Maastricht Science Programme

Core courses

Core courses

Maastricht Science Programme

Introduction to Natural Sciences: Chemistry

Full course description

The emphasis of this course will be on a number of essential topics in modern chemistry. The first part of the course will give an overview of the structure of atoms and their place in the periodic table as well as the properties of various types of chemical bonds and chemical bonding theory. The second part will present an introduction into physical chemistry with important topics such as the characteristics of gases/liquids/solids, thermodynamics and reaction kinetics. In the final part, the course focuses on a selection of important chemical subjects, which form the basis of chemical studies in general. Typical topics in this part of the course are based on acid-base chemistry and electrochemistry.

Course objectives

• To have an understanding of the nature of various atoms and their organization in the periodic table of the elements. • To have the ability to recognize various classes of chemical compounds and to understand their basic physical and chemical properties. • To obtain an understanding of the basic physical chemistry of fundamental importance to most natural and chemical processes, with an emphasis on thermodynamics and kinetics. • To be familiar with the essentials of acid-base behaviour and electrochemistry. • To have sufficient background for further, more advanced, courses in chemistry, biochemistry and the life sciences.

Prerequisites

Co-requisites PRA1001 Research Methods

Corequisites

• Research Methods

Recommended reading

"Chemistry3: Introducing inorganic, organic and physical chemistry" Burrows, Holman, Parsons, Pilling, Price. Second Edition, Oxford University Press

CHE1001

Period 1
5 Sep 2016
28 Oct 2016
Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[B. Blom](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment, Participation

Maastricht Science Programme
Introduction to Natural Sciences: Biology

Full course description

This course aims at introducing the students to the most fundamental biological principles of life. The cell as the basic unit of life will be studied as well as classification of organisms in order to understand the basic principles of the diversity of species. A basic understanding of photosynthesis and cellular respiration will be provided in this course. The ability to replicate, to multiply and produce offspring is studied in the field of genetics, and the basic Mendelean genetics will be studied. The basic principles of evolution will be introduced. How living organisms relate to each other will be explained and basic principles of ecology are presented.

Course objectives

This course is an introduction to the field of biology, builds on the previous high-school knowledge of the students and aims to develop a deeper understanding of: • the basic characteristics of life: metabolism, growth, reproduction, response to stimuli + communication • the relation between structure and function of bio-molecules in living organisms • the cell as the unit of living organisms • biodiversity, evolution & taxonomy • the basics of metabolism and photosynthesis • the principles and mechanisms underlying classical genetics • the basic principles of ecology • population dynamic and how populations respond to environmental changes

Prerequisites

Co-requisites PRA1001 Research Methods

Corequisites

- [Research Methods](#)

Recommended reading

Campbell, Reece et al. (2015). Biology, A Global Approach (10th edition, global edition). Pearson (ISBN10: 1-292-00865-2 ISBN13: 978-1-292-00865- 3, ISBN 978-1-292-00875-2 is the same book but with access to online study material, which is NOT required for this course. The 9th global edition is also acceptable).

BIO1001

Period 1
5 Sep 2016
28 Oct 2016
Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[L.I.N.N. van Griethuijsen](#)
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Written exam, Attendance, Participation, Final paper

Maastricht Science Programme
Research Methods

Full course description

This course focuses on experimental research methods and reporting. In addition, it teaches the students the basic laboratory skills to perform experiments in a chemical or biological laboratory as well as the physics laboratory. Students learn to work in a safe manner, with respect for themselves, others and the environment. Basic techniques will be taught, such as the accurate measurement of volumes and weights. The students will gain experience in the logistics of setting up and doing an experiment with the final goal of communicating their findings in a report. Typical topics, which will be covered in this skills training are: • Chemical and biological separations and isolations (distillation, extraction, chromatography) • Acid and bases (measuring pH, using buffer solutions, titrations). • Chemical and biological kinetics (enzymes, reaction order) • Thermodynamic properties of compounds and reactions • Introduction into microscopy and imaging of biological samples

Course objectives

• To be able to perform basic chemical and biological laboratory research experiments in a safe and scientifically sound manner. • To understand the handling of materials and solutions (weighing, making solutions, handling solutions, working with pipettes and volumetric glassware). • To learn to setup and execute a scientific research experiment. • To provide an introduction to scientific research reporting.

Prerequisites

Co-requisites BIO1001 Introduction to Natural Sciences: Biology CHE1001 Introduction to Natural Sciences: Chemistry

Corequisites

• [Introduction to Natural Sciences: Chemistry](#)

- [Introduction to Natural Sciences: Biology](#)

Recommended reading

"Practical skills in Biomolecular sciences" by Reed R, Holmes D, Weyers J, Jones a. (Pearson, 4th edition 2012; ISBN10 1408245523; ISBN13 9781408245521).

PRA1001

Period 1
5 Sep 2016
28 Oct 2016
Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
T.D. Steen Redeker
Teaching methods:
Skills, Assignment(s)
Assessment methods:
Assignment

Maastricht Science Programme
Introduction to Liberal Arts and Sciences

Full course description

Introduction to Liberal Arts & Sciences introduces you to the intellectual skills, the generic skills and the development of values and ethics inherent in the liberal arts & sciences tradition. The first part of the course aims at providing you with an understanding of the natural sciences from a philosophical perspective. What is science? What is the scientific methodology? What are the norms and values in a scientific environment? The variety of perspectives that you are introduced to when answering these questions will allow you to develop your critical thinking skills and will provide you with insights that you can use in your personal development as a scientist. After exploring the philosophy of science in the first part of the course, the second part of the course teaches you to apply and communicate your knowledge and ideas effectively by devoting attention to argumentation and science communication.

Course objectives

The objective of the course is to make you think about the natural sciences from a philosophical perspective: what is science; what is the scientific method? The course also challenges you to develop your intellectual and generic skills further: how to integrate different perspectives; what is ethical in science; how to communicate in/about science? To achieve this, the course has the following sub-objectives: • To deepen your understanding of natural sciences by introducing you to different

perspectives on science and scientific methodologies. • To make you aware of what is needed to be a 'good' natural scientist. You are introduced to norms and values in scientific environments and are challenged to think critically by offering diverging views on the topics discussed in the course. • To equip you with the skills and knowledge required to communicate your knowledge and ideas effectively. You are stimulated to achieve these goals when working in teams.

Prerequisites

Co-requisites PRA1002 Research, Data Analysis and Presentation Academic Skills

Corequisites

- Research, Data analysis and Presentation Academic skills

Recommended reading

All students are required to read the book: Watson, J.D. (Author) & Jones, S. (Introduction), The Double Helix, A Personal Account of The Discovery of the Structure of DNA, ISBN: 978-0- 7538-2843-4. In addition students will study a variety of articles and book chapters which will be made available online on a weekly basis.

INT1001

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
L.I.N.N. van Griethuijsen
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Participation, Assignment, Written exam, Attendance

Maastricht Science Programme

Research, Data analysis and Presentation Academic skills

Full course description

The academic world has its own strict set of rules with respect to collecting data, analysing them, and writing and reporting about them. This course will provide you an introduction into this academic skills

set. The first step for any scientific investigation is to find out what is already known. Although you probably always have used Google to find information, this search engine is not the best tool to find peer- reviewed scientific knowledge. Therefore, you will be introduced into two common scientific search tools and shown how to use them: Web of Science and Scifinder. Once you have found literature, you will learn how to manage and use the citations with a bibliographic data management tool called Endnote. Next to literature searches, you will be introduced into the rules of writing a proper scientific article. Scientific writing is a branch of its own with particular and peculiar do's and don'ts. Scientific articles present content in a certain order and have a clear division into topics. They also require a particular writing style. Many students have at first problems with writing scientifically and therefore a substantial portion of this skill is devoted to this topic. A scientific article is mostly about data. However, these data are never presented in the form they were collected. Usually some form of statistical analysis is required. In this skill you will practice with the most basic descriptive statistical techniques available to explore data. Finally, the presentation training is designed to help you strengthen your abilities to present scientifically, effectively and efficiently at seminars and similar events.

Course objectives

To familiarize students with the most basic skills required in science. These include: • Common statistical data analysis skills • Finding and selecting literature using Web of Science and Scifinder • Referencing literature using Endnote • Writing a scientific article

Prerequisites

Co-requisites MAT1001 Introduction to Natural Sciences: Calculus / PHY1002 Mathematical Foundations of Physics INT1001 Introduction to Liberal Arts and Sciences

Corequisites

- Introduction to Liberal Arts and Sciences
- Introduction to Natural Sciences: Mathematical Foundations of Physics

Recommended reading

For the writing skills part the book "A guide to academic writing skills" (2nd ed., Wilkinson & Hommes) will be used. This book will be provided via EleUM.

PRA1002

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinator:
F.G.A. Birembaut
Teaching methods:

Lecture(s), PBL, Skills
Assessment methods:
Final paper, Assignment, Presentation

Maastricht Science Programme
Philosophy of Science

Full course description

During the four weeks of the course students will study the philosophy of science hand in hand with its application to a scientific case study: paleontology, or the study of fossils. Each week one tutorial will be devoted to the philosophical discussion of scientific issues and one tutorial to the implications of these discussions for how science is done in the context of fossil research. In week 1 an introduction to the philosophy of science will be given that will also address the empirical study of objects, logical positivism, the problems of inductivism, and issues concerning the (un) certainty of scientific claims. Parallel to that, students will investigate (in small groups) what kind of information different scientific disciplines (biochemistry; radiology; biology) can generate with respect to certain objects (fossils). Visits will be made to the Natural History Museum. Week 2 will be devoted to the idea of the theory-dependence of scientific observation and the philosophical concept of paradigms. Parallel to that, students will study the history of the (scientific) investigation of fossils, in order to investigate what role conflicting paradigms played in the past and present of fossil research. In week 3 a broader view on the production of scientific knowledge will be offered, placing science in a social context. The philosophical discussion will look at the role of worldviews in science and the 'social turn' that characterizes many of the recent approaches in the philosophy of science. Parallel to that, students will read primary sources that reveal the religious, political and epistemological presuppositions that shaped some of the most important developments of fossil research in the 19th century. In the fourth week students will write a short essay that should synthesize the insights gained during the first three weeks

Course objectives

The course aims at giving the students an overview of the main theoretical approaches within the philosophy of science; and teaches them skills to apply these approaches to the study of a concrete scientific discipline.

Recommended reading

• The central textbook of the course is: Peter Godfrey-Smith, Theory and Reality: An Introduction to the Philosophy of Science (Chicago and London: The University of Chicago Press, 2003). ISBN 0-226-30063-3. This book is available as an e-book in the University Library Maastricht, so that it can be used by all students at the same time. • Background information of the history of fossils can be found in: Martin J. S. Rudwick, The Meaning of Fossils: Episodes in the History of Paleontology, 2nd edition (Chicago and London: The University of Chicago Press, 1985). ISBN 0-226-73103-0.

PRO1001

Period 3
9 Jan 2017
3 Feb 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
E. Homburg
Teaching methods:
Lecture(s), PBL, Work in subgroups, Research
Assessment methods:
Assignment, Attendance, Written exam, Presentation

Maastricht Science Programme
Introduction to Natural Sciences: Mathematical Foundations of Physics

Full course description

Mathematics is inextricably linked to the understanding of science and this course is designed to cover the mathematical concepts that will prove fundamental tools for the natural science courses you will encounter at MSP, with an emphasis on physics. As new students to the MSP come from a diverse range of backgrounds, your knowledge of mathematics will vary considerably. As such, each of you will find that some of the material from this course acts as revision whereas some topics are completely new – please bare in mind that it's what you know at the end of the course that counts! It is important to note that maths is only useful if it can be implemented, and this skill is acquired by attempting to solve problems and perform calculations; this is the main aim of the weekly tutorials. The course will address complex numbers, differentiation, differential equations, integration, functions of two variables and multiple integrals. This course is part of the academic core in the natural sciences.

Course objectives

• To provide an introduction to the main topics of calculus. • To provide students with the necessary knowledge and skills to successfully study other advanced science courses. • To introduce complex numbers, functions, differentiation and integration – for functions of a single variable and for functions of several variables. • To demonstrate methods for solving linear differential equations. • To enable students to develop the insight to solve certain problems in science and engineering through functions, (differential) equations and other techniques of calculus (such as integration, differentiation and optimization).

Prerequisites

Co-requisites PRA1002 Research Data Analysis and Presentation Academic Skills

Corequisites

• Research, Data analysis and Presentation Academic skills

Recommended reading

Engineering Mathematics, 7th Edition, Stroud, K. A. and Dexter D. J. (Palgrave, 2013).

PHY1002

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[D.L. Carroll](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Participation, Assignment

Elective courses

Biology courses

Maastricht Science Programme
Cell Biology

Full course description

This course aims to develop a detailed understanding of the cell as the basic unit of life. The cell can be seen as an organism that can perform a wide range of functions. In eukaryotes, these functions are linked to the different compartments/organelles in the cell: nucleus, mitochondria, chloroplasts, endoplasmatic reticulum, lysosomes, endosomes, etc. There is a continuous transport between the different organelles (intracellular vesicular transport) and between the cell interior and the extracellular environment (endocytosis & exocytosis). All these cellular transport mechanisms will be studied in detail. Additionally, the cell contains intracellular structures that regulate shape, strength, and motility, i.e. the cytoskeleton. The cytoskeleton is a highly dynamic structure and the different components of the cytoskeleton (microtubules, F-actin, intermediate filaments) and their assembly and disassembly will be explained. Finally the basic principles of signal transduction will be studied, i.e. how does the cell react to signals from the environment, how are these signals detected and how are these processed into a primary cellular response?

Course objectives

• To present the structure of prokaryote (bacteria) and eukaryote cells (animal, plant, fungal). • To comprehend the structure/function relationship of the plasma membrane. • To understand the functions of cell organelles and sub-cellular structures. • To deepen the knowledge about transport of

material in- and out of the cell • To understand communication between the cell interior and exterior of the cell (cell signalling). • To understand the principles of transport between the different cell organelles and how molecules and proteins are reliably transported to the different organelles. • To create understanding of cell motility and how the cell controls its shape (cytoskeleton).

Recommended reading

There are two possibilities à one of these is mandatory: 1. "Molecular Biology of the cell" 6th edition (2014). B. Alberts, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts, P. Walter; Garland Science: Taylor and Francis Group, New York, NY10017, USA (ISBN: 978 0 8153 44643) 2. "Essential Cell Biology" 4th edition (2014). B. Alberts, D. Bray, K. Hopkin, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter. Garland Science: Taylor and Francis Group, New York, NY10016, USA (ISBN: 978 08153 44551) Number 1 is a more extensive book, which is recommended for those students who will continue in the molecular biology and/or cell biology direction. Number 2 is a shorter version of number 1, so it lacks some of the detailed description.

BIO2001

Period 1
5 Sep 2016
28 Oct 2016
Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
V.L.S. LaPointe
Teaching methods:
Lecture(s), PBL, Presentation(s), Assignment(s)
Assessment methods:
Assignment, Written exam, Presentation, Attendance

Maastricht Science Programme
Evolutionary Biology

Full course description

Evolution is the most important principle in biology. It is the only scientific biologically theory that unifies all phenomena of life from the level of (macro)molecules to ecosystems. Ever since the Modern Synthesis early last century (when Darwin's insights were combined with modern genetics), evolutionary research has expanded enormously. Subsequent developments – the birth of molecular biology, the ever increasing power of computers and the development of phylogenetics - have led to an enormous increase in our understanding of the processes and patterns of evolution. This course emphasizes the general principles of evolution, the hypotheses on the causes of evolutionary change

(relevant for most organisms), and the large patterns which are visible in the history of the earth. This course is an excellent opportunity to obtain a base in evolutionary knowledge, regardless of the field you will work in (biology or elsewhere). The course zooms in from macro-evolutionary patterns to micro- evolutionary processes. You will look at the geological and paleontological history of the earth and how biologists use phylogeny to reconstruct deep past (the tree of life) using genetic data. A fundamental unit within biology is the species and therefore also theories of species and speciation will be discussed. Furthermore, how random changes in populations (genetic drift) and natural selection influence evolution will be investigated using simulation models. In relation to this you will look beyond alleles into quantitative genetics and the evolution of phenotypes, and also at the process of adaptation. Finally, evolution is used to 1) explain life history characters (e.g. how many children does an organism produce) and obtain a different view on human medicine, and 2) understand co-evolution between species.

Course objectives

During this course you will gain insight in the most important patterns and processes of evolution. Furthermore, you will be able to explain and illustrate the synthetic character of evolutionary theory with examples (i.e. you understand and can explain why evolutionary theory is a unifying concept for all biological sciences and an important foundation for the "human sciences" of medicine, psychology and sociology).

Recommended reading

• Evolution, making sense of life. C. Zimmer and D.J. Emlen, 1st ed. 2013. Roberts & Company Publishers. • One modelule of Simbio's evobeaker package (http:// http://simbio.com/products-college/EvoBeaker) for evolutionary simulations (exact module to be announced later).

BIO2005

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[R.H.J. Erkens](#)
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Attendance, Written exam, Presentation, Assignment

Maastricht Science Programme

Genetics

Full course description

The course discusses the principles of genetics with application to the study of biological function at the level of molecules, cells, and multicellular organisms, including humans. The topics include: structure and function of genes; chromosomes and genomes; biological variation resulting from recombination, mutation and selection; DNA repair and the genetic basis of disease inheritance; and evolutionary genetics.

Course objectives

• To understand the chemical structure of DNA and the molecular mechanisms of DNA replication. • To get familiar with the basic principles how information stored in genes is converted to a (cellular) phenotype in the form of RNA and protein. • To comprehend and be able to apply the concepts of genome structure, comparative genomics, and functional genomics. • To understand the molecular basis of single gene inheritance (Mendel's first law), sex-linked single gene inheritance and to interpret human pedigrees. • To use the above information to deduce the concepts of Darwin's theory of Natural Selection, molecular evolution and the origin of new genes and species. • To have sufficient background for more advanced courses in biochemistry and the life sciences.

Prerequisites

Pre-requisites BIO2001 Cell Biology Co-requisites PRA2014 Skills Genetics

• Cell Biology

Corequisites

• Genetics

Recommended reading

"Introduction to Genetic Analysis" by Griffiths, Wessler, Carrol, Doebley (W.H. Freeman, 10thedition, International Edition, 2012. bol.com price €64,99).

BIO2007

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
5.0

Instruction language:
English

Coordinator:
L.J. de Windt

Teaching methods:
Lecture(s), PBL

Assessment methods:
Attendance, Written exam, Participation, Assignment

Maastricht Science Programme
General Zoology

Full course description

Animals are everywhere, on land, in water and in the air. They comprise an extremely diverse kingdom, with all species being a mixture of shared and unique biological characteristics. These characteristics are a product of evolutionary history and adaptation to particular features of the abiotic and biotic environment. In this course you will focus on the major groups within the animal kingdom, what defines them, how they are organised and how they are related to each other; you will also examine the specific adaptations of certain animals in more depth. The question "What is an animal?" will be considered as will the issue of how animals are grouped and related to each other. This will be done in the context of the major phyla, their defining morphological, anatomical and physiological features and the sorts of adaptations and behaviours that they exhibit. You will also examine certain adaptations such as bright colouration, feeding or parental care in greater depth, using particular animal groups as a source of examples.

Course objectives

• To characterise the defining biological features of the animal kingdom • To provide an overview of the characteristics of the major animal groups • To explain the systematics and phylogenetics of major groups within the animal kingdom • To place the morphological, anatomical and behavioural aspects of animal groups in an evolutionary context • To examine in more detail particular biological adaptations using specific animal groups as examples

Recommended reading

Miller, S.A & Harvey, J.P. (2012). Zoology, 10th edition. McGraw-Hill. ISBN 978-1259251740

BIO2004

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
J.J. Sloggett
Teaching methods:
Lecture(s), PBL
Assessment methods:
Participation, Final paper, Written exam

Maastricht Science Programme

Human Anatomy and Physiology

Full course description

While Mathematics is seen as the father of science, Physiology is the mother. Physiology attempts to explain the physical and chemical factors that are responsible for the origin, development, and progression of life. Human physiology investigates the mechanisms of the human body making it a living being (Guyton). In the healthy human body it is of the utmost importance that the working conditions for all cells are kept "constant". In this respect it is worthy to note that essentially all organs and cells of the human body perform functions that help to maintain this constant nature or homeostasis. We will begin by discussing the physiology of the cell, and the function of the membrane in it. Furthermore, we will discuss renal, respiratory, and cardiovascular physiology, followed by endocrinology and gastrointestinal physiology, control and feedback.

