Teaching staff	dr. H.B. Westbroek, F.L. de Vries MSc
Teaching method(s)	Seminar
Level	500

Teaching Practice I

Course code	O_MLPRAKI ()
Period	Period 1+2+3
Credits	15.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	ir. E.J.F. Scheringa
Examinator	ir. E.J.F. Scheringa
Level	500

Teaching Practice II

Course code	O_MLPRAKII ()
Period	Period 1+2+3
Credits	15.0
Faculty	Fac. der Gedrags- en Bewegingswetensch.
Coordinator	ir. E.J.F. Scheringa
Examinator	ir. E.J.F. Scheringa
Level	500

Technology and Innovation Processes

Course code	E_BA_TIP ()
Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Fac. der Economische Wet. en Bedrijfsk.
Coordinator	dr. P.R. Tuertscher
Examinator	dr. P.R. Tuertscher
Teaching method(s)	Lecture, Study Group
Level	400

Course objective
After finishing this course, students will be able to:
• Explain challenges, concepts, and theories related to processes of technological innovation
• Apply concepts and theories to analyze real life cases and develop solutions to improve innovation processes
• Critically reflect upon theoretical assumptions and methodological approaches in research on technology and innovation

Course content
This course is about processes of technological innovation within and between organizations. In short, this course concerns the creation of innovative ideas and their conversion into products and services that have value for a company and its customers. This course helps students to understand and improve the complex and uncertain process of technological innovation. Topics that will be addressed include the evolution of technology, collaborative innovation, uncertainty and learning, business model innovation, the role of the institutional contexts, and timing in innovation processes. The course will focus on specific fields of technology: energy, information technology, life sciences / biotech, and semiconductors.

Form of tuition
The course will consist of a combination of interactive lectures (6), seminars (6), and assignments. The lectures will also include a critical discussion of selected readings, stimulated by obligatory individual reflections on this literature. The seminars will be used to have groups of students present and discuss assignments.

Type of assessment
Students will be graded based upon three types of assignments:
• Individual reflections on literature
• Group assignments based on real life cases
• Final group assignment in which theoretical perspectives have to be applied to a specific technological innovation

Course reading
A collection of scientific articles, to be announced on Blackboard.

Recommended background knowledge
Basic knowledge of innovation management and organization studies

Transdisciplinarity and Transition

Course code	X_430604 ()

Period	Period 2
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. J.T. de Cock Buning
Examinator	prof. dr. J.T. de Cock Buning
Teaching staff	prof. dr. J.T. de Cock Buning
Teaching method(s)	Lecture, Seminar, , Study Group
Level	400

Course objective
• You can reproduce and apply the essence of current transition theories, e.g. the multi-level perspective.
• You can design a tailor made transdisciplinary approach to identify and cope with hurdles in an innovation trajectory, based on amongst others the Interactive Learning and Action approach.
• You are able to make an in-depth semi-structured interview guide.
• You are able to execute, transcribe, analyse and summarise an in-depth interview.
• You are able to apply analytical tools, such as causal analysis, actor analysis, fact-value framing, SWOT.
• Your are able to integrate multi-disciplinary knowledge and multi-stakeholder interests into a management advice for a transition process.

Course content
Innovation often implies a troublesome and risky process starting with a bright idea, via a small niche innovation towards a competitive position. This course focuses on the analytical skills necessary to guide and advice a niche innovation.

Guiding and advising implies that you are aware of the social forces prohibiting a breakthrough and how to identify and implement tailor made solutions to deal with these forces. Therefore, this course introduces you to several theories related to innovation and societal forces, and we will offer you training with a toolbox of various analytical methods to explore the specific hurdles of a given project, in order to design a tailor made advice.

Little by little, academic research reveals the complexity of societal mechanisms behind transitions, e.g., cultural aspects, psychological aspects, structures of states, institutions and multinationals. Transdisciplinarity is an emerging discipline in which research approaches and analytical methods are developed to connect relevant parts of different disciplines to solve complex processes, including transitions. Transitions are referred to as complex because different stakeholder groups are involved (e.g. industry, academia, consumers and NGOs) and these stakeholders often have different visions on what is "best" for society.

On the basis of experiences with large innovative consortia (Genomic Initiative - ecological genomics, Sustainable innovation/brain imaging, BE-Basic/synthetic biology) you will learn all about the do’s and don’ts of the Interactive learning and Action approach, how to use an actor analysis to delineate you allies and enemies, how to use semi-structured interviews to deepen your understanding of reasons behind problems, how to construct a causal

analysis to understand the complexity of the problems you face, and how a SWOT analysis can help to identify strategic priorities.

Parallel to the lectures you will work in a group on an advice regarding an innovation, conducting interviews with key players and analysing the complexity of interests.

Form of tuition
The total study time is 6 EC (6x28 = 168 hours). Tuition methods include lectures, training sessions, self-study, and a group project on a specific case. In the case study, you will integrate different theories and tools, and apply the toolbox introduced during the lectures.
- lectures 12 hours
- coach meetings 16 hours
- skills training 6 hours
- execution of 2 interviews 2 hours
- execution expert meeting 2 hours
- presentation of project results 4 hours
- self study and project 124 hours
- examination 2 hours (two mini-exams of 60 minutes)

Please note that attendance to the project meetings is compulsory. For the group project, you will make rules with your group during the first meeting with your coach.

