Human Movement Sciences: Sport, Exercise and Health (Research) (MSc)

Vrije Universiteit Amsterdam - Faculteit der Bewegingswetenschappen - M Human Movement Sciences (Research) - 2016-2017

The two-year (120EC) programme Human Movement Sciences: Sport, Exercise and Health (Research) aims at training for so-called “translational research”; research on the cutting edge of fundamental and clinical human movement sciences that tries to integrate fundamental knowledge and clinical questions. This requires a strongly multidisciplinary approach, but also a well developed knowledge and experience of the workings of fundamental research and clinical practice. The Research Master's offers a very broad, but human movement oriented programme, stretching from molecular biology to cognitive neuroscience and human motor behaviour. The programme intends to prepare students for a research career in the area of movement-related disorders.

Admission to the programme
The programme is open for students with a clinical, science or technical BSc diploma related to the field of Movement Sciences. The Master’s programme is a so-called selective master, which implies that the programme has a maximum intake of thirty students per year and that admission is linked to strict criteria such as the average grade (for either BSc-, or premaster programme), the quality of the premaster / bachelor research project and of course, motivation and proficiency in English.

Structure of the programme
The first year of the programme is dedicated to training for research, which embraces a core programme on subjects relevant for translational, interdisciplinary research, training in general research methods and methology and selective courses to prepare especially for the research year.

The second year is dedicated to research and is spent as either one internship (60EC), or a combination of a minor (24EC) and major internship (36EC). The department offers ample possibilities for spending (part of the) internship abroad.

The research master programme coordinator serves as the advisor for all students. Approval of all study programmes has to be obtained from the Examination Board.

Master courses are taught in English. The course material is in English.

Overview of the programme

Master's Programme Human Movement Sciences: Sport, Exercise & Health (Research)

Inhoudsopgave

First year research master fundamental and clinical HMS optional courses

Vakken:

Naam	Periode	Credits	Code
3D-Kinematics	Periode 4	3.0	B_3DKIN
Animal Experiments for HMS	Periode 6	6.0	B_ANIMEXP
Applied Biomechanics	Periode 2	6.0	B_APPLBIOMEC
Clinical Exercise Physiology	Periode 3	3.0	B_CLINEXERC
Concepts in HMS	Periode 1	6.0	B_CONCEPTS
Coordination Dynamics: principles and applications	Periode 2	6.0	B_CLINCORDYN
Electromyography	Periode 5	3.0	B_ELECTROMYO
Energy Flow Models	Periode 1	3.0	B_ENERFLOW
Entrepreneurship in Human Movement Sciences	Periode 5	6.0	B_ENTREPREN
Maximal Neuromuscular Performance	Periode 1	3.0	B_MAXNEUR
Mechanical and Adaptive Myology	Periode 4	3.0	B_MECHADMYO
Neuromechanics	Periode 5	3.0	B_NEUROMECH
Perception for Action	Periode 4	3.0	B_PERCACTION
Perceptual-motor Learning	Periode 2	6.0	B_PERCML
Time Series Analysis	Periode 5	6.0	B_TIMESERANA
Topics in Rehabilitation	Periode 1	6.0	B_TOPICS
Training, Aging and Disuse	Periode 2	6.0	B_TRAD

First year research master fundamental and clinical HMS obligatory courses

Vakken:

Naam	Periode	Credits	Code
Advanced Methodology	Periode 5	6.0	B_ADVANMETH
Exercise and Clinical Immunology	Periode 1	6.0	B_EXCLINIM
Molecular Cell Biology	Periode 4	3.0	B_MOLECULBIO
Neurosciences	Periode 2	6.0	B_NEUROSC
Scientific Communication	Periode 6	3.0	B_SCCOMMUN
Tissue Engineering and Mechanobiology	Periode 6	3.0	B_TISSUEENG
Treating Locomotor Disease	Periode 3+4	6.0	B_LOCOMOTOR

Second year research master fundamental and clinical HMS obligatory programme

Students can choose to do one Research Internship (60 EC), or do two internships (a Major internship 36 EC and a minor Internship 24 EC).