Course objectives

• Membrane Physiology • Electrophysiology • Cardiac vascular physiology • Hormonal and neuronal control • Fluid and Salt balance • Gastrointestinal physiology

Prerequisites

BIO1001 Introduction to Natural Sciences: Biology CHE1001 Introduction to Natural Sciences: Chemistry

Recommended reading

Books available from http://accessmedicine.mhmedical.com/Index.aspx

BIO2010

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
N.M.S. van den Akker
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam, Participation

Maastricht Science Programme

Genomics and Proteomics

Full course description

The introduction of genomics applications has added an extra dimension to the understanding of the molecular nature of life. Prerequisites were the unraveling of the genome of humans and other organisms, and the development of high-throughput methods for the simultaneous analysis of the expression levels of as much as possible genes. This course will give students insight in the analytical principles behind omics- technologies such as array-based analysis, in the information that can or cannot be obtained by the different 'omics'-approaches, and in the novel developments of omics-applications such as miRNA arrays, analysis of the epigenome, and next generation sequencing. Specific themes of the course are trancriptomics, proteomics, metabolomics with special attention for the surplus value of combining of data from various omics- approaches as the best way to understand life. Special areas of attention are Nutrigenomics and Toxicogenomics.

Course objectives

• To understand how genomics applications are used to unravel the biology of life. • To understand the basic principles of omics-techniques. • To gain insight in the advantages and limitations of genomics-based experiments. • To appreciate the surplus value of combining data from different omics-applications as a systems approach. • To provide the basis for gaining insight in bioinformatics and computational genomics.

Recommended reading

• Drake et al. Challenges to developing proteomic-based breast cancer diagnostics. OMICS 2011. • Sweeney et al. The human gut microbiome: a review of the effect of obesity and surgically induced weight loss. JAMA Surgery, 2013 • Metzker ML. Sequencing technologies - the next generation. Nat Rev Genet. 2010 11:31-46. • Malone et al. Microarrays, deep sequencing and the true measure of the transcriptome. BMC Biology 2011. • Trifonova et al. Postgenomics diagnostics: metabolomics approaches to human blood profiling. OMICS 2013. • Mounayar et al. Nutri-metabolomics applied to taste perception phenotype. OMICS 2014.

BIO3010

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
E.C.M. Mariman
Teaching methods:
Lecture(s), PBL, Paper(s), Assignment(s)
Assessment methods:
Attendance, Participation, Final paper, Written exam

Maastricht Science Programme
General Botany

Full course description

Plants are a vital part of anyone's life. However, many people suffer from plant blindness: the inability to notice the plants in one's own environment. This blindness can lead to the inability to recognize the importance of plants in the biosphere, and in human affairs. However, it also leads to a lower appreciation of the aesthetic and unique biological features of the life forms belonging to the Plant Kingdom. Finally, the blindness contributes to the misguided and anthropocentric ranking of plants as inferior to animals. This course is designed to show the general importance of plants and illustrate their unique adaptations. Topics that will be covered fall into two main categories: plant structure, and plant physiology and development. Topics of plant structure include: growth and division of cells, primary growth of stems (the herbaceous plant), leaves, roots, secondary growth (the woody plant), and flowers and reproduction. Plant physiology and development will include plants and energy (e.g. photosynthesis, respiration), nutrition and transport in plants (soils, mineral uptake and water flows), and plant growth and development.

Course objectives

During this course you will gain insight in the importance of plants for life on earth and the unique adaptations that plants have. The course will illustrate all major aspects of plant form and function (from the cellular level to the level of the organism), and plant development.

Recommended reading

Botany, an introduction to plant biology. J.D. Mauseth, 5th ed. 2014. Jones & Bartlett Learning. ISBN:978-1-4496-6580-7

BIO2003

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
R.H.J. Erkens
Teaching methods:
Lecture(s), Assignment(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme

Ecophysiology

Full course description

Ecophysiology is the study of physiological adaptations of organisms in relation to the environments in which they live. It has become an increasingly important science, because an understanding of the relationship between organism and environment is essential in order to predict the effects of man-made environmental change. The physiology of an organism incorporates many of its most important adaptations to the environment in which it lives. In this course you will consider the variety of environmental pressures imposed on organismal physiology. You will examine the often ingenious solutions that evolve in response to these pressures, and how different organisms and groups of organisms have evolved different physiological means of dealing with the same problem. The course will focus both on the abiotic environment (e.g. issues related to climate, gas exchange) and the biotic environment (e.g. how digestive physiology is adapted to plant toxins). Towards the end of the course you will look at Conservation Physiology, one of the practical applications of ecophysiology. There is a particular focus on the physiological adaptations of animals. Although BIO2004 General Zoology is not a prerequisite for this course, the course is recommended before you take Ecophysiology.

Course objectives

• To understand what ecophysiology is and the role in plays in an academic and applied context. • To gain a basic knowledge of the physiology of certain non-human organismic groups • To understand in detail the characteristics of different abiotic environments that impose strong adaptive pressures on organismal physiology • To understand specific direct physiological adaptations evolved in response to these environmental pressures • To gain an insight into physiological adaptations to the biotic environment • To understand the principle of convergent evolution and how different groups may have evolved different physiological solutions to the same evolutionary pressures

Prerequisites

BIO2001 Cell Biology

- Cell Biology

Recommended reading

Scientific papers

BIO3002

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
J.J. Sloggett
Teaching methods:

Lecture(s), PBL
Assessment methods:
Attendance, Presentation, Participation, Written exam

Maastricht Science Programme
Ecology

Full course description

Ecology is the study of the interactions of organisms with each other and with the abiotic environment. It covers many levels, including individuals, populations, communities and ecosystems. In this course we will examine the ecological patterns and processes that operate at these various levels and how they interact. Particular focus will be placed on the role that humankind plays in ecology today and on how factors such as deforestation, eutrophication and invasive species have affected natural systems.

Course objectives

• To understand what ecology as a discipline encompasses and its relevance for humanity • To understand the different levels of organisation that ecology is studied at from the level of the organism up to the level of the entire planet, and how studies at these different levels interact • To understand concepts, theories, and evidence about the ecological processes that determine the distribution and abundance of organisms • To understand the impact that humans exert on natural processes and the ecological consequences of anthropogenic activity

Prerequisites

BIO1001 Introduction to the Natural Sciences: Biology

Recommended reading

To be announced.

BIO2002

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
J.J. Sloggett
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam, Participation

Maastricht Science Programme
Microbiology

Full course description

The 7 weeks course will start with two introduction lectures on Bacteriology and Virology. The general principles of replication, classification, metabolism and antibiotic resistance of bacteria as well as the presence of bacteria in several organ systems and the composition of the indigenous flora will be discussed in week 1. The general priciples of replication, classification and pathogenesis of viruses will be discussed in the introduction lecture of week 2. Several aspects of bacteriology and virology will be further discussed in the expert and tutorial group meetings, which will include topics as HIV, Tuberculosis and ESBL.

The knowledge you have obtained in the first two weeks will serve the basis for the following three weeks, where Infectious diseases, Outbreaks & resistance and Microbiological diagnostics will be discussed in the lectures as well as in the tutorial groups. In these topics, both the bacterial and viral aspects will be discussed.

The last part of this course will deal with genetically modified microorganisms, in which you gain inside in the purposes of modification and the tools that are available. In the PBL tutorial group linked to this part of the course (Case: The Experiment), you will design your own experiment on paper; genetically modification of viral genes.

Course objectives

To obtain basic knowledge of medical microbiology, i.e. of bacteriology, virology and genetically modification of microorganisms.

To study the characteristics of a selection of micro-organisms in relation to their related infectious diseases, more specific pathogenesis, epidemiology, diagnosis and therapy.

Prerequisites

Co-requisite: PRA3010 Microbiology

No pre-requisites

Corequisites

- Microbiology

Recommended reading

Murray. Medical Microbiology. (7th ed.), Elsevier Mosby.

BIO3003

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
M.J. Mooij
Teaching methods:
Lecture(s), Research, PBL
Assessment methods:
Attendance, Presentation, Assignment, Written exam

Maastricht Science Programme
Molecular Biology

Full course description

The general aim of this course is to obtain detailed knowledge about the molecular processes in cell signalling and control of gene expression. Topics include intracellular signalling pathways; chromatin structure and remodelling; recruitment and assembly of transcription factors; eukaryote mRNA synthesis, processing, modification, stability and translation; stem cells and reprogramming; and the culmination of the above factors that drive common complex human disease. The tutorials will be partially in Problem Based Learning (PBL) and multiple-choice format, with exercises designed to provide a perspective of how cutting edge molecular biological techniques are applied to tackle major research questions in modern biomedical research.

Course objectives

• To get acquainted with the best-characterized cell signaling mechanisms in eukaryotic cells. • To understand gene structure/function and different gene regulatory mechanisms (chromatin remodeling and (post)transcriptional regulation) in prokaryotes and eukaryotes. • To understand how molecular biology, when used in combination with other biological disciplines (e.g. biochemistry, genetics, imaging), can provide tools to understand (diagnostics) and intervene (therapy) in the cellular complexity of human disease.

Prerequisites

Pre-requisites BIO2001 Cell Biology BIO2007 Genetics Co-requisites PRA3003 Molecular Biology

- Genetics
- Cell Biology

Corequisites

- Molecular Biology

Recommended reading

A reader is provided at the start of the course. Other recommended literature source: "Molecular Cell Biology" by Lodish, Berk, Kaiser (W.H. Freeman, 7thedition, 2012. bol.com price €145, international Edition available at amazon.com for a lower price), "Introduction to Genetic Analysis" by Griffiths, Wessler, Carrol, Doebley (W.H. Freeman, 10thedition, International Edition, 2012. bol.com price €64,99), "Molecular biology of the Cell" by Alberts et al.

BIO3001

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[P.A. Da Costa Martins](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Written exam

Maastricht Science Programme
Animal Behaviour

Full course description

This course will introduce you to how behaviour of animals is studied and the (relatively young) history of this field. We will look at the origins (ultimate cause) of behaviour; the function of behaviour in an animal's survival and reproduction, and how behaviours evolve over evolutionary time. We will also look at the proximate causes of behaviour; what triggers behaviours and what is the role of ontogeny (organismal development)? Although the basis of behaviour lies in neurobiology and the brain, these will not be discussed in detail in this course. We will discuss the role of memory and learning in relation to animal behaviour.

Course objectives

• Gain an understanding of how animal behaviour is studied • Understand what triggers behaviour and the importance of behaviour in an animal's chances of survival and reproductive success • Describe types of selective forces that shape the evolution of behaviour • Understand the role of memory, learning and imprinting in behaviour • Gain a general knowledge of the development of the field of animal behaviour and how it is linked to related fields such as neurobiology and psychology
Prerequisites

BIO2005 Evolutionary biology BIO2004 General Zoology* * As this course is offered for the first time in Spring 2015, students can get a waiver if they did not (yet) take General Zoology.

- [Evolutionary Biology](#)
- [General Zoology](#)

Recommended reading

TBA

BIO3004

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[L.I.N.N. van Griethuijsen](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Assignment, Written exam

Maastricht Science Programme
Tropical Ecology

Full course description

Tropical forests are amongst the most species-rich biomes of the world. Yet, our understanding of their evolution, functioning and development are far from complete. There are three main tropical rainforest areas, the Neotropics (Central and South America), Africa and Asia, but for this course you will mainly focus on the Neotropics. You will look at what defines the tropical region, the differences and similarities between the three large blocks of rainforest, and investigate the structure and biodiversity of tropical rain forests. Also, you will look at the development of tropical forests, how biodiversity changes over time (ecologically and evolutionarily) and how trophic levels work within these forests. Furthermore, the role of tropical forests in relation to climate change and global carbon cycling will be investigated, and a link will be made to tropical savannas and dry tropical forests. Finally, you will investigate the IUCN red list and will experience the practices of nature conservation in tropical areas.

Course objectives

Rain forests are perhaps the most interesting of all biomes in the popular imagination. However, rain forests on different continents have fundamentally different characteristics that make each of them unique. Also within continents, regions, or overall zones the differences might be quite large. In this course you will get an overview of the characteristics and importance of tropical rain forests, study their history and think about their future.

Prerequisites

BIO2002 Ecology

- [Ecology](#)

Recommended reading

This skill will use solely primary literature as a basis for the tasks. No text book is required.

BIO3007

Period 2
31 Oct 2016
23 Dec 2016

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
R.H.J. Erkens
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam, Presentation

Chemistry courses

Maastricht Science Programme

Organic Chemistry

Full course description

This course focuses on the basis of organic chemistry. In the first part of the course, important fundamental topics, such as atomic theory, bonding theory, hybridization, molecular orbital theory and resonance will be discussed. A special topic will be stereochemistry, which is an essential topic in organic chemistry and the life sciences, since stereochemistry often determines the activity of biological compounds or medicines. Subsequently, the course continues with an introduction into reactivity of organic molecules. Focus, will be on a selection of fundamental organic reactions, which form the basis for a wide array of other organic reactions. To this end, a logical review will be provided of the reactivity of the most important functional groups, as applied in organic synthesis.

Course objectives

• To give the ability to recognize and name common organic compounds. • To know the basic physical and chemical properties of common organic compounds. • To understand stereochemistry and its impact on the properties and applications of organic molecules. • To enable you to understand the most important organic reactions and be able to apply these reactions to obtain well defined organic compounds.

Prerequisites

Co-requisite PRA2002 Chemical Synthesis

Corequisites

- Chemical Synthesis

Recommended reading

Klein; "Organic Chemistry"; 2th edition; 2015; Wiley (ISBN: 9781118452288)

CHE2001

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinators:
T.J. Cleij
H. Diliën
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Written exam, Attendance, Participation

Maastricht Science Programme
Inorganic Chemistry

Full course description

This survey course will introduce the students to the world of chemistry beyond carbon. As an introductory course it will focus on the principles of bonding and interaction between atoms, both of the main group and the d-block elements. Topics covered include but are not limited to molecular orbital theory, main group elements, acids and bases, coordination chemistry, and the solid state. An introduction to group theory and organometallic chemistry is also included.

Course objectives

• To introduce the student to the general principles of inorganic chemistry • To provide an understanding of the basic bonding relationships amongst atoms in inorganic compounds • To introduce the student to d-block chemistry • To provide a descriptive survey of non-carbon elements and their properties • To provide the basis for the further studies of inorganic chemistry
Prerequisites

Recommended CHE2001 Organic Chemistry PRA2002 Chemical Synthesis Co-requisites PRA2004

Inorganic Synthesis

Corequisites

- [Inorganic Synthesis](#)

Recommended reading

To be determined amongst: Huheey, Keiter, Keiter, Inorganic Chemistry (Harper Collins); Shriver and Atkins' Inorganic Chemistry (Oxford); and Wulfsberg, Inorganic Chemistry (University Science Books)

CHE2002

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinators:
[B. Blom](#)
[F.G.A. Birembaut](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Assignment, Written exam, Participation, Presentation, Attendance

Maastricht Science Programme

Organic Reactions

Full course description

This course focuses on chemical reactivity. In this course, a broad review will be presented of the most important functional groups and their reactivity. This review will not only consist of comparatively simple molecules, such as alcohols, aldehydes, ketones, carboxylic acids and amines, but will also be illustrated with examples from more complex biomolecules. Knowledge of the various types of organic reactions will provide the basic skills to design multistep synthesis sequences to obtain specific organic compounds. In this context special attention will also be paid to organometallic reactions and their importance for multistep organic synthesis. Furthermore, the reaction types will be placed in an appropriate context with regard to practical applicability and industrial processing. Finally, also theoretical aspects regarding reaction mechanisms will be presented.

Course objectives

• To provide a comprehensive overview of chemical reactivity. • To understand the reactivity of most common functional groups. • To be able to present detailed reaction mechanisms for typical organic reactions. • To give the ability to design multi-step reaction sequences to obtain a specific organic compound. • To provide insight into industrial processes to obtain organic chemicals.

Prerequisites

Pre-requisites CHE2001 Organic Chemistry CHE2004 Spectroscopy Co-requisites PRA3001 Advanced Organic Synthesis

- Organic Chemistry
- Spectroscopy

Corequisites

- Advanced Organic Synthesis

Recommended reading

"Organic Chemistry" by Paula Bruice (Pearson, 6th revised edition, 2010)

CHE3001

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
H. Diliën
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Final paper, Written exam, Participation

Maastricht Science Programme
Chemistry for the Future: Generation and Storage of Alternative Energy

Full course description

Although current energy is derived from a variety of sources, most of our energy comes from fossil fuels. However, the amount of these fossil resources is finite and at some stage, alternative sources of energy will have to be developed. Hence, the topic of alternative energy is of considerable interest to researchers in the natural sciences. This course explores these interests from a chemical point of view. Various sources of alternative energy will be discussed. In addition, energy storage solutions will be studied, since the effective storage of energy is of considerable importance for the succesfull implementation of alternative energy. Topics studied in the context of this course are, amongst others, solar power, batteries, hydrogen generation/storage, fuel cells and biomass.

Course objectives

• To understand important sources of alternative energy • To know the basic principles of various methods of generation and storage of alternative energy • To know the chemical principles behind a variety of alternative energy sources and storage methods • To have knowledge of the typical materials utilized in alternative energy production and storage • To be aware of issues relevant to society regarding the implementation of alternative energy sources • To understand the basic principles of physical chemistry in the context of alternative energy

Prerequisites

CHE1001 Introduction to Natural Sciences: Chemistry

• Introduction to Natural Sciences: Chemistry

Recommended reading

"General Chemistry: Principles and Modern Applications" by Petrucci et al. (Pearson, 10th edition, 2010). Selected scientific articles

CHE2005

Period 4
6 Feb 2017
7 Apr 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
B. Blom
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Final paper

Maastricht Science Programme
Transition Metal Chemistry

Full course description

This course will build up on the student's knowledge about the d-block elements acquired in the inorganic chemistry course. The course will start with a review of the basic properties and electronic structure of transition metals, progressing into a deeper understanding of both. The review of crystal field theory will lead into a discussion on spectroscopic transitions and Jan-Teller distortions. A review on the basics of coordination chemistry will also be undertaken, rapidly progressing into a discussion on the different reactions undergone by transition metal coordination compounds and the kinetic and thermodynamic principles behind them. The student will be introduced to organometallic chemistry and its main principles. A selected number of organometallic catalytic cycles will be discussed and analysed.

Course objectives

• To build up on the student's knowledge of d-block elements acquired during Inorganic Chemistry • To allow the student to gain deeper understanding of the electronic structure and properties of d-block elements • To deepen the student's understanding of crystal field theory and its applications in spectroscopy and magnetochemistry • To provide the student with a complex understanding of the reaction types and mechanistic pathways in the coordination chemistry of d-block elements • To introduce the student to organometallic chemistry • To provide a descriptive survey of basic organometallic reactions and their mechanistic pathways • To give the student a brief introduction to molecular catalysis

Prerequisites

Pre-requisites: CHE1001 Introduction to Natural Sciences: Chemistry CHE2001 Organic Chemistry CHE2002 Inorganic Chemistry Recommended Courses: CHE3001 Organic Reactions Co-requisites: PRA3008 Transition Metal Chemistry

- Organic Chemistry
- Inorganic Chemistry

Recommended reading

Shriver and Atkins' "Inorganic Chemistry"; 5th edition (Oxford, 2010)

CHE3002

Period 5
10 Apr 2017
9 Jun 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
B. Blom
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Written exam, Assignment

Maastricht Science Programme

Spectroscopy

Full course description

The emphasis of this course will be on a number of essential topics in the field of spectroscopy. The course will focus on several spectroscopic and chromatographic techniques such as Nuclear Magnetic Resonance (NMR), UV-Vis spectroscopy, FT-IR spectroscopy, gas and liquid chromatography and mass spectrometry. First, the theoretical background and physical basics of the techniques will be

discussed. Then, the reading and interpretation of spectral analysis will be covered. The main focus of the course will be on the acquiring of knowledge and practical expertise to characterize chemical compounds. An analytical strategy to get structural information for unknown molecules from experimental data will be developed.