Type of assessment
The course grade is based on the project (group and individual) and the exam. All aspects (including both mini-exams) have to be concluded with the grade of 5.5 or higher.

Team project report (40%)
Team project presentation (10%)
Individual attitude and skills assessment (20%)
2 individual written mini-exams (30%)

Course reading
Book: Biotechnology and Food
Articles are made available via Blackboard

Entry requirements
Proven knowledge of organisations and management and business is required

Target group
Master students SBI track (mCh)

Registration procedure
As the number of participants will dictate the number of different projects (and the related team coaches), the deadline for VU-net registration will be 4 weeks before the start of the course. Retracting your registration for the course after the deadline will have detrimental effects on the composition of the teams, the network of contacted interviewees and contracted coaches.

Remarks
This course mimics the world of a transition task-force. This implies 100% use of the available time (=20 hours a week) to accomplish all the necessary steps in conceptualisation of the complexity, data collection,

interviews, analysis, validation of pre-liminary result with external experts, and finally presenting your change strategy. You will need to use and integrate all knowledge you acquired before.

Tutoring Students

Course code	X_432625 (432625)
Period	Period 2
Credits	3.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	dr. M. Wijtmans
Examinator	dr. M. Wijtmans
Teaching staff	dr. M. Wijtmans, dr. H.B. Westbroek
Teaching method(s)	Lecture
Level	400

Course objective
This course aims to prepare students for coaching tasks in tutorials and practical courses. Students will encounter aspects of teacher-student interaction, including several models that are involved in the coaching process.

Course content
The course contains various topics and activities. Students make an analysis of various learning aims as well as prepare, conduct and reflect on a presentation of a pre and post discussion regarding tutorials and practical courses. They will observe and interpret the application of problem solving and coaching models in tutorials and practical courses. Attention will be paid to strengths and weaknesses in models of teacher-student interaction. An important constituent is the student's analysis of his/her own pattern of communication. Topics on safety and lab journal procedures in practical courses as well as on the grading of lab reports are also included.

Form of tuition
4 consecutive hours per week (seven weeks long):
- Lectures
- Simulations
- Self-study
- Group work

Type of assessment
- An essay on the strengths and weaknesses in a model of teacher-student interaction.
- A learning report on presentations concerning predict, observe, explain in practical work.
- A written analysis on grading lab reports.
- A written feedback on the planning of and enactment in tutorials.

Course reading
Will be provided.

Target group

mCh-AS, mCh-MDSC, mCh-MSP, mCh-SES, mDDS-BCCA, mDDS-CMCT, mDDS-DD&S, mDDS-DDSA, mDDS-DDTF

Registration procedure
VUnet

Remarks
This course is compulsory for MSc students who become assistants in practical courses and tutorials in the department of Chemistry and Pharmaceutical Sciences. Moreover, the course is recommendable for any MSc student who has a general interest in educational coaching strategies and models.

Number of participants is limited to 24 (first-come, first-serve basis).

Priority is given to MSc students. If any of the 24 seats are left, the course may also be accessible to 3rd year BSc students FAR en SK with a strong interest in educational aspects (first-come, first-serve basis). Interested BSc students should first contact Maikel Wijtmans (m.wijtmans@vu.nl).

Ultrafast Laser Physics

Course code	X_422556 (422556)
Period	Period 4
Credits	6.0
Language of tuition	English
Faculty	Faculteit der Exacte Wetenschappen
Coordinator	prof. dr. K.S.E. Eikema
Examinator	prof. dr. K.S.E. Eikema
Teaching staff	prof. dr. K.S.E. Eikema
Teaching method(s)	Lecture
Level	400

Course objective
To provide a broad overview of both the ultrafast techniques and phenomena in physics and chemistry.

Course content
This course covers both the principles behind ultrafast optical pulse generation and control, and its applications in physics and chemistry. After a review of basic femtosecond laser techniques, the interaction of light with matter in the linear and nonlinear regime will be discussed. This includes the concepts of dispersion (in 1st and higher order) and pulse propagation effects, nonlinear processes such as second-harmonic generation, parametric amplification, stimulated Raman scattering, photon echos. Also pump-probe and transient spectroscopy with be discussed. Other topics that will be covered are pulse measurement techniques such as FROG and SPIDER, femtosecond frequency combs, spectrum extension methods such as continuum, THz and X-ray generation, attosecond physics, spectral and temporal shaping of pulses, including applications such as coherent control. These concepts will be illustrated using applications in physics and chemistry.

Form of tuition
Lectures with excersices and demonstrations (excursions to the lab).

Type of assessment
Written exam.

Course reading
Lecture notes and papers.
Recommended book: "Ultrashort Laser Pulse Phenomena" by J-C Diels and W. Rudolph, 2nd
edition (2005), ISBN 978-0-12-215493-5

Recommended background knowledge
Some background in optics and electrodynamics is required.

Target group
Master students physics.

Remarks
Please make sure the study guide shows the right length of the lectures:
it is 3 hours per lecture (NOT 4 as mistakenly written in the current
schedule for period 5 in 2015!!!).