Vakken:

Naam	Periode	Credits	Code
Research Internship Research Master	Ac. Jaar (september)	60.0	B_RIRM

3D-Kinematics

Vakcode	B_3DKIN (900632)
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. H.E.J. Veeger
Examinator	prof. dr. J. Harlaar
Docent(en)	prof. dr. H.E.J. Veeger
Lesmethode(n)	Hoorcollege, Computerpracticum
Niveau	500

Doel vak
The student is capable to:
• Define and calculate local joint coordinate systems;
• use and understand different calibration methods and their limitations;
• translate technical motion descriptions into clinically relevant units;
• apply the above to experimental data;
• interpret and comment on methods as described in the literature.

Inhoud vak
In this course students are introduced to the fundamentals of three-dimensional kinematics, as well as the (more or less) standard application methods.
The course will comprise three separate blocks focusing on
1. the definition and use of local coordinate systems in the calculation of osteokinematics;
2. the use of technical marker sets as well as the practical implications of data processing, especially correcting for missing markers and;
3. the calculation procedures for obtaining helical axes, needed for the definition of functional axes-based coordinate systems

Onderwijsvorm
Lectures, computer practicals and tutorials

The three computer practicals are linked to in-term assessments. Each practical will contribute for 15% to the final score.

Toetsvorm
- completion of all 3 assignments is mandatory to qualify for the exam
- two in-term tests on calculation skills, partially exempting for exam
- final test on calculation skills + literature
- score: 3 x 20% for calculation questions (one for each block)
40% for essay question
above 100% = 9/10

Literatuur
Relevant papers will be listed in Blackboard.
A useful source is the book by Zatsiorsky (Zatsiorsky, Valdimir M., Kinematics of Human Motion. Champaign, Illinois: Human Kinetics, 1st edition, 1998. ISBN 0-880110767-5), which will be used as reference material.

Vereiste voorkennis
This course requires proficiency in Matlab and matrix calculation. If there is a deficiency related to Matlab skills, students are strongly advised to take the TUE web-based matlab course that can be found at http://www.imc.tue.nl/
The BSc course “Mechanische Analyse …” is advised.

Aanbevolen voorkennis
Matlab and matrix calculation

Overige informatie
The maximum number of participants in this course is limited to 40.

Advanced Methodology

Vakcode	B_ADVANMETH (900808)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. B.T. Knapik
Examinator	dr. B.T. Knapik
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak
An introduction to statistical methods common in modern experimental research

Inhoud vak
Students will learn ins and outs of applying and interpreting statistical techniques that are common or are becoming common in modern experimental research. The topics covered in this course are:
-- Introduction to R: statistical package R will be used throughout the course
-- Basic statistical principles (e.g. research design, data exploration)
-- Inference about a population mean
-- Inference about two populations: independent and paired t-tests, and nonparameteric

difference tests
-- Inference about more than two populations: one-way and two-way ANOVA, nonparametric version of one-way ANOVA
-- Regression models: simple and multiple linear regression with numerical and categorical explanatory variables, testing, model selection, extension to generalized linear models
-- Repeated measures and dependent observations: generalized estimating equations and mixed effects linear models.

Onderwijsvorm
Lectures and computer assignments.

Toetsvorm

By weekly reports on data analyses using the R package.

Literatuur
Lecture slides and additional handouts.

Vereiste voorkennis
Basic mathematics. Some previous experience with programming is handy.

Intekenprocedure
VUnet.

Animal Experiments for HMS

Vakcode	B_ANIMEXP ()
Periode	Periode 6
Credits	6.0
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. H. Maas
Niveau	500

Doel vak
Aim of this course is to prepare research master students who are going to perform animal experiments for their research project in their second year. The course is focused on the respectful and responsible use of laboratory animals in Human Movement Sciences related research. Refinement of techniques, reduction in the number of animals used and replacement wherever possible by non-sentient systems will be guiding principles.