Course objectives

• To have a basic understanding of the theoretical background of the measurement principles typically used in spectroscopy and spectrometry. • To learn to read and interpret the diverse types of spectral data obtained from the most common spectroscopic techniques. • To learn to identify and characterize chemical compounds using a variety of available analytical techniques. • To be able to develop an analytical strategy to identify an unknown compound.

Prerequisites

CHE2001 Organic Chemistry

• Organic Chemistry

Recommended reading

Spectroscopy; Lampman, Pavia, Kriz, Vyvyan; 4th edition (International Edition): Brooks/Cole

CHE2004

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
H. Diliën
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Participation

Maastricht Science Programme
Physical Chemistry

Full course description

This course focuses on advanced aspects in physical chemistry and how it contributes in solving problems encountered in biology, (bio)chemistry and the environment. Thermodynamics and electrostatics are two of the most important tools that can predict the behaviour of molecules, which can then lead to a broad spectrum of topics related to the life and environmental sciences, including (i) (bio)energetics, (ii) phase transitions, (iii) ion and electron transport, (iv) chemical reaction, (v) (bio)macromolecules and self-assembly, and (vi)physical properties. PBL tasks are embedded to

create an understanding how to apply general principles of physical chemistry to biological, (bio)chemical and environmental problems. Development of plausible models for physical or chemical mechanisms, incl. numerical analytical methods to solve the models and testing against observations/experimental evidence, are essential throughout the course.

Course objectives

• To provide a molecular and mathematical understanding of basic concepts in physical chemistry on a more advanced level. • To explain and describe the behaviour of systems when temperature and pressure is changed. • To apply the general principles of thermodynamics in understanding and description of chemical and environmental processes like bookkeeping heat by means of enthalpy when solutions mix. • To demonstrate how molecules interact in terms of electrostatics, from reacting to an existing field to inducing one. • To present how these interactions apply in known (bio)systems and can predict physical properties of molecules.

Recommended reading

Atkins, P., De Paula, J. (2009) Physical Chemistry (9th ed.) Oxford University Press

CHE2003

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinators:
[J.A.W. Harings](#)
[F.G.A. Birembaut](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Presentation, Written exam

Maastricht Science Programme
Industrial Chemistry

Full course description

The main purpose of this course is to bring alive the concepts forming the basis of the chemical process industry. The production of chemicals entails specific solutions to problems related to process control, upscaling, energy use, unit operations, etc. which are often governing the choice of certain processes over other alternatives. Some insight in chemical reactors is required in order to fully appreciate industrial aspects of the production of organic as well as inorganic basic chemicals. If there is an opportunity, the curriculum will be illustrated with a plant visit at Chemelot.

Course objectives

- to make the students familiar with chemical process industry; - to gain knowledge of the basic industrial processes for basic organic and inorganic products; - to make the students understand the specific challenges industry copes with.

Prerequisites

CHE1001 Introduction to Natural Sciences: Chemistry CHE2001 Organic Chemistry Recommended CHE2002 Inorganic Chemistry

- [Organic Chemistry](#)

Recommended reading

"An introduction to industrial chemistry" by A. Heaton (Springer, 3rd edition, 1996).

CHE3005

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)

ECTS credits:
5.0

Instruction language:
English

Coordinator:
[K.V. Bernaerts](#)

Teaching methods:
Lecture(s), PBL

Assessment methods:
Participation, Written exam

Maastricht Science Programme

Modern Catalytic Chemistry

Full course description

This course will provide a comprehensive introduction to the topic of catalysis, with a focus on homogeneous catalysis mediated by organometallic compounds; and emphasis on modern chemistry and key processes. Each week a different important and relevant catalytic process will be reviewed in detail: Polymerisation and selective oligomerisation; catalytic C-C coupling reactions; Hydroformylation (including the Monsanto process); Hydrosilylation (with modern developments) and other hydrometalation reactions; catalytic metathesis (alkene and alkyne), and their applications in some modern cases studies; etc. It is recommended that this course is taken after CHE 3002, or concurrent, as the key fundamental reaction steps are organometallic in nature.

Course objectives

• To outline, describe and discuss the essential principles of catalysis. • To provide a survey of the different types of chemical catalysis, to include transition metals, organocatalysis. • To introduce the state-of-art in the field, illustrated by appropriate examples. • To examine case studies of key reactions for the synthesis of fine chemicals. • To provide the basis for the further studies in this rapidly- moving field, and to link catalysis to other areas of chemistry.

Prerequisites

Pre-requisite: CHE2001 Organic Chemistry Recommended CHE2002 Inorganic Chemistry CHE3001 Organic Reactions CHE3002 Transition Metal Chemistry

• Organic Chemistry

Recommended reading

To be determined amongst: Organic Chemistry (Bruice), Inorganic Chemistry (Shriver and Atkins), Organic Chemistry, 2nd ed. (Clayden, Greeves, Warren), Catalysis in Asymmetric Synthesis, 2nd ed. (Caprio, Williams), Applied Organometallic Chemistry and Catalysis (Whyman). Primary scientific and patent literature as appropriate: Crabtree : The Organometallic Chemistry of the Transition Metals": N.B. C. Elschenbroich Organometallics

CHE3004

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
B. Blom
Teaching methods:
Lecture(s), PBL
Assessment methods:
Assignment, Presentation, Take home exam, Participation

Maastricht Science Programme
Quantum Chemistry

Full course description

This course will start by focusing on the basics of quantum chemistry and the solving of the Schrödinger equation and utilising it to describe the particle in a box model. We will then move forward and use the model to describe atoms and then diatomic molecules, linking it to the rise of quantum numbers. The course will then move onto valence chemistry and the LCAO model to predict some of the properties of diatomic molecules finishing with Hückel theory to demonstrate organic molecules' reactivity.

Course objectives

• To apply the quantum model to describe real chemical examples • To predict some molecular properties by solving quantum chemistry equations • To recognise and critique the failures of the model

• Mathematics for the Natural Sciences

Recommended reading

Physical Chemistry by Peter Atkins (please check edition with coordinator) Molecular Quantum mechanics by Peter Atkins (optional)

CHE3006

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
F.G.A. Birembaut
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Participation

Maastricht Science Programme
Biochemistry

Full course description

Biochemistry is considered the mother of all Life Sciences. Understanding Biochemistry will facilitate learning of more specialised Life Sciences such as Molecular and Cell Biology. This course addresses the biochemistry of the molecular components of cells. We will cover the structures, functions and interactions of the biomacromolecules, including proteins, lipids, carbohydrates, DNA and RNA, which perform many of the activities associated with life. We will provide insight in the specificity and action of enzymes, the biocatalysts of the cell. Further, we will explain principles of the regulation of metabolic pathways that result in the generation of ATP, the major energy currency of the cell. We will highlight the biochemistry of the central dogma (gene --> protein). The theory studied in this course will be explained by examples of biochemistry in every day life. For instance how DNA profiling works in forensic science and how a mutation in a gene changes structure and function of proteins and causes diseases such as sickle cell aneamia.

Course objectives

At the end of the course you will be able to: • define Biochemistry and the science of Biochemistry. • describe the general structure and function of the biomacromolecules such as proteins, lipids, polysaccharides and nucleotides. • understand principles of synthesis and degradation of biomacromolecules. • explain the specificity and action of enzymes, the biocatalysts • enter higher level courses on Biochemistry and Molecular Biology to finally allow entrance to various Master programs in the Life Sciences.

Recommended reading

• Berg, J.M., Tymoczko, J.L., Stryer, L. (2015) Biochemistry. 8th ed. W.H. Freeman • Nelson, D.L. Cox, M.M. (2016) Lehninger Principles of Biochemistry. 8th ed. W.H. Freeman • Devlin, T.M. (2011) Textbook of Biochemistry with Clinical Correlations. 7th ed. John Wiley & Sons • Kuriyan, J. Konforti, B., Wemmer, D. (2013) The Molecules of Life. 1st ed. Garland Science • Garrett and Grisham. Biochemistry. (4th ed.). Thomson Brooks/Cole

CHE2006

Period 2
31 Oct 2016
23 Dec 2016

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinators:
C.P.M. Reutelingsperger
N.M. Deckers
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Presentation

Interdisciplinary courses

Maastricht Science Programme
Introduction to Biomedical Engineering

Full course description

Biomedical engineering is a highly interdisciplinary field at the interface between engineering and medicine and biology. In biomedical engineering, principles and methodologies typical of engineering are applied to solve problems from the medical and biological sciences. This course will introduce (some of) the subdisciplines within biomedical engineering, including systems physiology, bio-instrumentation, bio- medical signal analysis and bio-medical imaging. General issues of each of the

subdisciplines will be illustrated together with selected examples and neuroscience applications.

Course objectives

To provide an overview of the different fields of biomedical engineering.

Prerequisites

None.

Recommended reading

Various book chapters and research articles

INT1003

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[F. de Martino](#)
Teaching methods:
Lecture(s), Assignment(s), PBL
Assessment methods:
Assignment, Attendance, Written exam

Maastricht Science Programme
Basic Principles of Pharmacology

Full course description

Pharmacokinetics (what the body does to a drug) and pharmacodynamics (what a drug does to the body) describe basic principles that are important for predicting and understanding drug effects in the human body. Pharmacokinetics can be defined as the characterization of transport processes of drug in the body throughout the phases of absorption, distribution, metabolism and excretion. These transport processes are usually studied in blood or blood plasma and evaluated in terms of pharmacokinetic parameters such as clearance, volume of distribution and elimination half-life. These principles are of particular importance in the clinical use of drugs when dealing with pharmacodynamic issues such as drug interactions, concentration response relations, therapeutics versus non therapeutic effects, dosing schedules and differential drug actions at receptor sites. The course will discuss two important (psycho)pharmacological principles of receptors: first, they are organized in multiple subtypes, and second, their interaction with drugs can be defined as agonist, partial antagonist, antagonist and inverse agonist. The course will cover the major principles of signal transduction, in particular in relation to the nervous system. Furthermore, the basic principles of drug metabolism and toxicity will be discussed. Finally, the process of drug discovery and development is a

topic of interest.

Course objectives

• To explain the basic principles of pharmacokinetics and pharmacodynamics of drugs.

Prerequisites

None.

Recommended reading

Katzung BG et al. Basic and clinical pharmacology. McGraw Hill (11th edition), 2009, e-version via library

INT1002

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinators:
E.F.P.M. Vuurman
B.J.A. Janssen
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Written exam, Assignment, Attendance

Maastricht Science Programme
Commercializing Science and Technology

Full course description

Commercialising Science & Technology helps you to understand and master the entrepreneurial process of turning science into products and products into businesses. University labs and corporate R&D department increasingly rely on professionals that help bridging the gap between science production (conference presentations, scientific publications, and patents) and commercial value creation (revenues, funding for scientific and applied research). Not only corporate research labs, also academic research groups increasingly need to be able to legitimize how their research might ultimately result in economic activity. For example, obtaining a research grant from public sponsors is (partially) dependent on the researchers' ability to explain the commercialization of the scientific insights that they seek to produce. In addition, industry-university collaboration has become more intense. As a result, researchers need to understand how their work relates to the functioning of companies. In this course you start building an understanding for the bridging of science to business. It provides insight in technology transfer and licensing as well as an understanding of the dynamics of

science production and deployment. In addition, the course will provide insights into the characteristics of an "entrepreneurial spirit" and students will experience to what extent they themselves have an "entrepreneurial spirit".

Course objectives

• Primary goal: o To understand how and when research findings and technological breakthroughs can be transformed into new business. o To foster an entrepreneurial spirit • Secondary goals: o To understand how technology can be transferred from research labs to start-ups and established companies. o To understand the role of academic and other not-for-profit research labs in creating business opportunities. o To understand how the patenting process. o To appreciate the characteristics of the prevalent modes of science and technology commercialisation: licensing, spinning out and new business development.

Recommended reading

We will provide a reader with suggested papers and (at cost price) a reader with cases. In addition, the following handbook can provide useful background information for each of the topics covered in this course. Its reading is however not required. Shane, S. 2004. Academic Entrepreneurship: University Spinoffs and Wealth Creation. Aldershot: Edward Elgar.

INT1005

Period 5
10 Apr 2017
9 Jun 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
M.A. Carree
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Participation, Written exam, Final paper

Maastricht Science Programme
Science in Action

Full course description

This course is situated in the field of Science and Technology Studies (STS) and analyses the social and cultural complexities involved in the production and dissimination of scientific knowledge. We wil take the idea that most knowledge production today happens in a context of multi- disciplinarity, as our point of departure. This perspective will help us to understand how science operates in today's complex world. To gain insight in science we zoom in on the organization of knowledge production and its collaborative character. We also study processes in which credible facts are established and

published. Furthermore, this course also pays attention to the integrity of science and in particular its grey areas. Beside the immediate context in which scientific facts are established (i.e. the lab), the course also takes into account the wider socio-economic context in which science operates. This involves not only the commercialization of science, but also the way its promises and expectations are related to our hopes and fears. Finally, you will gain insights into the way the cultural-historical contexts affects the interpretation of facts. Based on discussions and analyses of these topics the course aims to make you reflect critically on 'common sense' views of the making and use of scientific claims. Besides tutorial meetings, the course also involves lectures, discussion meetings, video analysis, and a visit to a scientific lab for an interview. Students will engage in intensive hands-on project work during this course, whereby they will examine changes in the organization of scientific practice in a domain of their choosing.

Course objectives

• Students gain insight into the contemporary challenges and dynamics of knowledge production in the sciences. • Students gain insight into the complexities of how scientific knowledge is distributed and communicated in society. • Students reflect critically on 'common sense' views of the making and use of scientific claims.

Recommended reading

• E-Reader. • UM library.

INT2007

Period 2
31 Oct 2016
23 Dec 2016

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
C.M.W. Douglas
Teaching methods:
PBL, Lecture(s), Assignment(s)
Assessment methods:
Attendance, Assignment, Participation, Presentation, Observation

Maastricht Science Programme
Biomaterials

Full course description

The ultimate goal of this course is to introduce the students to the field of biomaterials science. Biomaterials are (mostly synthetic) materials that are intended to improve treatment humans or animals. There are different classes of biomaterials, among which are synthetic and biobased (green) polymers, ceramics, fibers, etc. The exact structure and physico-chemical characteristics of these

biomaterials will be explained. For instance, the exact composition, elasticity, biodegradation, chemical reactivity, stability, surface chemistry and topology are important parameters. The techniques that are used to evaluate the physical, chemical and biological characteristics of biomaterials are, consequently, an important subject in this course. Biomaterials are used in contact with tissues, the skin, or body-fluids and have to possess a number of special characteristics to be applicable. The response that is provoked from the contacting tissue is critically important. Therefore, the exact interaction between tissue and cells with the different biomaterials has to be studied. The concepts of biocompatibility, biosafety, toxicity, blood- and cyto- compatibility will be introduced and explained in this course. Detailed information on the methods that are used to determine the biological response of a biomaterial will be provided. In the practical part of the course the students will be introduced to basic techniques involved in the characterization of biomaterials and determination of biocompatibility.

Course objectives

• To give an overview of all materials that are being applied as biomaterials. • To understand the synthesis and structure of different biomaterials; polymers, hydrogels, ceramics, fibers, etc. • To provide a detailed understanding of the interaction of biomaterials with surrounding tissues and the complete organism. • To introduce the student to the evaluation, characterization, and testing of biomaterials.

• Organic Chemistry

INT3003

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
P. Habibovic
Teaching methods:
Lecture(s), PBL, Research
Assessment methods:
Attendance, Written exam, Presentation, Final paper

Maastricht Science Programme
Molecular Toxicology

Full course description

Human molecular toxicology studies the molecular mechanisms underlying toxicity of compounds in man. The conversion to reactive intermediates and metabolites is key in the actual toxicity of compounds. Therefore, the role of metabolism in the formation of metabolites and reactive intermediates and the protection against these species is extensively addressed. Moreover,

compounds generally display a toxicity that is restricted to a specific organ and type of toxicity. This concept of selective toxicity is elaborated. Focus is on redox-controlled processes in biotransformation and in modulation of cell function. Topics include a survey of the molecular mechanisms determining (selective) toxicity; the versatility of enzymes, such as cytochrome P450 and glutathione S-transferases in the biotranformation of compounds; consequences of genetic polymorphisms of biotransformation enzymes; chemical and biological properties of various classes of reactive intermediates; structure-activity relationships and other approaches applied to predict metabolism; and strategies to reduce toxicity.

Course objectives

• To gain knowledge on experimental approaches to identify and quantify metabolites, reactive intermediates and their selective interaction with specific cellular target molecules (selective toxicity) • To get acquainted with the procedures applied to assess the toxicity of drugs and chemicals. • To understand the role of bioactivation and bio-inactivation in the toxicity of drugs and other xenobiotics. • To be able to apply strategies used to predict toxicity • To understand strategies to reduce or prevent toxicity • To understand risk factors involved in inter-individual susceptibility to xenobiotics, including genetic polymorphisms, drug- drug and food-drug interactions.

Prerequisites

INT1002 Basic Principles of Pharmacology CHE1001 Introduction to Natural Sciences: Chemistry

- Introduction to Natural Sciences: Chemistry
- Basic Principles of Pharmacology

Recommended reading

A selection of scientific papers will be provided during the course.

INT2008

Period 4
6 Feb 2017
7 Apr 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
G.J.M. den Hartog
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Written exam, Presentation

Maastricht Science Programme

Science and the Visual Arts

Full course description

Contemporary conservation of paintings, sculptures and other works of visual art is unthinkable without the natural sciences. Chemists investigate the behaviour of paints and other materials like plastics in order to prevent or repair degradation. Sophisticated spectroscopic techniques are employed to look through paint layers and discover hidden information. Building materials are subjected to artificial aging processes in order to better protect them from wear and tear. Time and again, however, the question is raised whether these techniques succeed in capturing the 'artiness' of the artworks. The introduction of scientific investigation methods has thoroughly changed the practice of fine arts conservation and restoration, but not without provoking debates with art-historically trained conservation professionals, who favour the educated eye of the connoisseur above the graphs of the spectrometer. This course will trace the growing impact of the sciences in fine art conservation since the late 19th century and how it has reframed the way museums define their task of preserving and presenting cultural heritage. Actual case histories, like the 'cleaning controversy' of 1947 and the recently completed Victory Boogy Woogy research project will illustrate both the tensions and the fruitful collaborations between the scientific and the aesthetic approaches to art. Visits to conservation laboratories (e.g. SRAL, RCE) and talks with practising conservators and conservation scientists will be part of the course. Parallel to the tutor meetings students work collectively on a practical conservation research assignment.

Course objectives

• To get acquainted with an important field of applied scientific research: conservation science • To obtain understanding of the historical development of conservation science as a discipline and profession. • To obtain understanding of how scientific practices function in cultural contexts such as fine arts conservation. • To recognise the debates and controversies scientific research and its applications may raise in the context of the arts. • To acquire hands-on experience with the laboratory practice of fine arts conservation.

Prerequisites

None.

Recommended reading

Selected articles and chapters will be provided to the students

INT3010

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[R. van de Vall](#)

Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Presentation, Written exam

Maastricht Science Programme
Philosophy of Technology

Full course description

Technology is everywhere. From smartphones to GMOs, from the internet to biomedicine – it helps shape how we communicate, what we eat, what we know and how we age. But can we even agree on what 'technology' is? Is it merely applied science? A neutral tool, that's used for better or worse? Or is it an autonomous force running on a logic of its own? Do we need to develop new concepts and tools in order to understand modern technologies? And what can technology tell us about what it means to be human? This course offers an overview of key approaches and issues in classic and modern philosophy of technology, in order to help students better reflect on what technology is and how specific technologies impact our society. We will explore important theoretical notions like 'technological determinism', 'technological solutionism', the 'co- constitution of technology and society', and the idea that technologies can have a politics – even a morality – 'designed into' them. We will see how these notions apply to some heated public debates, including human enhancement, privacy online, and smartphone etiquette. And we will consider such questions as 'what is the relationship between technology and the good life?', and 'how does technology shape our own experience of the world?

Course objectives

• To introduce a number of key thinkers, approaches and issues in the philosophy of technology. • To grasp the important contribution philosophy can make to understanding technological development and to making sense of contemporary debates and controversies surrounding technological innovations in society. • To further acquaint students, following course PRO1001, with humanistic interpretations and analyses of science and technology. • To provide philosophical tools to reflect on the political, ethical and social impact of technology on the contemporary world.

Prerequisites

PRO1001 Philosophy of Science

• [Philosophy of Science](#)

Recommended reading

A list of readings will be provided in the course manual; additional readings to be found by students.

INT3001

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)
ECTS credits:

5.0
Instruction language:
English
Coordinators:
[T. Schneidleder](#)
[T. Sharon - Schneidleder](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Presentation, Written exam

Maastricht Science Programme
Nanomaterial Science and Technology

Full course description

This course will start with an overview on the potential use of nanotechnology and materials. Secondly the production of nanomaterials by the so-called bottom-up approach will be discussed. Working with nanomaterials demands a variety of high-end analytical techniques. By looking at the principles of these techniques a better insight will be obtained on their use and restrictions. As most nanomaterials will have different physical properties as their bulk counterpart the potential environmental and human health impacts has to be assessed. In this part of the course an overview of the discussion on this impact will be presented. The last part of the course will focus on the application of nanoparticles in coatings with a focus on the processing and stability of the particles and the different applications of these coatings

Course objectives

• To have an understanding of the potential of nanotechnology and a keen insight in the latest developments of nanotechology • To have an understanding of some of the major synthetic routes to obtain nanomaterials • To obtain an understanding of the analytical methods needed for the analysis and characterisation of nanomaterials • To have an understanding of potential environmental and human health impacts of nanomaterials • To be familiar with the use of nanoparticles in the application field of coatings.

Prerequisites

PHY1001 Elements of Physics

• [Elements of Physics](#)

Recommended reading

Will be based on a collection of relevant scientific papers and textbooks.

INT2001

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
T.J. Cleij
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Presentation, Participation

Maastricht Science Programme
Science and Sustainable Development

Full course description

Achieving sustainable development is one of the greatest challenges of the 21st century. Sustainability issues, such as climate change or resource scarcity, typically refuse to sit neatly within traditional academic disciplines. This common factor makes these challenges difficult to grapple with, whether as researcher, businesses, or governments, and therefore for societies as a whole. This course introduces students to the concept of sustainable development, focusing in particular on the relation with the natural sciences. The first part of the course aims at developing the students' understanding of the main concepts underlying the complex issue of sustainable development. Departing from an interdisciplinary and integrative perspective, they will explore topics including the Tragedy of the Commons and biogeochemical cycles. In this context, we will focus on two of the most pressing (and interrelated) sustainability issues: climate change and (material) resource use. Key terms discussed are, for example: climate system (feedbacks), enhanced greenhouse effect, carbon footprint, and life cycle assessment. Subsequently, students will work on a case study. The case deals with the sustainability of electric cars can how they may become a successful technological innovation for a sustainable society.

Course objectives

• To gain a basic understanding of the concept of sustainable development from an interdisciplinary and integrative perspective, and of the possible contribution of science to sustainable development. • To explore two of the most pressing (and interrelated) sustainability issues: climate change and (material) resource use • To apply this knowledge in a 'sustainability assessment' case study.

Recommended reading

Each task discusses a few selected articles that will be available as E- readers.

INT2002

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:

5.0
Instruction language:
English
Coordinator:
[A.E. van Zeijl - Rozema](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Participation, Final paper, Written exam

Maastricht Science Programme
Advanced Microscopy: Theory and Applications

Full course description

The use of advanced imaging techniques in light and electron microscopy is wide-spread, particularly in the fields of material science and biological imaging. In recent years, the resolution and/or functionality of such tools has been increased due to the development of fluorescence microscopy, two-photon excitation microscopy, correlative light-electron microscopy and stimulation emission depletion (STED) microscopy [first experimentally shown by the winners of the 2014 Nobel Prize in Chemistry]. In electron microscopy, rapid developments in aberration correction and in image filtering allow users to understand much more about the samples they are investigating. This course will introduce a number of advanced imaging techniques to participants, detailing theoretical aspects as well as practical considerations. This course is aimed any students from the programme with an interest in imaging and its principles.

Course objectives

• To acquaint the student with an understanding of principles of (light) microscopy and limiting factors in resolution • To introduce and detail a number of microscope designs and theory as to how they overcome the resolution limit • Introduction and understanding of electron microscopy and its application to material science and biological imaging • To explain sample preparation procedures and perform a demonstration of some of the equipment

Prerequisites

BIO1001 Introduction to Natural Sciences: Biology MAT1001 Introduction to Natural Sciences: Calculus or PHY1002 Introduction to Natural Sciences: Mathematical Foundations of Physics Recommended PHY1001 Elements of Physics

Recommended reading

TBC

INT3002

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)

ECTS credits:

5.0

Instruction language:

English

Coordinator:

M.A.M.J. van Zandvoort

Teaching methods:

PBL, Lecture(s)

Assessment methods:

Assignment

Maastricht Science Programme
Biobased Materials and Technology

Full course description

Presently, a transition from petrol-based to a more sustainable and biobased society is taking place. This change is driven by the predicted depletion of oil-reserves. This creates an opportunity to not only replace currently made plastics and polymers with sustainable Biobased alternatives, but also to produce new materials with additional useful functionalities derived from biological renewable sources. This requires a multidisciplinary approach in which production of biological resources, its processing and possible modification are first steps. New technologies may be required to indeed obtain the right methods and synthesis routes to produce the new Biobased materials for applications in healthcare, consumer products and other applications. In this course the different aspects of the field of Biobased Materials will be studied. The aim is to create a critical, but also creative attitude towards Biobased materials and technologies in general. The students should be able to recognize the challenges and possibilities with respect to materials in the transition towards a Biobased economy and society.

Course objectives

• To understand what Biobased Materials are and what their impact is on society • To create an understanding of sources of Biobased intermediates, building blocks and materials • Get an insight in the synthesis and production methods of intermediates, building blocks and Biobased Materials • To deepen understanding of the relation between material composition, properties and material applications • To study the added value (if any) of Biobased Materials • To study the impact of Biobased materials and technologies on the environment (biodegradation, sustainability, CO_2 footprint)

Prerequisites

Recommended CHE2001 Organic chemistry (strongly recommended)

Recommended reading

A list of selected papers will be provided in the course manual.

INT3005

Period 2

31 Oct 2016

23 Dec 2016

[Print course description](#)

ECTS credits:

5.0

Instruction language:

English

Coordinators:

[M.L.W. Knetsch](#)

[Y. van der Meer](#)

Teaching methods:

Lecture(s), PBL

Assessment methods:

Assignment, Presentation, Written exam

Maastricht Science Programme

Creativity and Concept Development of New Business

Full course description

This is not an ordinary course. Think of it as a ideation laboratory where you will learn by doing. We do not offer lectures or tutorials, but host a series of interactive workshops. In the course we work with Chemelot based companies that each year contribute a challenge that the class will work on. That challenge relates to finding commercial promise for new materials. Such materials are developed in research labs at universities and companies. A key role of corporate R&D-labs is to translate novel technology into new products and new business. Customer feedback may also trigger product and business development. Envisioning how novel technology can be used to develop and market new products is an inherently creative process that should not only be mastered by entrepreneurs and business developers, but also by scientists and technologists. This course is focused on developing your competence at two important tasks for the creation of new business: [1] discovering (technological) opportunities, [2] developing product concepts, value propositions and business models. During this course we will touch upon important aspects of creative problem solving. But, most of all, we will provide you with insights that will help you to develop your own creative skills. The starting point of the course is our belief that creativity is a skill that can be learned and trained. We will follow different paths to help you investigate your own creativity skills and to find the best way to improve them.

Course objectives

• To be able to apply creativity techniques to problem solving • To understand how creativity can be used to transform technology into product concepts. • To be able to draft value propositions and business models that result from product ideation.

Prerequisites

Recommended: INT1005 Commercialising Science and Technology

- [Commercializing Science and Technology](#)

Recommended reading

Reader with papers

INT3006

Period 1

5 Sep 2016

28 Oct 2016

[Print course description](#)

ECTS credits:

5.0

Instruction language:

English

Coordinator:

W.E.J. Bodewes

Teaching methods:

Lecture(s), Working visit(s), PBL, Skills

Assessment methods:

Attendance, Final paper, Written exam

Maastricht Science Programme

Regenerative Medicine

Full course description

Regenerative medicine has been defined as an interdisciplinary field that integrates principles of engineering and life sciences to develop biological substitutes that restore, maintain, or improve tissue and organ functions. Three main gears are generally needed to achieve tissue regeneration: cell-based therapies, tissue-inducing factors, and biocompatible matrices or scaffolds. These components have been investigated singularly or in combination to create engineered tissues. Regenerative medicine research includes the following areas: • Biomaterials: including novel biomaterials that are designed to direct the organization, growth, and differentiation of cells in the process of forming functional tissue by providing both physical and chemical cues. • Cells: including enabling methodologies for the proliferation and differentiation of cells, acquiring the appropriate source of cells such as autologous cells, allogeneic cells, xenogeneic cells, stem cells, genetically engineered cells, and immunological manipulation. • Biomolecules: including growth and other differentiating factors. • Engineering design aspects: including 2D cell expansion, 3D tissue growth, bioreactors, vascularization, cell and tissue storage and shipping (biological packaging). • Biomechanical aspects of design: including properties of native tissues, identification of minimum properties required for engineered tissues, mechanical signals regulating engineered tissues, and efficacy and safety of engineered tissues In this course, we will introduce most of these elements through some examples that have already successfully reached the clinics and others that have still to be further improved to enter daily clinical practices.

Course objectives

The objectives of the course "Regenerative Medicine" are to introduce students to classic and novel concepts at the base of strategies to regenerate tissues and organs. The courses will briefly overview

the biomaterial classes used to fabricate scaffolds and the processing technologies used for fabrication. Further insights on cell sources and cell nutrition will be explained. Different applications will be discussed spanning from skin to skeletal tissues and organ regeneration. After attending the course, students will be able to understand: • biomaterials and processing technologies used to fabricate scaffolds for tissue engineering; • cell sources and activity; • cell nutrient limitations in engineered tissues and technologies used to enhance cell viability; • successful and unsuccessful strategies to regenerate tissue and organs; • ethical principles revolving around regenerative medicine and clinical applications.

- Cell Biology
- Organic Chemistry

Recommended reading

"Tissue Engineering", editors J. de Boer and C.A. van Blitterwijk, Academic Press Series in Biomedical Engineering, Elsevier Inc (2015). "Principles of Regenerative Medicine", editors A. Atala, R. Lanza, J.A. Thomson, and R.M. Nerem, Elsevier Inc (2008).

INT3008

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Coordinator:
L. Moroni
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Presentation, Written exam, Final paper

Maastricht Science Programme
Systems Biology

Full course description

The goal of this course is to introduce the students to the field of systems biology. With the progress of genome sequencing and other -omics technologies, a wealth of multilevel data on the molecular nature of biological systems has been generated. Although systems are composed of elements, the essence of a system lies in its dynamics and interactions. It is evident that neither the biologist nor the mathematician is capable of integrating their current expertise and knowledge in the required way. That is the gap systems biology has to fill. Systems biology is a new approach to biological and biomedical research based on a more holistic perspective and relying on the use of mathematical and computational models, complementing experiments in the lab. This course provides an overview of systems biology and its building blocks, experimental approaches, and a variety of mathematical models and tools. Students will be introduced to the mathematical basis of evolution, dynamics systems, networks, and constraint based modelling. We discuss many examples from amongst others cancer metabolism and neuroscience. Practical skills will be trained by carrying out computer

experiments. Successful participation at this course is the perfect preparation for a Master in Systems Biology.

Course objectives

• To give a thorough overview of the relevant areas of Systems Biology • Studying relevant Mathematical and Computational techniques • Understanding complex and multiscale Biological processes • Learning students to apply this knowledge in concrete biomedical contexts • Integrate mathematical and biological concepts • To introduce the student to the major Systems Biology tools and software

Recommended reading

Hand-outs will be distributed during the course. Recommended Literature: Eberhard O. Voit, A first course in systems biology, 2013, Taylor & Francis Group, ISBN 978-0-8153-4467-4. Bernhard O. Palsson, Systems Biolog – Constraint-based Reconstruction and Analysis, 2015, Cambridge University Press, ISBN 978-1-107-03885-1.

INT3007

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)

ECTS credits:
5.0
Coordinator:
Z.I.T.A. Soons
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment

Mathematics courses

Maastricht Science Programme
Differential Equations

Full course description

This is a course about the art of using differential equations to model different phenomena in Physics, Chemistry and Biology. A differential equation is a mathematical equation for an unknown function of one or several variables that relates the values of the function itself and its derivatives of various orders. Differential equations can be broadly classified as linear and nonlinear, and ordinary and partial. This course is limited to linear and nonlinear ordinary differential equations. We will focus on understanding whether these differential equations have a solution, and if so, what properties this solution has. We will see how to solve first order and higher order differential equations including linear differential equations, second order differential equations with constant coefficients,

undetermined coefficients, and variation of parameters. Since nonlinear differential equations are the main tool in the Natural Sciences and the differential equations occurring in real applications almost never can be solved analytically, we will see different methodologies for solving differential equations.

Course objectives

• To develop the insight that certain problems in the natural sciences can be described through functions and differential equations and can be solved by techniques such as integration, differentiation, optimization. • To be able to classify differential equations by type and order. • To be able to solve specific types of differential equations (e.g., linear differential equations, second order differential equations with constant coefficients, undetermined coefficients, and variation of parameters). • To have some understanding of how to use series, Laplace transforms, and numerical methods to solve differential equations.

Prerequisites

MAT1002 or MAT2004 Linear Algebra The student should be familiar with basic rules of differentiation and integration in order to understand the theoretical lectures and being able to solve the exercises during the tutorials.

• Linear Algebra

Recommended reading

Hand-outs will be distributed during the course. Examples of books on differential equations are: An Introduction to Ordinary Differential Equations – J. C. Robinson – 2004 – Cambridge University Press Introductory Differential Equations, 4th Ed. – Martha L. Abell and James P. Braselton – 2014 – Elscae Nonlinear dynamics and Chaos, 2nd Ed. – Steven H. Strogatz – 2014 – Westview Press

MAT3004

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Attendance, Written exam

Maastricht Science Programme
Numerical Mathematics

Full course description

Numerical Mathematics is a branch of mathematics dealing with the development analysis and application of methods for the solution of problems in the sciences and engineering using digital

computers working with finite-precision numbers. Since the development of high-performance digital computing, numerical mathematics has become a cornerstone of modern science, since many mathematical formulations of scientific problems cannot be solved analytically, requiring the application of numerical methods. In this course we address essential concepts in numerical mathematics, and algorithms for the solution of some core problems in the mathematical sciences, including floating-point numbers, algebraic equations, polynomial interpolation, integration and differentiation, ordinary differential equations, least-squares approximation, Fourier series, systems of linear equations, and matrix eigenvalues.

Course objectives

• To provide an understanding of core techniques in scientific computing. • To have an understanding of theoretical properties of numerical algorithms. • To be able to analyse which methods are appropriate or inappropriate for the solution of a given problem. • To be able to modify existing numerical methods to solve new problems. • To provide the students with necessary background knowledge and skills to numerically solve problems arising in later courses and in scientific practise.

Prerequisites

Pre-requisite: PRA2003 Programming MAT1005 Mathematics for the Natural Sciences Recommended: MAT1002 or MAT2004 Linear Algebra

- [Programming](#)
- [Mathematics for the Natural Sciences](#)

Recommended reading

J. Douglas Faires & Richard Burden, "Numerical Methods" (International 4th Edition) ISBN-13:978-0-495-38569-1 (Recommended; not required) Curtis F. Gerald & Patrick O. Wheatley, "Applied Numerical Analysis" (7th Edition) ISBN-13: 978-0-321-13304-5 (Suggested alternative)

MAT2003

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[P.J. Collins](#)
Teaching methods:
Lecture(s), PBL, Skills
Assessment methods:
Attendance, Written exam, Assignment

Maastricht Science Programme

Imperative Programming

Full course description

The course provides the basics of computer science and computer programming. After a short introduction to computer organization, the principles of structured programming in Java are presented. The main topics of the course are: data types, statements and sequential execution, conditional statements, loops, methods, and recursion. No prior programming experience is assumed.

Course objectives

• To have an understanding of general computer software architecture, program organization, and data representation. • To have the ability to write computer programs using an imperative programming language, such as Java. • To obtain the skills needed to recognize problems in source code and how to use the appropriate tools and/or methods to fix them ("debugging"). • To gain an understanding of good programming practices, such as proper indentation, following programming conventions, and writing efficient programs. • To have sufficient background for further, more advanced, courses in the computer science track.

Prerequisites

MAT1001 / PHY1002 Mathematical Foundations of Physics

Recommended reading

"Think Java: How to Think Like a Computer Scientist" by Allen B. Downey (Green Tea Press, 2012).

MAT1004

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
G. Spanakis
Teaching methods:
Lecture(s), PBL, Work in subgroups
Assessment methods:
Assignment, Computer test, Attendance, Written exam

Maastricht Science Programme

Game Theory

Full course description

What is a game? The word game may make you think of things like poker, chess or backgammon, within the context of this course its meaning is far broader. A game is basically a decision problem in which several parties are involved. Generally these parties have different and conflicting interests, and often there is no solution to the decision problem that will make all parties happy. The parties in the conflict are normally called players (or agents), but one should keep in mind that these may just as well be firms competing for their market shares, animals fighting over a territory, children trying to get the biggest piece of cake, or politicians fighting over the distribution of budgets. We encounter very fundamental issues like rationality, expectations, fairness, power, cooperation, threats, manipulations, risk, stability. In some games everything depends on strategic possibilities of the players. In such games we also encounter information structures; what does each player know about the other player's possibilities and goals. Does A know that B knows that A knows that B knows etc? Game Theory: Game Theory analyzes different types of games and their solution concepts. Analyzing, or solving, a game boils down to answering a mathematical question and then interpreting the result. In the games that we discuss in the Game Theory course the solution depends on strategic possibilities of the players. We will discuss the games in order of increasing strategic possibilities, which means that as the course progresses, the games become more complex. Many examples shall be discussed to clarify the issues and many exercises will be provided to learn how to compute solutions.

Course objectives

To familiarize the students with the mathematical fundamentals of Game Theory

Prerequisites

MAT1001 / PHY1002 Mathematical Foundations of Physics

- Mathematics for the Natural Sciences

Recommended reading

Lecture Notes Introduction to Game Theory by Frank Thuijsman will be provided.

MAT3003

Period 4
6 Feb 2017
7 Apr 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
G.M. Schoenmakers
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Data Structures and Algorithms

Full course description

This course will treat the systematic design and application of data structures and algorithms. As a central concept, Abstract Data Types or ADTs will be used. As part of the basic ADTs, such as lists, trees, and graphs, the associated algorithms and their complexity will be treated. Design principles for algorithms such as recursion, divide-and-conquer, and dynamic programming will be treated as well.

Course objectives

• To understand the concept of Abstract Data Types (ADTs) and how they support program design. • To have sufficient background of standard ADTs and their properties. • To have sufficient background of standard algorithms and their properties. • To gain the ability to develop and analyse new algorithms. • To be able to select the appropriate ADTs and algorithms for a given problem. • To gain the ability to judge whether and which ADTs should be applied, whether algorithms are appropriate and efficient. • To be able to specify ADTs and algorithms to be included in program designs.

Prerequisites

Pre-requisites MAT1004 Imperative Programming PRA2003 Programming

- Imperative Programming
- Programming

Recommended reading

Goodrich & Tamassia (2014): Algorithm Design and Applications. Wiley, ISBN 978-1118335918.

MAT3001

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
M.H.M. Winands
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Computer test

Maastricht Science Programme

Mathematical Systems Theory

Full course description

To describe natural phenomena and processes, mathematical models are widely used. Mathematical systems theory provides the framework to deal with such models in a systematic and useful way. The focus in this course is on dynamical models (i.e., where time plays a role) that have interaction with the environment through inputs and outputs. We discuss the following topics and concepts: Transfer functions of linear systems, controllability, observability, minimality; System representations with emphasis on state-space representations and canonical forms; Stability of linear and nonlinear systems; Interconnection of linear systems including feedback; Frequency domain analysis and the relationship with filter theory, Fourier analysis and time series analysis. To demonstrate the applicability of the techniques and concepts, many examples from science and engineering are mentioned and briefly discussed.

Course objectives

• To have the ability to interpret dynamical phenomena as mathematical systems and to cast them into such form. • To understand the basic concepts of linear systems theory. • To be familiar with analysis techniques for linear systems, to understand their behavior and interaction. • To be familiar with application areas of mathematical systems.

Prerequisites

Prerequisite: MAT1002 or MAT2004 Linear Algebra Recommended: MAT1005 Mathematics for the Natural Sciences

- Linear Algebra
- Linear Algebra

Recommended reading

Hand-outs will be distributed during the course. Recommended background literature: • C. Heij, A. Ran, F. van Schagen, Introduction to Mathematical Systems Theory. Linear Systems, Identification and Control, Birkhäuser, 2007. ISBN-13: 789-3-7643-7548-5. • R.J. Vaccaro, Digital Control. A State-Space Approach, McGraw- Hill International Editions, 1995. ISBN: 0-07-066781-0. • D.W. Jordan and P. Smith, Nonlinear Ordinary Differential Equations, 2nd ed., (Oxford Applied Mathematics and Computing Science Series), Clarendon Press, 1987.

MAT2001

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
R.L.M. Peeters
Teaching methods:

Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Participation

Maastricht Science Programme
Optimization

Full course description

Optimization occurs in most branches of science and in many different forms. In this course we address the most common and basic optimization techniques. First we consider unconstrained functions in several variables. We discuss stationary points and optima, and provide analytical methods based on solving systems of equations. Computer implementations use iterative numerical techniques (gradient methods and hill climbing, Newton methods, etc.). We put some emphasis on least squares problems. These are often encountered in the context of fitting models to measurement data. Next we address linear functions subject to linear constraints, which give linear programming problems. These have many applications, and several solution methods are available (e.g., the simplex algorithm, interior point methods and primal-dual methods). We discuss many examples and exercises. To demonstrate the wide range of applicability, these are taken from different fields of science and engineering.

Course objectives

• To become familiar with the basic concepts and methods of optimization. • To understand how techniques from calculus and linear algebra are useful for optimization. • To become familiar with a diversity of optimization problems and solution techniques. • To be able to cast certain real-world problems into the form of optimization problems. • To be able to solve certain optimization problems with software (Matlab).

Prerequisites

MAT1002 or MAT2004 Linear Algebra Recommended In addition it is useful to have a basic understanding of approximation by Taylor series. Student should have basic knowledge in calculus, especially in derivatives.

- Linear Algebra
- Linear Algebra

Recommended reading

Hand-outs will be distributed during the course. Recommended literature: • F.S. Hillier and G.J. Lieberman: Introduction to Operations Research (10th edition). McGraw-Hill, 2015 ISBN 978-0-07-352345-3. • A.D. Belegundu and T.R. Chandrupatla: Optimization Concepts and Applications in Engineering (2nd ed.). Cambridge university Press, 2011.

MAT2002

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:

5.0
Instruction language:
English
Coordinator:
C. Galuzzi
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Mathematics for the Natural Sciences

Full course description

This course builds on the material in PHY1002 and introduces some new concepts that are important in natural sciences. It is suitable for students interested in any scientific discipline who want to further their understanding of mathematics. The topics covered include further differentiation and integration, exponential decay and growth, fourier series and fourier transform, vectors and matrices and a brief introduction to linear algebra. Practical applications of these problems will be emphasised throughout the course.

Course objectives

• To acquire an understanding of mathematical methods that are important in Natural Sciences • To be able to apply this knowledge to numerical calculations. • To gain an appreciation of the applications of these methods within the natural sciences.
Prerequisites

MAT1001 /PHY1002 Introduction to Natural Sciences: Mathematical Foundations of Physics

Recommended reading

"Mathematical methods for physics and engineering", J.K Riley and M.P Hobson, (3rd edition) Note from the course co-ordinator: Just because the textbook is a physics-based textbook, this does not mean the course is not suitable for biologists and chemists J

MAT1005

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinators:

[C.J. Pawley](#)
[F.G.A. Birembaut](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Assignment, Written exam

Maastricht Science Programme
Applied Statistics

Full course description

At the end of this course, students should be familiar with the basic concepts of inferential statistics, and will be able to perform basic statistical analysis in a variety of scenarios. In most scientific research, researchers have to deal with the problem of drawing conclusions about some population characteristic of interest, relying only on a sample of observations from that population. Inferential statistics is a way to tackle this problem. This course starts by covering the foundations of inferential statistics, emphasizing the logic behind the statistical reasoning process. This logic is then employed to explain a number of widely used applied statistical methods: ANOVA, Chi-square, Nonparametric Wilcoxon tests and multiple regression. Students will learn how to run each of these applied tests using the statistical software package SPSS. Additionally, they will learn how to determine the minimal number of observations needed to be able to show, with a fixed probability, a specified research hypothesis.

Course objectives

• To enhance students' understanding of the basics of inferential statistics. • To broaden the scope of statistical methods that students are acquainted with by introducing a number of widely used applied tests that were not covered in PRA1002. • To understand how researchers determine required sample sizes for a number of (simple) designs and to be able to apply these methods. • To familiarize students with statistical software, so that they can independently run the analyses that are covered in this course and are able to correctly interpret the corresponding output.

MAT1006

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[J. Schepers](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:

Attendance, Written exam, Assignment

Maastricht Science Programme
Linear Algebra

Full course description

Linear algebra is the branch of mathematics which is primarily concerned with problems involving linearity of one form or another. This is reflected by the three central themes of this introductory course. The first theme is concerned with what can be recognized without doubt as the most frequently occurring mathematical problem in practical applications: how to solve a system of linear equations. For this problem a complete algebraic solution procedure is developed which provides the student with a way to deal with such problems systematically, regardless of the number of equations or the number of unknowns. The second theme addresses linear functions and mappings, which can be studied naturally from a geometric point of view. This involves geometric 'objects' such as points, lines and planes, and geometric 'actions' such as rotation, reflection, projection and translation. One of the main tools of linear algebra is offered by matrices and vectors, for which a basic theory of matrix-vector computation is developed. This allows one to bring these two themes together in a common framework, in what turns out to be an exceptionally fruitful way. By introducing the notions of vector spaces, inner products and orthogonality, a deeper understanding of the scope of these techniques is developed, opening up a large array of rather diverse application areas. The third theme surfaces when the point of view is shifted once more, now from the geometric point of view to the dynamic perspective, where the focus is on the effects of iteration (i.e., the repeated application of a linear mapping). This involves a basic theory of eigenvalues and eigenvectors, which have many applications in various branches of science as will be discussed. For instance, important applications in problems involving dynamics and stability, and applications to optimization problems found in operations research. Many examples and exercises shall be provided to clarify the issues and to develop practical computational skills. They also serve to demonstrate practical applications where the results of this course can be successfully employed.

Course objectives

In this course we provide an introduction to the main topics of linear algebra. Emphasis is on an understanding of the basic concepts and techniques, and on developing the practical, computational skills to solve problems from a wide range of application areas.

Recommended reading

Lay, David C. (2012). Linear Algebra and Its Applications. (4th ed.). Pearson. ISBN 13: 978-0-321-62335-5

MAT2004

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:

English
Coordinator:
R. Cavill
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Statistics

Full course description

Many real-life situations involve uncertainty and give rise to problems in the fields of probability theory or statistics. In this course, the focus will be on the deep understanding of tools which are necessary to analyse such situations. Firstly, we will address (or refresh) basics of probability theory and the underlying combinatorial principles, because it is impossible to properly understand statistical concepts without understanding probability and its mathematical foundations. Subsequently, we will focus on (both discrete and continuous) random variables, concepts of expectation, mean, variance and independence, proceeding to probability distributions (e.g. discrete uniform, binomial, multinomial, hypergeometric, geometric, Poisson, continuous uniform, normal, gamma, exponential). Here we will learn for what problems these distributions are useful and under which assumptions they can/should be applied, stressing also common misconceptions when trying to apply certain concept blindly (which unfortunately happens very often among applied scientists). We will extend our scope to multi- dimensional random variables and joint, conditional, and marginal probability distributions. We will also discuss random sampling, sample distributions of means and variances, and the central limit theorem, again focusing on common misconceptions related to these topics. We will address also statistical estimation (point estimation and interval estimation; confidence intervals). Finally, we will discuss various hypothesis tests (and related errors) and goodness-of-fit tests. In their presentations, students will focus on selected statistical topics and how these can be applied in practice, using scientific articles in applied probability/statistics as their study source.

Course objectives

• To have deep understanding of fundamental concepts in probability and statistics, including how these concepts are derived, why they are useful, what assumptions you have to pose when applying them, etc. • To be familiar with the most frequently used probability distributions/densities and statistical procedures (statistical estimation and hypothesis tests), here again with focus on the deep understanding as opposed to approaching these concepts as a "black box" or a "recipe". • To develop a critical thinking when deciding whether certain statistical procedure is the most suitable for a certain problem, as opposed to blindly applying a pre-specified procedure. • To be able to read and summarize scientific articles in applied probability/statistics.

Recommended reading

• Book: Walpole, Myers, Myers & Ye: Probability & Statistics for Engineers & Scientists. Any edition (pdf format will be provided via EleUM) • Lecture notes and selected scientific articles (will be provided via EleUM)

MAT2005

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Coordinator:
[K. Stanková](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment, Presentation

Maastricht Science Programme
Calculus

Full course description

• In this course, we will discuss, among others, the following topics: limits and continuity, integration and differentiation, inverse and transcendental functions, mean value theorem, sequences and series. In addition to the main facts and concepts, problem solving strategies will be discussed as well. Both the intuition behind the concepts and their rigorous definitions will be presented along with a number of examples and formal mathematical proofs so to better understand the concepts. • Knowledge and understanding: Calculus offers an indispensable basis, in the contents as well as in the methodologies, for studying and applying exact sciences, which will be built on during the rest of the curriculum. • Applying knowledge: The skills and facts which are taught in this course are of use for most of modern engineering or scientific problems. After the completion of the course, the students should be able to solve simple problems in the areas mentioned above and to judge the validity of a mathematical argument, which is related to the material of the course. • Skills: After having passed the exam, the student will be able to tackle not only the standard type of problems (graph-drawing, calculation of maxima and minima of functions, computing limits, summing infinite series etc.), but also apply his knowledge to considerably more relevant problems.

Course objectives

• To become familiar with functions and limits. • To become familiar with differentiation and integration. • To understand how to use differentiation and limits/continuity of a function to sketch the graph of a function. • To become familiar with sequences and series. • To understand the basic of differential equations and Taylor series.

Recommended reading

Hand-outs will be distributed during the course. Recommended literature: • Calculus, A Complete Course by A. Adams and C. Essex, 8th Edition – Pearson 2014 • Thomas' Calculus' by M. Weir, J. Hass, and C. Heil, 12th Ed. Or newer -- Pearson

MAT2006

Period 1

5 Sep 2016
28 Oct 2016

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[C. Galuzzi](#)
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Written exam, Attendance, Assignment

Neuroscience courses

Maastricht Science Programme
Neuroscience of Action

Full course description

The most general function of our brain is to interact with our environment to obtain what we desire and to avoid what is disadvantageous. The brain plans and executes actions to accomplish this. Actions can be simple (e.g., picking up a pencile), effortful (e.g., endurance running), complex (e.g., dancing), or symbolic (e.g., stick up your thumb to get a ride), etc. In all of these actions our brain is involved, but not to the same degree. Evolution has organized motor functions in a hierarchical system that delegates important motor and control functions to lower levels of the nervous system. This allows the brain to spent more time on other important functions, among which the selection of goals and the planning of how to pursuit them. Our understanding of the neural mechanisms of decision making, action selection, action planning and action execution has gained a lot from studying neural disorders (Parkinson's disease, orbitofrontal patients, obsessive compulsive disorder, etc.) which will also be considered in the course.

Course objectives

The course investigates the neural implementation of action, from the lowest level of simple reflexes to the highest level of the decision to act in order to obtain a goal.

Prerequisites

Pre-requisites • INT1004/NEU1002 Cognitive Neurosciences: Biological Foundations of Behaviour • INT2003/NEU2001 Cognitive Neurosciences: from Sensation to Perception

- [Cognitive Neurosciences: Biological Foundations of Behaviour](#)
- [Cognitive Neurosciences: from Sensation to Perception](#)
- [Cognitive Neuroscience: from Sensation to Perception](#)
- [Cognitive Neurosciences: Biological Foundations of Behaviour](#)

Recommended reading

Journal articles, book chapters.

NEU3001

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
P.L.J. Stiers
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Presentation, Written exam

Maastricht Science Programme

Cognitive Neuroscience: from Sensation to Perception

Full course description

The goal of this course is to understand the basic physiologic principles that underlie visual and auditory perception. The course will introduce the sensory systems that are responsible for vision and hearing in humans. Central topics include the nature of the stimulus (physical attributes such as amplitude and frequency, and perceptual attributes such as intensity and color), the transduction process (the transformation of a physical stimulus into a neural signal leading to a subjective experience), the functional neuroanatomy of the human sensory system (the organization of sensory neurons into functional maps, columns, and pathways), and mechanisms for object perception (the organization of sensory features into meaningful percepts, for example, a face in a crowd or speaker at a loud party). Finally, the course will introduce psychophysical and neuroscientific methods designed for measuring perception.

Course objectives

To understand the physiologic basis of visual and auditory perception.

Prerequisites

INT1004/NEU1002 Cognitive Neurosciences: Biological Foundations of Behaviour

- Cognitive Neurosciences: Biological Foundations of Behaviour
- Cognitive Neurosciences: Biological Foundations of Behaviour

Recommended reading

• E. Goldstein, 2010. Sensation to Perception, 8th Edition. Belmont, CA. Wadsworth publishing • E-reader

NEU2001

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[L. Hausfeld](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Presentation, Written exam

Maastricht Science Programme
Introduction to Neuroscience

Full course description

This course begins with the study of the nervous system structure, ranging from the macroscopical to microscopical level, and its development. Next, the fundamental mechanisms by which information flows within and between nerve cells will be addressed. This includes the aspects of membrane permeability, action potential generation and propagation, synaptic transmission, post-synaptic mechanisms of signal integration and the construction of neural circuits. Finally, the vascular system and the microenvironment of the brain will be discussed.

Course objectives

• To introduce the students to the field of neuroscience, the study of the nervous system. • To provide fundamental basis of the anatomy, development, and physiology of the nervous system.

Corequisites

• [Brain Anatomy](#)

Recommended reading

• M. F. Bear, B. W. Connors, M. A. Paradiso. Neuroscience, Exploring the Brain. Lippincott, Williams & Wilkins, 2006 (3rd edition). • E. R. Kandel, J. H. Schwartz, T. M. Jessell, S. A. Siegelbaum, A. J. Hudspeth. Principles of Neural Science, McGraw-Hill, USA, 2012 (5th edition). • L. H. Squire, H. E. Bloom, N. C. Spitzer, S. Du Lac, A. Ghosh, D. Berg. Fundamental Neuroscience. Academic Press, 2008 (3rd edition).

NEU1001

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
L.C.C. de Nijs
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Presentation

Maastricht Science Programme

Cognitive Neurosciences: Biological Foundations of Behaviour

Full course description

Throughout our lives, we encounter an innumerable amount of situations. Each of these circumstances requires a unique response. Our brain allows us to adapt our response to every new situation.

Course objectives

• Students will have a basic understanding of biological foundations of behaviour • Students will understand the basics of movement and memory • Comprehension of chemical control (neurotransmission and hormones) by the brain and dysfunctional control (e.g. addiction) • Student will have a basic understanding of language, sleep/wake behaviour, consciousness

Recommended reading

Required literature Neuroscience: Exploring the Brain – Bear, 3rd edition. Additional literature Principles of Neural Science – Kandel, 4th edition

NEU1002

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:

5.0
Coordinator:
S. Jongen
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Neuropsychopharmacology

Full course description

In the first part of the course the focus will be on the molecular and cellular biology of the nervous system. Focus will be the neurotransmission process, in particular the role of neurotransmitter receptors as a basis for understanding the mode of action of CNS drugs. The second part of the course will give an overview of the major classes of a number of CNS drugs: the hypnotics and sedatives, the anxiolytics, and the drugs used to treat CNS degenerative disorders. The pharmacology of these drugs will be put in the perspective of their clinical use. The final part of the course will be devoted to illicit drugs, their acute and long term effects, and their potential as medicines.

Course objectives

• To know the basic principles of neurotransmission & the basic mechanism of drug-receptor interaction • To understand the mechanism of action of the major groups of drugs acting in the central nervous system • To understand the major neurotransmitter systems in the brain and their role in cognitive and affective disorders and functions • To understand the pharmacotherapy of anxiety disorders, CNS degenerative disorders, ADHD • To understand the acute and long term effects of drugs of abuse

• Basic Principles of Pharmacology

Recommended reading

Journal articles, book(s) chapter(s).

NEU2002

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
K.P.C. Kuypers
Teaching methods:

Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Presentation

Physics courses

Maastricht Science Programme
Elements of Physics

Full course description

Physics is the study of all aspects of Nature, covering the behaviour of objects under the action of given forces and the nature and origin of gravitational, electromagnetic, and nuclear force fields. This is an introductory course in Physics intended for a broad audience with a scientific interest, that comprehensively trains students to the basic, classical, and essential fundamentals of physics. As such it is a prerequisite for most courses in the further Physics curriculum. The course aims at an understanding of the fundamental principles of Nature and how to apply them in concrete practical situations. The emphasis is on intuition rather than mathematical rigour; this is addressed in the follow-up physics courses. In this course we address the principal corner stones of Physics: 1. Elements of physical experimentation; 2. Elements of classical mechanics; 3. Elements of thermodynamics; 4. Elements of electromagnetism; 5. Elements of optics and waves; 6. Elements of modern physics. Each of these subjects is taught on a theoretical level as lecture, and on a practical level with exercises in practical training sessions. This course is a good preparation for the physics lab skills involving experimental and practical physics PRA1003, PRA2007, PRA3002.

Course objectives

• To acquaint the student with the essential building blocks of Physics. • To acquire a general understanding of the theoretical and practical methods in these fields and to be able to apply this knowledge to concrete problems. • To serve as sufficient basis in physics for students in their future education. • To be able to apply this knowledge to practical problems. • To be able to read texts that build on the subjects of this course.

Recommended reading

University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011

PHY1001

Period 2
31 Oct 2016
23 Dec 2016
Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:

5.0
Instruction language:
English
Coordinator:
R.L. Westra
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Written exam, Assignment, Attendance

Maastricht Science Programme
Classical Mechanics

Full course description

Classical mechanics forms the central part of all physical science and engineering. It accurately describes the dynamical effects of forces under all conditions. It can be divided into statics: the study of equilibrium, and dynamics: the study of motion caused by forces. Though classical mechanics fails on the scale of atoms and molecules, it remains the framework for much of modern science and technology. This is an intensive course that comprehensively trains the students to the basic, classical, and essential fundamentals of classical mechanics. The course aims at an understanding of the fundamental principles of Classical Mechanics and how to apply them in specific situations. Here we address the major parts of Classical Mechanics: statics and kinematics, Newton's laws, work and energy, momentum and collisions, rotational dynamics, and gravitation. Each of these subjects is taught on a theoretical level as lecture, and trained on a practical level with exercises and practical training sessions. Associated (but not co- required) to this course are skill courses Physics Laboratory 1-3, involving experimental practical training sessions.

Course objectives

• To acquaint the student with the basics of Classical Mechanics • To acquire general understanding of theoretical and practical methods in Classical Mechanics. • To serve as sufficient basis for future education. • To be able to apply this knowledge to concrete practical problems. • To be able to read texts that build on the subjects of this course.

Prerequisites

Pre-requisites MAT1001 Introduction to Natural Sciences: Calculus or PHY1002 Introduction to Natural Sciences: Mathematical Foundations of Physics PHY1001 Elements of Physics Recommended MAT1002 Linear Algebra

• Elements of Physics

Recommended reading

1. University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011 2. A course manual and title for the associated text book will be provided during the course.

PHY2001

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[R.L. Westra](#)
Teaching methods:
Lecture(s), PBL, Assignment(s)
Assessment methods:
Attendance, Written exam, Assignment

Maastricht Science Programme
Quantum Mechanics

Full course description

Quantum theory governs the universe at its most basic level but also relates to its largest scales. In the first half of the 20th century natural sciences were turned on its head by the radical discoveries of Einstein, Planck, Bohr, Heisenberg, and Schrödinger. An entire new logical and mathematical foundation —quantum mechanics— eventually replaced classical physics. We will explore the quantum world, including the particle theory of light, the Heisenberg Uncertainty Principle, and the Schrödinger Equation. This course aims at an understanding of the fundamental principles of Quantum Mechanics, and its applications to physics. The course is organized around the following topics: the non-intuitive nature of quantum mechanics; basic logic in classical and quantum mechanics; the time evolution of quantum systems; quantum entanglement and the nature of reality; particles moving in one dimension and their operators; the Heisenberg uncertainty principle. Each of these subjects is taught on a theoretical level as lecture, and on a practical level with exercises. Moreover, Students collaborate in teams in a QM problem oriented project. This course relates to the practical skill courses Physics Laboratory PRA1003, PRA2007, and PRA3002.

Course objectives

• To acquire general understanding of the theoretical and practical understanding of the basic principles of Quantum Mechanics. • To use this knowledge to study, model, and understand elementary particles, atoms and molecules. • To serve as basis for future students who want to specialize in these topics. • To be able to apply this knowledge to practical problems. • To be able to read scientific texts that build on the subjects of this course.

Prerequisites

Prerequisite: MAT1005 Mathematics for the Natural Sciences Recommended: MAT1002 or MAT2004 Linear Algebra MAT2006 Calculus PRA1004 Scientific Computing

• [Mathematics for the Natural Sciences](#)

Recommended reading

"University Physics", Young Freedman, Pearson 13th International Edition. "Quantum Mechanics", Susskind, Friedman, Basic Books, ISBN 0465036678

PHY3001

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[R.L. Westra](#)
Teaching methods:
Lecture(s), Work in subgroups, PBL
Assessment methods:
Attendance, Written exam, Assignment

Maastricht Science Programme
Thermodynamics and Statistical Physics

Full course description

Thermodynamics is the study of many-particle systems in terms of their macroscopic quantities such as temperature, heat, energy, and entropy. Statistical Physics relates these macroscopic quantities to the microscopic properties such as kinetic and rotational energy and vibrations, using statistics. In this course, students will achieve comprehension of the fundamentals of Thermodynamics and Statistical Physics. We cover the major elements of this subject: temperature and heat, thermal properties of matter, the first and second law of thermodynamics, entropy and free energy, the relation between macroscopic parameters and microscopic dynamics, and the statistics of thermodynamic ensembles. Each of these subjects is taught on a theoretical level as lectures, and trained on a practical level with exercises and by using knowledge in applied situations. This course can be complimented by skills training with appropriate experimental practical training sessions.

Course objectives

• To acquaint the student with the basics of Thermodynamics and Statistical Physics • To acquire general understanding of theoretical and practical methods in Thermodynamics and Statistical Physics • To serve as sufficient basis for future education. • To be able to apply this knowledge in analysis and resolution of practical problems.

Prerequisites

MAT1001 / PHY1002 Mathematical Foundations of Physics

Recommended reading

Required Thermodynamics: from concepts to applications, A. Shavit & C. Gutfinger, CRC Press, 2nd Edition, December 2008 Recommended Statistical Thermodynamics, L.C. Fai & G.M.Wysin, CRC Press, 1st Edition, October 2012

PHY2002

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)

ECTS credits:
5.0
Instruction language:
English
Coordinator:
[C.J. Pawley](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Final paper, Written exam

Maastricht Science Programme
Solid State Physics

Full course description

Solid state physics is a discipline which deals with the physical properties of solid materials. The course will start with a description of different crystal structures along with various analytical (diffraction) techniques used to explore these. We will then go onto discuss material properties (thermal and electronic) and the models used to explain the physical phenomenon observed. In the largest part of the course, the focus will be on electrical conduction. This topic will be treated in considerable detail, since it is very important for the application of materials. The discussion will start with the Drude free electron model and continues with more advanced descriptions of conductivity based on quantum models. An important topic in this context is the development of band structures, during which we will also talk about semiconductors. Finally, some attention will be also paid to the phenomenon of superconduction.

Course objectives

• To provide an overview over the field of solid state physics. • To successfully picture crystal structures and different geometric lattice arrangements. • To understand the thermal and electronic properties of materials and their relation to the solid state structure. • To know the various models used to describe the conductivity in solid matter and the assumptions upon which they are based. • The understand band theory and how this can be used to describe the nature of semi-conducting materials. • To have basic knowledge of the concept of superconductivity.

Prerequisites

Prerequisite PHY1002 Introduction to Natural Sciences: Mathematical Foundations of Physics Plus ANY two PHY courses (equivalent to PHY 10 credits) Recommended PHY1001 Elements of Physics MAT1002 Linear algebra PHY2002 Thermodynamics and Statistical Physics PHY2003 Vibrations and waves PHY2004 Quantum Mechanics

Recommended reading

No mandatory literature, but the following books can be used as reference: The Solid State, Rosenberg H. M, 3rd Edition, Oxford University Press (1993) Solid State Physics, Kittel C. 8th Edition, John Wiley and Sons (2004)

PHY3003

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[D.L. Carroll](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Assignment, Written exam

Maastricht Science Programme
Theory of Relativity

Full course description

The theory of relativity deals with the physical effects of high speed or curvilinear motion and gravity on the structure of space and time. This theory is the unique work of the physicist Albert Einstein, which overthrew earlier physical theories, and redefined the fundamental concepts of space, time, matter, energy, and gravity. Along with quantum mechanics, relativity is a central concept in modern physics. In particular, relativity provides the basis for understanding cosmic processes and the geometry of the universe itself. This intensive course intends to comprehensively train the participants in the essential fundamentals of the theory of relativity. Here we address the major elements of this subject: special relativity, spacetime, mass and energy, Minkowski space, gravity, and cosmology. Each of these subjects is taught on a theoretical level as lecture, and trained on a practical level with group exercises which can be solved during PBL sessions.

Course objectives

• To acquaint the participants with the entirety of special relativity • To introduce participants to the

concepts and ideas in general relativity • To acquire general understanding of theoretical and practical methods in relativity • To be able to apply this knowledge in analysis and resolution of practical problems. • To be able to read texts that build on the subjects of this course.

Prerequisites

PHY2001 Classical Mechanics

- Classical Mechanics

Recommended reading

Relativity: An introduction to space-time physics, Steve Adams, Taylor and Francis (US), First edition, 1997 Special Relativity, T.M.Helliwell, University Science Books (US), First edition 2010 Relativity: A very short introduction, Russell Stannard, Oxford University Press (UK), First edition, 2008

PHY3002

Period 2
31 Oct 2016
23 Dec 2016

Print course description
ECTS credits:
5.0
Coordinator:
C.J. Pawley
Teaching methods:
Lecture(s), Assignment(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Vibrations and Waves

Full course description

Vibrations and waves covers the behaviour of many physical systems ranging from optical or acoustic to mechanical, oscillating systems. Participants will investigate simple harmonic oscillators, particle and packet velocities as well as damped, driven and coupled oscillators. The use of Fourier series to describe waves will allow a more mathematical analysis to take place. We will explore of sound propagation in a variety of media including sounds in gasses, liquids and solids (strings, rods etc.). In addition, the behaviour of interfering waves (such as formation of standing waves) will be demonstrated. Material properties such as reflection, transmission and impedance will also be covered.

Course objectives

• To acquaint the student with the fundamental principles of vibrations and waves as they apply to all systems • To develop an understanding of damping and forcing on vibrations • To identify appropriate mathematical methods to solving problems relating to these phenomena (such as differential equations) • To understand wave characteristics such as standing waves, beats, wave

packets and the Doppler effect

Prerequisites

PHY2001 Classical Mechanics

- [Classical Mechanics](#)

Recommended reading

Vibrations and Waves, A. P. French, W.W.Norton (US), 2nd edition, 1971 Vibrations and Waves, George C. King, John Wiley and Sons (UK), 1st edition, 2009

PHY2003

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[C.J. Pawley](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Participation, Assignment, Written exam

Maastricht Science Programme
Electromagnetism

Full course description

Electromagnetism, also known as Maxwell theory, is the science of one of the four fundamental forces in Nature and deals with the effects of electrical charge and the associated force fields and energies. Electromagnetism unites the concepts of electricity and magnetism. These two concepts and their relations form the core of this course, which ultimately can be expressed in the four fundamental laws of electromagnetism: Maxwell's equations. Important components of the course are: 1. ELECTROSTATICS: Charge, electric forces, Coulomb's law, the electric field, electric potential and energy; 2. (CLASSICAL) ELECTRODYNAMICS: Electrical flux, Gauss law; 3. MAGNETISM: Magnetic fields, magnetic flux, Gauss's law for magnetism; 4. MAXWELL's LAWS: The four Maxwell equations and the Lorentz Force; 5. ELECTROMAGNETIC RADIATION AND WAVES; 6. ADVANCED TOPICS. These topics are divided over the six lecturing weeks of the course.

Course objectives

• To acquaint the student with the basics of electromagnetism. • To acquire general understanding of theoretical and practical methods in electromagnetism. • To serve as sufficient basis for future education in physical sciences. • To be able to apply this knowledge to concrete practical problems. •

To be able to read texts that build on the subjects of this course.

Prerequisites

PHY1001 Elements of Physics Recommended: MAT1002 or MAT2004 Linear Algebra

- [Elements of Physics](#)

Recommended reading

A course manual and title for the associated text book will be provided during the course.

PHY2004

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Coordinator:
[A.B. Poser](#)
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Nuclear and Elementary Particle Physics

Full course description

This course provides an overview of the key concepts in nuclear and elementary particle physics. Nuclear physics is the study of complex nuclei. The following topics will be explored: basic nuclear properties, the nuclear force, models of nuclear structure, different types of nuclear decay, and nuclear fission and fusion and their applications. Particle Physics provides us with an understanding of the fundamental particles in the universe and the interactions between them. This course will provide an overview of the particles and interactions in the Standard Model of particle physics. Students will be taught how to use Feynman diagrams to calculate interaction cross-sectons for simple examples within Quantum Electrodynamics (QED), which describes the electromagnetic interaction. An overview of the development of the Standard Model through experimental observations will also be provided. This course requires a good understanding of Quantum Mechanics. Special relativity is also inherent in Modern Particle Physics, however for this course any necessary concepts will be taught in the lectures. Students should note that the format of the course will be slightly different in 2016 to previous years. The first four weeks of the course will follow a standard but condensed format, such that all of the required theory is covered by the end of the forth week. For the last two weeks of the course there will be no lectures but students will be expected to work in groups and produce an extended literature review on an advanced topic in the field (although there will be no tutorials meetings with the course co-ordinator will be possible during this time). This course has no midterm

exam, but there will be assessed problem sheets to complete throughout the period.

Course objectives

• To acquire a general understanding of key concepts in Nuclear and elementary Particle physics • To be able to apply this knowledge to numerical calculations. • To be able to read scientific texts that build on the subjects of this course.

Prerequisites

PHY3001 Quantum Mechanics OR PHY2005 Quantum Theory No waivers will be given: students must have passed either of these courses

- Quantum Mechanics
- Quantum Theory

Recommended reading

"Nuclear and Particle Physics", Martin B R, (2nd Edition Wiley 2009)

PHY3004

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
S.L. Williams
Teaching methods:
Lecture(s), PBL
Assessment methods:
Written exam

Maastricht Science Programme
Relativistic Electrodynamics

Full course description

Electrodynamics is the first example of a field theory: charged particles create a field and this field acts on other charged particles. In other words electromagnetic forces are mediated by a field. This should put in contrast to Coulomb's law in electrostatics or even Newton's gravitational law. Both laws imply the objectionable notion of an action on a distance: moving a charge or mass at location A instantaneously gives rise to a different force at point B. How the electromagnetic field evolves in time is given by the 4 famous Maxwell equations. These equations for example state that light propagates at a constant speed, which eventually led to Einstein's theory of relativity. Electrodynamics is thus by construction a relativistic theory. This course will start at the Maxwell equations and their consequences: conservation laws, electromagnetic waves, radiation, etc... I will

introduce the magnetic vector potential. We have a certain freedom in defining this vector potential, this freedom is more formally called "gauge invariance", an important concept in understanding any field theory. Evidently, I will also discuss the tight relation between electrodynamics and relativity and explain for example how magnetism can be understood as relativistic electric force.

Course objectives

● To acquire general understanding of electrodynamics. ● To be able to use Maxwell equations to solve practical problems such as transmission along coaxial lines. ● To understand the importance of gauge invariance and Lorentz invariance in field theories.

Prerequisites

PHY2004 Electromagnetism PHY3002 Theory of Relativity MAT1002 Linear Algebra MAT1001 / PHY1002 Mathematical Foundations of Physics OR MAT3004 Differential Equations

* Theory of Relativity
* Electromagnetism
* Mathematics for the Natural Sciences

Recommended reading

"Introduction to Electrodynamics", David Griffiths, 4th Edition: Chp. 7- 12

PHY3005

Period 5
10 Apr 2017
9 Jun 2017

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinator:
T.J. Cleij
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme
Quantum Theory

Full course description

This courses serves as an introduction to the world of Quantum Theory, It provides a good basis for students who will require quantum mechanics either within physics or chemistry, as well as providing a good overview for students with a general interest in the subject. The course will commence with a discussion of the failings of classical physics, and will continue with an introduction to the postulates of Quantum Mechanics and Schrodinger´s equation. Throughout the course there will be a focus on

applying the postulates of Quantum Mechanics to systems we are familiar with, for example the electron orbitals in a hydrogen atom and the harmonic oscillator.

Course objectives

• To acquire an understanding of the failings of classical physics and the important concepts in Quantum Theory. • To be able to apply the postulates of Quantum Mechanics to numerical calculations.

Prerequisites

MAT1005 Mathematics for Natural Sciences

- [Mathematics for the Natural Sciences](#)

Recommended reading

"Introduction to Quantum Mechanics", David J Griffiths

PHY2005

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
5.0
Instruction language:
English
Teaching methods:
Lecture(s), PBL
Assessment methods:
Assignment, Written exam

Maastricht Science Programme
Electronics

Full course description

In this lecture course you will learn the fundamentals of electronics beginning with simple electrical theory. You'll explore the role of different components and devices, learn the laws governing their behaviours and should develop an understanding of basic circuitry. You will learn about Ohm's and Kirchhoff's laws, resistances, voltages, DC and AC currents, capacitors, inductors, diodes, junctions, transistors and MOSFETS. You'll also cover the basics of digital electronics (logic gates and Boolean algebra). We will look at how combinations of discrete devices can be used to build up more complex circuitry and you will have the opportunity to see how electronics can be used to build up the technology which we are most familiar today from flat-screen TVs and smartphones to mars rovers. Nearly everything we use in this day and age relies on electronics. We hope that throughout this course you learn to appreciate how the technology around you functions and we hope to pull apart some electronic devices to explore their inner workings.

Course objectives

• To acquaint the student with the basics of analogue and digital electronics, and their differences. • To understand how components in various direct and alternating current circuits behave. • To introduce semiconductor physics, particularly diode and transistor characteristics and their applications (although further detail can be found in PHY3003 Solid State Physics). • To provide an introduction to digital logic, its operations, principles and applications. • To describe the theoretical background required to successfully build and test circuits in the co-skill PRA2006. • To give an overview of how some everyday electronic devices and technologies function.

Prerequisites

Co-requisites: PRA2006 Electronics

Corequisites

• Electronics Lab

Recommended reading

Tba

PHY2006

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
5.0
Instruction language:
English
Coordinators:
D.L. Carroll
B.R.N. van Grinsven
Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Presentation, Participation, Written exam

Skills

Skills and Practical training

Maastricht Science Programme
Basic Physics Laboratory

Full course description

The aim of this course is understanding what physics means by performing instructive physical experiments that reveal fundamental physical principles, and also to attain a level of dexterity with experimental devices. Physics is an empirical science and not a mere collection of mathematical laws. In this sense this practical is an appropriate counterpart for the more theoretic and mathematical Physics courses. Moreover, the aim of this training is to train your ability to report and summarize your experimental work in a few pages. The course lasts six weeks, and consists of one full day of experimentation per week. The required attendance for this practicum is a full 100%. The practicum consists of a collection of 12 different experiments. Students cooperate in couples (of 2 students) and each week perform a different experiment. Each experiment consists of a theoretical and methodological preparation: i. Reading about the theory behind the experiment; ii. Determining what should be done and in what order; iii. Writing a plan containing the required steps for carrying out the measurements. Topics: MECHANICS: Newton's Laws Experiment, Conservation of momentum and impulse, Projectile Motion, Mechanical waves. THERMODYNAMICS: Thermal Energy, Equilibrium Temperature, Specific Heat, Ideal Gas Law LIGHT and OPTICS: Reflection and Refraction, Snell's Law, index of refraction, Michelson's interferometer.

Course objectives

• To acquaint the student with the basis of experimental physics. • To acquire understanding of practical methods in experimental physics. • Being able to solve technical problems in a physical experiment. • To be able to relate the experiment to the relevant physical theory. • To be able to process empirical data in relation to the theoretical physical predictions using the adequate statistical and graphical tools. • To be able to properly describe the experimental methods and results in technical reports.

Prerequisites

PHY1001 Elements of Physics

• [Elements of Physics](#)

Recommended reading

There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Moreover, this course relates to the introductory course Physics: Elements in Physics. The textbook for this course is: University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011. For the underlying physical principles of the experiments we refer to this textbook.

PRA1003

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
[C.J. Pawley](#)

Teaching methods:

Research, Skills, PBL

Assessment methods:

Assignment, Attendance

Maastricht Science Programme
Data Collection Techniques in the Neurosciences

Full course description

The skills will cover relevant laws of sensory perception (Weber, Fechner, Stevens), and introduce testing procedures for the measurement of detection and discrimination thresholds. These will include constant stimuli methods, and various adaptive testing procedures. In addition, there will be an introduction to Signal Detection Theory and derived measures of detectability or discriminability. In order to make this knowledge concrete, students conduct experiments based on several of these testing procedures. The end goal is to test one of the colleague-students and determine a sensory threshold with provided software. Students will also be familiarized with the analysis (Brainvoyager QX) and interpretation of an fMRI dataset. In addition to the empirical data collection and analysis, relevant literature will be covered on specific testing procedures, and on particularly beautiful examples of current state of the art experiments.

Course objectives

This skill has the aim of familiarizing students with basic techniques for data collection and analysis in behavioural neuroscience and fMRI.

Prerequisites

None.

Recommended reading

No mandatory literature. Hand-outs will be provided by coordinator.

PRA1005

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
[B.C.I. Jans](#)
Teaching methods:
Lecture(s), Work in subgroups, PBL, Skills
Assessment methods:

Attendance, Assignment, Participation, Presentation, Final paper

Maastricht Science Programme
Scientific Computing

Full course description

This skills provides an introduction to programming in high-level scientific programming languages like matlab, mathematica, simulink and comsol-multiphysics. It presents a broad overview of numerical methods for solving selected problems in scientific computing, including linear and nonlinear equations, interpolation, differential equations, integration, optimization, and random numbers.

Course objectives

After this skills the student should be able to analyze scientific problems in a structured way leading to the design and implementation of an appropriate solution in an adequate scientific programming language (such as matlab, mathematica, simulink and comsol-multiphysics).

PRA1004

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinators:
P. Bonizzi
E.K. de Lange
Teaching methods:
Lecture(s), Work in subgroups, Assignment(s), Skills
Assessment methods:
Attendance, Assignment, Computer test, Written exam

Maastricht Science Programme
Chemical Synthesis

Full course description

This skills focuses on the development of a clear understanding of the synthesis of organic chemical compounds. It is important for the students to learn how to convert their theoretical knowledge on chemical reactivity to actual design and execution of synthetic chemical reactions. Typical topics, which will be covered in this skills training are: • Safe handling of organic reagents and safe execution

of organic experiments. • Commonly used organic synthetic laboratory techniques. • Synthetic chemistry of various organic reaction types (e.g. nucleophilic substitutions and eliminations, electrophilic reactions and radical chemistry). • Stereochemistry in organic synthesis. • Purifications and separations in chemistry. • Spectroscopy and characterization of organic compounds.

Course objectives

• To be able to perform organic synthetic experiments in a structured and safe manner. • To understand specific separation and purification techniques commonly used in organic chemistry. • To gain a practical understanding of the impact of the choice of reagents, solvents and conditions on the outcome of an organic reaction. • To gain further skills in scientific research reporting.

Prerequisites

Pre-requisites: PRA1001 Research Methods PRA1002 Research, Data Analysis and Presentation Academic Skills Co-requisites CHE2001 Organic Chemistry

- Research Methods
- Research, Data analysis and Presentation Academic skills

Corequisites

- Organic Chemistry

Recommended reading

• Practical laboratory instructions. • For students intending on continuing and specializing in organic chemistry, a practical book, such as "Multiscale Operational Organic Chemistry" by John W. Lehman (Pearson, 2nd edition, 2009) may be interesting.

PRA2002

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinator:
H. Diliën
Teaching methods:
Assignment(s), Work in subgroups, PBL, Paper(s), Skills
Assessment methods:
Observation, Participation, Assignment

Maastricht Science Programme

Inorganic Synthesis

Full course description

This skills will focus in the synthesis and analysis of inorganic compounds, focusing primarily on coordination compounds and their spectroscopy.

Course objectives

• To implement principles seen in class in a laboratory setting • To learn the basic synthetic techniques in inorganic chemistry • To synthesize and study a range of inorganic compounds

Prerequisites

Pre-requisites PRA1001 Research methods PRA1002 Research, Data Analysis and Presentation Academic Skills Recommended: CHE2001 Organic Chemistry PRA2002 Chemical Synthesis Co-requisites CHE2002 Inorganic Chemistry

• Research Methods
• Research, Data analysis and Presentation Academic skills

Corequisites

• Inorganic Chemistry

Recommended reading

Girolami, Rauchfuss, Angelici: Synthesis and Technique in Inorganic Chemistry (University Science Books). Woollins: Inorganic Experiments (Wiley VCH).

PRA2004

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinator:
B. Blom
Teaching methods:
Skills
Assessment methods:
Attendance, Assignment, Written exam

Maastricht Science Programme

Genetics

Full course description

The skills trainings are aimed to obtain a basic introduction to techniques and methods in modern Genetics. The first skills take place at a designated skills laboratory at Chemelot campus; subsequent skills training topics "Genomes and Genomics" and are taught in a computer landscape. These days integrate theoretical and practical information. Each student will receive theoretical and practical in silico training in the morning, followed by a limited number of tasks to execute on the computer and answered in a skills report. The final skills consist of a student group presentation where the combined theoretical and practical skills on Genetics are applied to a pre-assigned task.

Course objectives

• To be able to purify genomic DNA from eukaryotic cells and plasmid (circular) DNA from prokaryotic cells and perform quantitative analyses on each product. • To perform and comprehend polymerase chain reaction (PCR) analysis. • Analyze DNA products using restriction digestion, ligation and agarose gel electrophoresis. • To isolate RNA from eukaryotic cells and apply reverse transcription to generate copy DNA • To study specific proteins by Western immunoblotting. • To independently use genetic and genomic websites, general and specialized databases and determine relationships of genes within and between databases. • To have sufficient technical training for more advanced skills in molecular biology and the life sciences. • To apply genetic principles to a pre-assigned task and present the findings to a larger audience.

Prerequisites

Pre-requisites BIO2001 Cell Biology Co-requisites BIO2007 Genetics

• Cell Biology

Corequisites

• Genetics

Recommended reading

"Introduction to Genetic Analysis" by Griffiths, Wessler, Carrol, Doebley (W.H. Freeman, 10thedition, International Edition, 2012. bol.com price €64,99).

PRA2014

Period 1
5 Sep 2016
28 Oct 2016

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinator:
L.J. de Windt
Teaching methods:
PBL, Research, Skills, Work in subgroups, Assignment(s)

Assessment methods:

Participation, Assignment, Attendance

Maastricht Science Programme
Advanced Academic Skills

Full course description

A good researcher does not only know a lot about his/her specific topic, they are also able communicate their findings to others. Several key skills are very important in this. Advanced Academic Skills will continue where PRA1002 left off, and will go more into depth. Advanced Academic Skills may be particularly useful for students who are more generally interested in the process of scientific communication.

Course objectives

• To improve written skills • To improve presentation skills • To improve argumentation skills • To teach students how to manage their time • To improve skills related to group working

Prerequisites

PRA1002 Research, Data Analyses and Presentation Academic Skills

• Research, Data analysis and Presentation Academic skills

Recommended reading

Literature via handouts. No mandatory textbook.

PRA2015

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
2.5

Instruction language:
English

Coordinator:
J.J. Sloggett

Teaching methods:
Skills, PBL

Assessment methods:
Attendance, Assignment, Presentation

Maastricht Science Programme

Physics Laboratory

Full course description

This skill will contain: • Design, use and measurement in physical experimentation; • Gathering data using automated processes; • Data manipulation and analysis using modern tools such as MATLAB or python; • Experiments in mechanics (Gyroscope dynamics, Driven Damped Harmonic Oscillator), Quantum Physics (Photoelectric Effect, Blackbody Radiation, Atomic Spectra), and Electrodynamics (Charge of the Electron (Millikan's experiment), Faraday's Law of Induction Experiment).

Course objectives

This practical is aimed at obtaining a deeper understanding of physics by performing various key experiments in the areas of Classical Mechanics, Quantum Mechanics, and Electromagnetism. Examples are the photoelectric effect, blackbody radiation, angular momentum, Faraday's law, and the Coulomb's law. The focus will be on the design and execution of the experiments and their relation to the fundamental laws and principles of physics. Another objective is the further training of physical laboratory techniques and procedures. Furthermore, attention will be paid on data analysis and reporting. This lab relates to level 200 physics courses such as Classical Mechanics, Quantum Mechanics, and Electromagnetism.

Prerequisites

PRA1003 Basic Physics Laboratory PHY1001 Elements of Physics Note: waivers are unlikely to be granted unless applicants can show their experience in experimental physics is equivalent to that of PRA1003.

- Basic Physics Laboratory
- Elements of Physics

Recommended reading

University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011. Practical Physics, G.L. Squires, Cambridge University Press, 4th edition, September 2001. Measurements and their Uncertainties: A practical guide to modern error analysis, I. Hughes & T. Hase, Oxford University Press, August 2010.

PRA2007

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinators:
B.R.N. van Grinsven

[C.J. Pawley](#)
Teaching methods:
Assignment(s), Work in subgroups, Research, Skills
Assessment methods:
Attendance, Assignment

Maastricht Science Programme

Advanced Organic Synthesis

Full course description

This skill will contain: • Advanced synthetic chemistry of various organic reaction types. • Multi-step organic synthesis. • Synthesis and handling of reactive compounds under inert atmosphere. • Extensive use of spectroscopic characterization.

Course objectives

The main objective of this skill is to provide a solid foundation in multi-step organic synthesis. Most organic compounds cannot be prepared in a single step. Instead, a sequence of reactions has to be designed to obtain these materials. Some of these steps may require complex chemistry, very reactive intermediates or inert atmospheres. This course focuses on these special situations.

Prerequisites

Pre-requisites PRA2002 Chemical Synthesis Co-requisites CHE3001 Organic Reactions

• [Chemical Synthesis](#)

Corequisites

• [Organic Reactions](#)

Recommended reading

• Practical laboratory instructions. • For students intending on continuing and specializing in organic chemistry, a practical book, such as "Multiscale Operational Organic Chemistry" by John W. Lehman (Pearson, 2nd edition, 2009) may be interesting.

PRA3001

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
[H. Diliën](#)
Teaching methods:
Research, Skills, Paper(s)

Assessment methods:
Assignment, Attendance, Final paper, Observation

Maastricht Science Programme
Spectroscopic Methods

Full course description

This course focuses on several topics in analytical chemistry and will contain: • Identification and structure elucidation of molecules and materials with advanced spectroscopy and spectrometry • UV-Vis spectroscopy • FT-IR spectroscopy • 1H and 13C NMR spectroscopy • Mass spectrometry Depending on timing, interest and number of students, there may also be some time devoted to mechanical and thermal analysis (e.g. DSC, TGA, rheology), the use of electroanalytical techniques and the determination of physical-chemical properties of compounds, such as lipophilicity, solubility, optical activity, pKa and dissolution.

Course objectives

• To learn to identify chemical compounds using a variety of available analytical techniques. • To have a basic understanding of the theoretical background of the measurement principles typically used in spectroscopy and spectrometry. • To be able to develop an analytical strategy to identify an unknown compound. • To be able to operate typical spectroscopic instruments.

Prerequisites

CHE2001 Organic Chemistry CHE2002 Inorganic Chemistry CHE2004 Spectroscopy

- Organic Chemistry
- Inorganic Chemistry
- Spectroscopy

Recommended reading

The textbooks from the pre-requisite courses.

PRA3014

Period 2
31 Oct 2016
23 Dec 2016

Print course description

ECTS credits:
2.5
Instruction language:
English
Coordinator:
H. Diliën
Teaching methods:
Skills, Research
Assessment methods:
Attendance, Presentation, Final paper, Written exam

Maastricht Science Programme
Programming

Full course description

The course is intended to introduce students to more practical concepts involved with computer programming. The students will gain experience implementing these concepts in programming tasks described by each assignments. Topics include: • Implementing recursive methods • Basics of object-oriented programming • Basics of graphical user interface (GUI) programming • String manipulation and parsing • File input and output • Introduction to data structures

Course objectives

To familiarize students with the practical skills required in computer programming
Prerequisites

MAT1004 Imperative Programming

• Imperative Programming

Recommended reading

Relevant literature will be available online and referred to on the assignments.

PRA2003

Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinators:
M. Lanctot
K. Driessens
Teaching methods:
Work in subgroups, PBL, Skills
Assessment methods:
Attendance, Assignment, Written exam, Computer test

Maastricht Science Programme
Field Skills in Biology

Full course description

This skills will include: • Training in the use of a diversity of methods to collect or count organisms in the field • Training on the measurement of some important environmental characteristics • The means to identify of species or higher taxa of certain environmentally or taxonomically important groups or indicator species in the field or lab • Planning of field experiments • Interpretation of field results, including some statistical work PLEASE NOTE: One of the classes in this course will be conducted in the evening until about 23.30. Attendance for this class is obligatory and if you register for this course, you must attend!

Course objectives

For an ecologist, the field is a much less controlled, though much more realistic environment than the lab, and a completely different set of practical skills are required. In this course you will learn how to generate well controlled reliable, results in the field. You will be shown a diversity of methods to collect, count and identify animals and plants, both direct (e.g. collect plants in the field) and indirect (e.g. identifying bats using their ultrasonic squeaks). You will learn how to measure important environmental variables that can determine the results you get (e.g. soil characteristics, temperature, humidity) and most importantly some basic means to plan for and interpret all that complex data.

Prerequisites

* PRA1001 Research Methods * PRA1002 Research Data Analysis and Presentation Skills

- Research Methods
- Research, Data analysis and Presentation Academic skills

Recommended reading

Wheater, C.P., Bell, J.R. & Cook, P.A. (2011). Practical Field Ecology: A Project Guide, John Wiley & Sons (Not obligatory but useful)

PRA2009

Period 5
10 Apr 2017
9 Jun 2017

Print course description

ECTS credits:
2.5
Instruction language:
English
Coordinator:
J.J. Sloggett
Teaching methods:
Research, Skills, Work in subgroups
Assessment methods:
Attendance, Assignment, Participation

Maastricht Science Programme

Tree of Life

Full course description

There is a great diversity of life forms present on this earth. Currently some 2 million species are described by scientists (i.e. they are formally named) but estimates of total, still occurring, diversity range from 10 to a staggering 100 million. This diversity count thus ignores all extinct organisms that ever lived. These numbers show that speciation is a very important process in evolution. All organisms, extinct and extant, are connected via a great "Tree of life", or phylogenetic tree. Most organisms that we are familiar with are part of only a few braches of this tree (classified as kingdoms): plants, animals, fungi and eubacteria. Most people recognize these general groups but are not aware of the different subgroups within these kingdoms. In this skill you will study different phyla in terms of morphology and anatomy in order to get a better understanding of the defining characteristics of these phyla. You will study fresh material, do dissections, but also study microscopic slides or petri dishes with medium. Furthermore, by working on the assignments you will gain a more in depth knowledge of the structure of the Tree of Life and in particular the evolutionary relationships between the studied phyla.

Course objectives

In this skills-training you will get an overview of the characteristics of some of the most important clades of life: plants, animals, fungi and eubacteria. At the end of this skills-training you should be able to recognize the most important phyla in these groups and explain their characteristics. Furthermore, you gain insight in the evolution of the Tree of Life.

Prerequisites

Pre-requisite BIO2005 Evolutionary Biology

- Evolutionary Biology

Recommended reading

Several book used in other courses will be used in this skill as well (e.g. books for Introduction to natural sciences: Biology, Evolutionary biology, General zoology, and General botany). There is no separate book for this skill required.

PRA2001

Period 2
31 Oct 2016
23 Dec 2016

Print course description

ECTS credits:
2.5

Coordinator:
R.H.J. Erkens

Teaching methods:
Assignment(s), Research, Skills

Assessment methods:
Attendance, Assignment, Presentation

Maastricht Science Programme
Advanced Physics Laboratory

Full course description

This skill is the culmination of the physics laboratory modules, and requires participants to use the skills that they have acquired in their previous lab experiences to good effect in order to design and conduct suitable experiments. The participants will have the opportunity to conduct experiments in material science, thermodynamics, optics, nuclear and particle physics and chaotic dynamics. During this skill, the participants will design experiments to test hypotheses in a variety of fields, ensuring that the data that they gather is sufficient to address pertinent questions in this field. Unlike the prerequisites, the participants will not be given step-by-step instructions for each experiment - a certain level of independence is both expected and required.

Course objectives

• To acquaint the participants with an overview of the main areas in high level experimental physics • To illustrate the relationship between observation, experiment and hypothesis • To give the participants a better understanding of the laws of physics • To hone the skills required for planning and conducting experimental physics • To develop the skills of experimental design and the impact this has on the outcome.

Prerequisites

PHY1001 Elements of physics PRA1003 Basic physics laboratory PRA2007 Physics laboratory Note: Waivers are unlikely to be granted unless applicants show significant expertise in experimental physics or similar subject (equivalent to the two pre-requisite skills).

- Physics Laboratory
- Elements of Physics
- Basic Physics Laboratory

Recommended reading

University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011. Practical Physics, G.L. Squires, Cambridge University Press, 4th edition, September 2001. Measurements and their Uncertainties: A practical guide to modern error analysis, I. Hughes & T. Hase, Oxford University Press, August 2010.

PRA3002

Period 2
31 Oct 2016
23 Dec 2016
Period 5
10 Apr 2017
9 Jun 2017

Print course description
ECTS credits:
2.5
Instruction language:
English

Coordinator:

[C.J. Pawley](#)

Teaching methods:

Work in subgroups, Skills, Research

Assessment methods:

Attendance, Participation, Assignment

Maastricht Science Programme
Programming in the Life Sciences

Full course description

In the life sciences the interactions between chemical entities is of key interest. Not only do these play an important role in the regulation of gene expression, and therefore all cellular processes, they are also one of the primary approaches in drug discovery. Pharmacology is the science studies the action of drugs, and for many common drugs, this is studying the interaction of small organic molecules and protein targets. And with the increasing information in the life sciences, automation becomes increasingly important. Big data and small data alike, provide challenges to integrate data from different experiments. The Open PHACTS platform provides web services to support pharmacological research and in this course you will learn how to use such web services from programming languages, allowing you to link data from such knowledge bases to other platforms, such as those for data analysis.

Course objectives

• To have the ability to recognize various classes of chemical entities in pharmacology and to understand the basic physical and chemical interactions. • To be familiar with technologies for web services in the life sciences. • To obtain experience in using such web services with a programming language. • To be able to select web services for a particular pharmacological question. • To have sufficient background for further, more advanced, bioinformatics data analyses. • To be familiar with modern software development practices.

Prerequisites

PRA2003 Programming

• [Programming](#)

Recommended reading

"Rang and Dale's Pharmacology" by Rang et al. (Pearson, 7th edition, 2012). "JavaScript & jQuery: The Missing Manual" by D.S. McFarland (O'Reilly, 2nd edition, 2011) "Open PHACTS: semantic interoperability for drug discovery" by A. Williams et al. Drug Discovery Today, 2012, http://dx.doi.org/10.1016/j.drudis.2012.05.016

PRA3006

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:
2.5
Instruction language:
English
Coordinator:
E.L. Willighagen
Teaching methods:
Skills
Assessment methods:
Participation, Attendance, Presentation, Assignment

Maastricht Science Programme
Polymer Processing

Full course description

In this practical course the processing and mechanical testing of polymers will be explored. The course will exist of four different experiments. In these experiments the processing and testing of a specific polymer will be conducted. Thermoplastic polymers will be compounded (pure and as a blend) and processed in a blow or flat film trough extrusion. By the use of injection moulding standard dog bones will be made for mechanical testing. Mechanical and physical properties of the product will be determined by tensile and bending strength analysis, Melt Flow Index (MFI) and a notched test bar impact test. Thermosetting polymers will be processed into composites. Different techniques for constructing composite materials will be addressed. Attaching different composite parts to each other is complicated and different methods will be explored. Mechanical and physical testing will be performed using the above described techniques. Rolling and pressing techniques will be used to process elastomers and the process of vulcanisation will be studied. After processing mechanical and physical testing will be performed. Coatings/paints play are an important application area of polymers. A basic coating will be made and will be processed. Characteristics like scratch and impact resistance of this coatings will be tested.

Course objectives

• To have the skills to determine the physical and mechanical properties of polymers and to increase the understanding of the underlying analytical methods • To obtains skills in the processing of polymers e.g. extrusion and injection moulding, compounding, pressing, etc • To obtain an understanding of the processing of different polymers like thermoplastic, thermosetting and elastomeric polymers and coatings/paints

Prerequisites

Pre-requisite: CHE2001 Organic Chemistry

• Organic Chemistry

Recommended reading

Practical Manual and SOP's of the used equipment

PRA3005

Period 2

31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:

2.5

Instruction language:

English

Teaching methods:

Skills, Research

Assessment methods:

Attendance, Participation, Assignment, Observation

Maastricht Science Programme

Molecular Biology

Full course description

The general aim of this skills course is to obtain detailed knowledge about the techniques that can be applied to address molecular processes in cell signaling and control of gene expression. Topics include the activation of intracellular signaling pathways; analysis of cellular responses; analysis of gene expression; analysis of protein activation; in silico analysis of signaling pathways; and the culmination of the above elements in an essay and assignment to indicate active understanding of the above processes. The skills days are designed to provide a perspective of how cutting edge molecular biological techniques are applied to tackle major research questions in modern biomedical research.

Course objectives

• To grasp the contextual setting which animal models are commonly used in Molecular Life Sciences. • To apply DNA cloning, transfection and imaging procedures using prokaryotic and eukaryotic cells. • To perform quantitative analyses on (non)coding RNA species and proteins from cell culture and organ biopsies. • To apply molecular biological principles to a pre-assigned task and present the findings to a larger audience. • To interpret scientific results and to write a scientific proposal on a Molecular Biological approach to relevant human disorders and defend it in a larger audience.

Prerequisites

Pre-requisites BIO2001 Cell Biology BIO2007 Genetics PRA2014 Genetics Co-requisites BIO3001 Molecular Biology

- [Genetics](#)
- [Genetics](#)
- [Cell Biology](#)

Corequisites

- [Molecular Biology](#)

Recommended reading

A reader is provided at the start of the course. Recommended literature sources: "Molecular Cell Biology" by Lodish, Berk, Kaiser (W.H. Freeman, 7th edition, 2012. bol.com price €145) and

"Introduction to Genetic Analysis" by Griffiths, Wessler, Carrol, Doebley (W.H. Freeman, 10th edition, International Edition, 2012. bol.com price €64,99).

PRA3003

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:
2.5
Instruction language:
English
Coordinator:
[P.A. Da Costa Martins](#)
Teaching methods:
Work in subgroups, Skills, Research
Assessment methods:
Attendance, Participation, Presentation, Written exam, Final paper

Maastricht Science Programme
Transition Metal Chemistry

Full course description

This course will focus on the synthesis of transition metal complexes and the experimental exploration of their chemical and physical properties. Some air sensitive techniques will be explored.

Course objectives

• To learn common techniques in inorganic synthesis • To perform synthesis of coordination compounds • To experimentally observe the principles of catalysis • To apply the knowledge gained in CHE3002 in a laboratory setting • To use the available instrumentation to spectroscopically analyse transition metal compounds

Prerequisites

Pre-requisites: PRA1001 Research Methods PRA2004 Inorganic Synthesis Recommended Courses: CHE3001 Organic Reactions Co-requisites: CHE3002 Transition Metal Chemistry

- [Research Methods](#)
- [Inorganic Synthesis](#)

Recommended reading

A course manual will be provided

PRA3008

Period 5
10 Apr 2017

9 Jun 2017

[Print course description](#)

ECTS credits:
2.5
Instruction language:
English
Coordinator:
[B. Blom](#)
Teaching methods:
Work in subgroups, Assignment(s), Research, Skills
Assessment methods:
Attendance, Assignment, Final paper, Participation

Maastricht Science Programme
Conservation Science Skills

Full course description

This skills training will be mainly given by the staff of the Stichting Restauratie Atelier Limburg (SRAL), in particular with Drs. René Hoppenbrouwers, general manager, and Kate Seymour, MA, head of education. The experiments will take place both at the SRAL (Maastricht) and at Chemelot. After a general introduction, the group will be divided into small subgroups that will work on the different practical and research problems, such as: - the analysis of paint cross-sections from (ancient) paintings, using different analytical techniques for the identification of pigments, binding materials, varnishes, etc. - the complex synthesis of the old pigment verdigris, via different routes, followed by the analytical identification of the different colourful reaction products. - the analysis of several blue pigments used in the past – such as smalt, azurite, ultramarine, Prussian blue and indigo, as a basis for the identification of those pigments in paintings. Also samples from the so-called Hafkenscheid collection (early 19th century) can be analysed by various techniques, as well as complex materials such as ancient mortars. A great number of different techniques will be employed: UV spectroscopy, microscopy, UV, X-ray diffraction, GLC, scanning electron microscopy, etc. Throughout the course the relevance of outcomes for arts-research and arts conservation will be discussed, and literature on artists' materials and research methods will be studied. We will also organize an excursion to a modern art research laboratory.

Course objectives

• To get acquainted with various analytical techniques used for the investigation of paintings and other works of art, and of artists' materials. • To obtain practical experience with some of these techniques. • To answer research questions connected to works of art and artists' materials, and discuss with the supervisors and (other) students the interpretation of the results • To further develop hands-on experience with the laboratory practices of fine arts conservation.

Prerequisites

Co-requisite: INT3010 Science and the Visual Arts

• [Organic Chemistry](#)

Recommended reading

Selected articles and chapters will be provided to the students

PRA3007

Period 5
10 Apr 2017
9 Jun 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
[E. Homburg](#)
Teaching methods:
Work in subgroups, Research, Skills, Assignment(s)
Assessment methods:
Attendance, Final paper, Presentation, Participation

Maastricht Science Programme
Advanced Molecular Laboratory Skills

Full course description

This course focuses on experimental research methods and reporting. In essence it is a sequel to the core practical training PRA1001 Research Methods. The main goal is to provide students with sufficient laboratory skills to successfully complete more advanced skills and projects in chemistry and biology related to molecular laboratory research. During the six weeks, students will perform a variety of integrated biology and chemistry experiments. It can be anticipated that three of the six skills days have an emphasis on chemical aspects of molecular research, whereas the other three days focus more on biological aspects. The course will be structured in the Research Based Learning (RBL) format, with ample room for student initiative.

Course objectives

• To be able to plan and execute experiments related to molecular research in chemistry and biology
• To understand typical separation and analysis tools frequently used in a chemical and biological laboratory • To be able to accurately develop and follow scientific protocols and procedures • To be able to do scientific reporting in the form of a lab notebook and scientific reports
Prerequisites

BIO1001 Introduction to Natural Sciences: Biology / CHE1001 Introduction to Natural Sciences: Chemistry / PRA1001 Research Methods

• [Research Methods](#)

Recommended reading

"Practical skills in Biomolecular sciences" by Reed R, Holmes D, Weyers J, Jones a. (Pearson, 3rd edition 2007).

PRA2005

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)

ECTS credits:
2.5

Instruction language:
English

Coordinators:
[T.J. Cleij](#)
T.D. Steen Redeker

Teaching methods:
Work in subgroups, Assignment(s), Research, Skills

Assessment methods:
Attendance, Observation, Final paper, Written exam

Maastricht Science Programme
Biology of Plants

Full course description

Flowering plants are the most diverse group of plants on earth and the ones everybody is familiar with. We use them for example for food, medicine and constriction. However, very few people have a proper understanding of the biology of flowering plants. This skill training will let you investigate five main aspects of a flowering plant's biology: 1) growth (including the role of nutrients), 2) photosynthesis and respiration, 3) reproduction (flowers and fruits), 4) transport (anatomical and physiological), and 5) development and morphogenesis (flowering and phototaxic responses). The last week will be devoted to a practical application of plant knowledge and will consist of a visit to a seed producer and plant grower. During this skill you will for the physiological part mainly carry out lab experiments and use microscopy for the anatomical part.

Course objectives

In this skill training you will investigate, and experiment with, some of the unique adaptations that flowering plants have. It will illustrate some major aspects of flowering plant form, function, physiology, and development.

Prerequisites

BIO1001 Introduction to Natural Sciences: Biology BIO2003 General botany

- [General Botany](#)

Recommended reading

As a general background text "Botany, an introduction to plant biology" (J.D. Mauseth, 5th ed. 2014. Jones & Bartlett Learning. ISBN:978-1-4496- 6580-7) can be used. The literature per experiment will consist of selected scientific articles from primary literature.

PRA3009

Period 4
6 Feb 2017
7 Apr 2017

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinator:
[R.H.J. Erkens](#)
Teaching methods:
Skills, Research, Working visit(s)
Assessment methods:
Attendance, Participation, Assignment

Maastricht Science Programme
Advanced Electronics

Full course description

The course builds on the introductory electronics lab and is split into three, two-week long projects covering the following topic areas: • Digital electronics for computing: This project covers the basics of binary number systems, Boolean algebra, and logic devices. You will build a digital clock to provide an appreciation of how digital devices can perform different functions. A similar device will be built using the Arduino microcontroller to better understand how an integrated microcontroller can achieve the same functions of many discrete logic components. • Analogue electronics with bioengineering applications: In this project you will build an ECG generator and measurement unit using analogue components with the aim of better understanding analogue electronics and their potential applications in biomedical engineering. Students will gain a more detailed insight into the charging and discharging characteristics of biological and technological capacitors as well as understanding the function of amplifiers, filters and counters. • Electrochemical impedance measurement and biosensor technology Impedance spectroscopy is an electronic read-out technology which emerged in the Nazi era, used to investigate the structural quality of U-boats. Through the decades the technology was optimized and is now an established technology, implemented in (bio) medical research. It has been used for the detection of proteins, neurotransmitters and even the detection of single nucleotide polymorphisms in DNA sequences. In this project you will mimic this last experiment and try to delineate impedimetric signals in way that DNA melting times can be calculated and based on this information you will try to distinguish between a full matching DNA sequence and a mutated DNA sequence.

Course objectives

• To appreciate the theory behind digital (Boolean) logic and logic gate applications and to develop an insight into how computers function. • To design, study and build circuits involving adders, flip-flops, counters and sequential logic and understand how these devices can be used in everyday electronics. • To understand how an electrocardiogram (ECG) measures the heart's electrical pulses and translates these into an analogue waveform. • To build an ECG generator and detector and collect measurements using these. • To use impedance spectroscopy to distinguish between different samples and understand the principles behind this technique.

Prerequisites

MAT1001 Introduction to Natural Sciences: Calculus or PHY1002 Introduction to Natural Sciences: Mathematical Foundations of Physics PRA1006 Electronics

- Electronics
- Electronics Lab

Recommended reading

A course manual and detailed experiment descriptions will be provided during the practical.

PRA3012

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
2.5
Instruction language:
English
Coordinator:
B.R.N. van Grinsven
Teaching methods:
Skills, Work in subgroups
Assessment methods:
Assignment

Maastricht Science Programme
Electronics Lab

Full course description

This practical addresses the basic concepts essential for mastering the principles of electronics applicable to direct current (DC) and alternating current (AC) circuit analysis. The emphasis is on the basic physics behind electronics, the application of the fundamental laws of electronics to discrete electrical components, and the network theorems used in circuit analysis. The first weeks involve schematic reading, the mathematics behind electronics, and elementary circuit analysis. Here the students acquire the fundamental concepts of DC and AC theory and progresses through capacitive circuits with emphasis on AC circuit analysis, with special emphasis on sinusoidal waveforms, filters

and rectifiers. The practical continues with semiconductor physics, namely diode and transistor characteristics and their applications, most notably operational amplifiers (and comparators). The next part of the practical entails the study of digital logic, its operations, principles and applications. The course concludes with an introduction to microprocessor circuits and techniques using the Arduino microcontroller.

Course objectives

• To acquaint the student with the basics of electronic fundamentals. • To master the principles of direct and alternating current electronics circuit analysis. • To make the student familiar with semiconductor physics, particularly diode and transistor characteristics and their applications, especially operational amplifiers. • To provide an introduction to digital logic, its operations, principles and applications.

Prerequisites

Co-requisites: PHY2006: Electronics

Corequisites

• [Electronics](#)

Recommended reading

A course manual and detailed experiment descriptions will be provided during the practical.

PRA2006

Period 1
5 Sep 2016
28 Oct 2016

[Print course description](#)
ECTS credits:
2.5
Instruction language:
English
Coordinators:
[D.L. Carroll](#)
[B.R.N. van Grinsven](#)
Teaching methods:
Skills
Assessment methods:
Attendance, Assignment

Maastricht Science Programme
The Limburg Landscape

Full course description

The landscape of Limburg, like any other landscape, displays a variety of features. Some of these reflect man's ongoing endeavour to adapt the landscape to its needs. For instance, there has been a

clear impact of human behaviour in the province from the moment that Neolithic farmers arrived in these parts around 4000 BC. Other features represent a natural evolution of the landscape on a scale of (tens of) millions to several thousands of years to very recent. Distinct features are the geology, the variety in landforms and different climatic conditions. This combination of geological, geomorphological and climatic factors has endowed the province with its own characteristic wealth of especially botanical variety but also explains the findings of for instance mosasaurs. Topics covered in this skills training are the geological history of Limburg, characteristics and management of the riverine landscape of the Maas, the practice of nature conservation and the ecology of different types of South Limburg forests.

Course objectives

The landscape of Limburg is unique in the Netherlands, especially the Southern part. In terms of botanical and geological diversity but also in terms of elevation the province has a clearly distinct profile from the other provinces in the Netherlands. It is also this landscape you see on a daily basis while studying at Maastricht University. The main objective of this skills training is to familiarise you with the biological characteristics and geological history of the province so you can understand the evolution of its natural landscape.

Prerequisites

PRA1001 Research Methods PRA1002 Research Data Analysis and Presentation Skills PRA2009 Field skills in Biology A bike to make field trips!

- Research Methods
- Research, Data analysis and Presentation Academic skills
- Field Skills in Biology

PRA3011

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
2.5
Instruction language:
English
Coordinator:
R.H.J. Erkens
Teaching methods:
Working visit(s)
Assessment methods:
Assignment, Attendance

Maastricht Science Programme
Applied Cell Biology

Full course description

This skill will contain: • Cell culture • Immunohistochemistry • qPCR • Metabolic assays

Course objectives

The main objective of this course is to provide a practical introduction into molecular and cell biology and to demonstrate how experimental cell biology can be used in the context of regenerative medicine. We will use osteoblasts to study the effects of a hypoxia mimic on angiogenic markers. A variety of experiments will be performed to study differences on RNA and protein level. Cell Profiler will be used for image/data analysis.

- Cell Biology
- Laboratory Skills for Molecular Research

Recommended reading

• Practical laboratory instructions. • A small molecule approach to engineering vascularized tissue. Doorn J1, Fernandes HA, Le BQ, van de Peppel J, van Leeuwen JP, De Vries MR, Aref Z, Quax PH, Myklebost O, Saris DB, van Blitterswijk CA, de Boer J. Biomaterials. 2013 Apr;34(12):3053-63

PRA3017

Period 1
5 Sep 2016
28 Oct 2016

Print course description

ECTS credits:
2.5

Instruction language:
English

Coordinators:
M.M.J. Kamphuis
J. de Boer

Teaching methods:
Skills, Research, Assignment(s)

Assessment methods:
Attendance, Participation, Assignment

Maastricht Science Programme
Brain Anatomy

Full course description

The aim of this practical training is to make you acquainted with the neuroanatomical terminology and to gain insight into the spatial and functional organisation of the brain. It is essential to have a basic knowledge of the brain anatomy when working in the field of neuropsychology or neurobiology. Many specific brain areas can be linked to particular functions. Thus, knowledge of the brain anatomy and its main functions allows direct linkage of specific neurological or psychiatric disorders to particular brain areas. After a short theoretical introduction, you will study whole brains and brain

material of mammals at both macroscopical (visual inspection) and microscopical level. The emphasis will be on major brain systems, including the basal ganglia and limbic system.

Course objectives

• The aim of the training is to become acquainted with the neuroanatomical terminology and to gain insight into the spatial and functional organization of the brain. • Focus on the limbic system, basal ganglia, plastinated human brains, brain dissection, and microscopical slices.

Corequisites

• Introduction to Neuroscience

Recommended reading

Papers from scientific journals and book chapters from books are provided.

PRA1007

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
2.5
Coordinator:
A. Jahanshahianvar
Teaching methods:
Skills, Assignment(s), Work in subgroups
Assessment methods:
Attendance, Written exam, Participation

Maastricht Science Programme
Practical Zoology

Full course description

The skill aims to provide a greater insight into the different aspects of zoology and how they are studied in the laboratory. You will learn different experimental approaches used in zoology in including physiological testing, behavioural analysis and measures of animals diversity. This course aims to provide you with better skills in handling both live and dead animal samples and in interpreting what you see in a biologically relevant way. Please note that in this course you are required to carry out experimental work with live (invertebrate) animals, which may harm them.

Course objectives

The skills will include: • Carrying out experiments on physiology, behaviour, biodiversity and other aspects of zoology • Analysing zoological data • Writing up zoology experiments • Knowledge of conservation of zoological samples

• Research, Data analysis and Presentation Academic skills

- General Zoology

Recommended reading

Recommended is the book used for course BIO2004 General Zoology

PRA2013

Period 4
6 Feb 2017
7 Apr 2017

Print course description
ECTS credits:
2.5
Coordinator:
J.J. Sloggett
Teaching methods:
Skills, Work in subgroups

Maastricht Science Programme
Microbiology

Full course description

Medical Microbiology is concerned with the diagnosis, treatment and prevention of infectious diseases. For identification and treatment of an infectious agent patient samples are analysed in a medical microbiology laboratory. In the first three weeks of this skill training you will get acquainted with the basic microbiological techniques such as, microbial culture, biochemical tests, antimicrobial resistance, and molecular characterisation. In the subsequent weeks, you will each analyse a potential outbreak for which you will need to determine the infectious agent, analyse the antimicrobial resistance pattern to propose therapy as well as the genetic composition of the micro-organism in order to determine genetic relatedness. For this you will use the techniques that you have learned in the previous weeks. Finally you will need to present your results in a practical report.

Course objectives

In this skill training you will perform microbiological tests such as a variety of biochemical and molecular methods that enable you to identify an infectious agent and genetic relatedness in case of an outbreak.

Corequisites

- Microbiology

Recommended reading

• Murray. Medical Microbiology. (7th ed.), Elsevier Mosby. • Primary literature

PRA3010

Period 5

10 Apr 2017

9 Jun 2017

[Print course description](#)

ECTS credits:

2.5

Instruction language:

English

Coordinators:

[S. Hulshof](#)

[S. Erkens - Hulshof](#)

Teaching methods:

Skills

Assessment methods:

Attendance, Assignment, Final paper

Maastricht Science Programme

Molecular Modelling

Full course description

Molecular modelling is an important part of chemistry for any industry but more particularly the pharmaceutical industry. It helps with determining the shape of molecules and therefore prevent problems down the line when those molecules need to react. It is also possible to study the reactivity of molecules as well as understand the pathway of certain reactions by determining the shape of the transition state. During these skill sessions, you will be using a piece of software called Gaussian® in order to perform various calculations on system that would apply in real life situations, solve problems as well as assess the validity of certain models.

Course objectives

• To provide an understanding of what can be achieved using molecular modelling software • To evaluate the most appropriate basis sets to use to solve different problems • To perform calculations in order to extract various measurable (HOMO/LUMO, Transition states, energies, electron densities...etc) • To analyse calculation results to draw conclusion as to a reaction will proceed • To study transition states and their relevance in chemistry

Prerequisites

Prerequisite CHE3006

• [Quantum Chemistry](#)

Recommended reading

Atkins, P., Friedman, R. Molecular Quantum Mechanics (5th ed.) Oxford University Press. Cramer, J. Essentials of Computational Chemistry – Theories and Models (2nd ed.) Wiley

PRA3018

Period 1

5 Sep 2016

28 Oct 2016

[Print course description](#)

ECTS credits:
2.5
Coordinator:
[F.G.A. Birembaut](#)
Teaching methods:
Skills, PBL
Assessment methods:
Attendance, Assignment, Final paper

Maastricht Science Programme
Synthetic Biology

Full course description

Synthetic biology aims to (re)construct genetic systems by using molecular biology, genetic engineering and microbiology methods from an engineering point-of-view. This engineering approach focuses on four important principles: abstraction, modularity, standardization and design/modelling. In this way it is possible to extend and apply genetic techniques to real world applications. The goal of this practical course is to design, build, and experiment with biological systems using molecular biology techniques relevant to the field of synthetic biology in combination with engineering concepts.

Course objectives

Understand synthetic biology concepts • Understand engineering concepts of design, build and test • Practical application of synthetic biology concepts • Learning and implementing basic molecular biology lab skills • Collect and analyze experimental data

Prerequisites

PRA2005 Molecular Lab Skills PRA2014 Genetics

- [Genetics](#)
- [Laboratory Skills for Molecular Research](#)

Recommended reading

Course manual

PRA2010

Period 2
31 Oct 2016
23 Dec 2016

[Print course description](#)

ECTS credits:
2.5
Instruction language:
English

Coordinator:
T.D. Steen Redeker
Teaching methods:
Skills, PBL
Assessment methods:
Attendance, Assignment

Projects

Projects

Maastricht Science Programme
Research Project

Full course description

2013-2014: 1. Physics is fun! Science Communication and Public Engagement (Donna Carroll and Chris Pawley) 2. Building Species-Distribution Models using Maximum Entropy modelling (Roy Erkens and Chris Pawley) 3. Predatory Leech Feeding Preferences (John Slogett) 4. GEnetic Diversity in a widespread tropical tree species (Roy Erkens and Rita Brandao) 5. Detecting microsporidian insec parasites using PCR (Rita Brandao and John Sloggett) 6. The Isolation and characterization of alkaloids in tropical plant leaves (Ariana Perez-Gavilan and Roy Erkens) 7. Measuring CO_2 uptake op algae using and Arduino (Jens Dassen and Roy Erkens) 8. Counting calories: a Study on the Estimation of the Caloric Content of food products (Ariana Perez-Gavilan and Donna Carroll) 9. Testing for Soil NPK: what is the best approach? (John Sloggett and Hanne Dilien) 10. Synthesis of Boron Calixarenes and the exploration of their properties as Host Molecules (Ariana Perez-Gavilan)

PRO1002

Period 6
12 Jun 2017
7 Jul 2017

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
J.J. Sloggett
Teaching methods:
PBL, Research, Skills, Assignment(s)

Thesis

Bachelor Thesis Research

Maastricht Science Programme
Bachelor Thesis Research

BTR3000

Semester 1
1 Sep 2016
3 Feb 2017
Semester 2
6 Feb 2017
31 Aug 2017

Print course description
ECTS credits:
30.0
Instruction language:
English
Coordinator:
T.J. Cleij

Maastricht Science Programme
Bachelor Thesis Research

BTR3001

Semester 1
1 Sep 2016
3 Feb 2017
Semester 2
6 Feb 2017
31 Aug 2017

Print course description
ECTS credits:
30.0
Instruction language:
English
Coordinator:
T.J. Cleij