Inhoud vak
In this course, the students are educated and trained in the principles and practical skills that are essential for the humane use and care of laboratory animals and for the quality of research. The two-year Research Master program Human Movement Sciences: Foundations in Sport, Exercise & Health aims at training for research on the cutting edge of fundamental and clinical human movement sciences that tries to integrate fundamental knowledge and clinical questions. The first year is dedicated to preparation for research. The second year is fully dedicated to a research internship of your own choice. The human movement sciences cover a great variety of subjects stretching from molecular biology and muscle physiology to cognitive neuroscience and human motor behavior. This also involves several experimental

approaches, ranging from in vitro work on for example cultured cells to in situ and in vivo studies using live animals, as well as experiments on human subjects. Appropriate education and training of all those engaged in the use of live vertebrate animals for scientific purposes is required. To prepare students for a research career using animal models, the course Animal Experiments for Human Movement Sciences offered to those students that are accepted for a research internship involving animal experiments.

Onderwijsvorm
This course consist of three major parts. All lectures and lab classes are obligatory.
1. Course on Laboratory Animal Science (3 EC) as coordinated by the Division of Animal Welfare & Laboratory Animal Science, Utrecht University.
2. Training on handling animals, fluid injections and anesthesia, as well as general microsurgical techniques (1.5 EC).
3. Training of project specific surgical skills (1.5 EC)

Toetsvorm
Part 1: written exam (grade 1-10); The student has a maximum of two opportunities to pass the written exam. There is no second chance for this course.
Part 2: practical exam (pass/fail); Assessment by Laboratory Animal Welfare Officer VU/VUmc Dr. ing. Klaas Kramer and Guus Baan.
Part 3: practical exam (pass/fail); Assessment by laboratory technician and research internship supervisor.
A student passes for this course only if all parts were graded by a mark >6 or by a pass.

Literatuur
Part 1: Course on Laboratory Animal Science
The theoretical part of the course is covered by a multi-author textbook (which has been trans-lated into several other languages): L.F.M. van Zutphen, V. Baumans and A.C. Beynen (eds.), Principles of Laboratory Animal Science: A contribution to the humane use and care of animals and the quality of experimental results, Elsevier Science Publishers, Amsterdam, 2003 (4th ed.) Also a CD-ROM Humane Endpoints in Laboratory Animal Experimentation is used and additional information is given with hand-outs from presentations, etc.

Part 2: Training anesthesia and fluid injections, as well as general microsurgical techniques
- Information for handling and fixing mouse and rat (Amsterdam Animal Research Center, VU University; in Dutch).
- Manual of Microsurgery on the Laboratory Rat, Part I. Remie R. et al. (1990). Chapters 3, 4, and 7.
- Chirurgische Knotentechnik. Ethicon; a Johnson & Johnson Company (2009).

Part 3: Training of project specific surgical skills
- General laboratory practice ("Algemene labvoorschriften") and those specific for the lab.
- Animal anatomy, those structures that are involved in the project specific surgery.
- Surgical protocol specific for the research project.

Vereiste voorkennis

- The student should have training which meets the legal requirements of 18 ECTS biological basic subjects (of which 7.2 ECTS anatomy/zoology and 7.2 ECTS physiology).
- The student has been accepted by a scientific staff member of the MOVE research institute Amsterdam for a research project that will involve animal experiments.
- Admission for this course requires proof of the above, including a short description of the involved animal experiments, sent to the course coordinator, who will decide if the course is appropriate for the internship.

Doelgroep
The course is an optional part of the Research Master program Fundamental and Clinical Human Movement Sciences. For those students that are going do a research internship involving animal experiments and also have the strong motivation to pursue a scientific career using animal models, it is essential to get trained in the theory, ethics, methodological design and practice of animal experimentation.

Overige informatie
The dates of part 1 of the course are not in line with the curriculum schedule of the VU University. Parts 2 and 3 may be completed in any period if agreed with the teaching staff.
There are a limited number of positions available for MSc students for part 1 of the course. Therefore, early registration (in the first year of the RM program) is recommended.

Applied Biomechanics

Vakcode	B_APPLBIOMEC ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. S.M. Bruijn
Examinator	dr. S.M. Bruijn
Docent(en)	dr. G.S. Faber
Lesmethode(n)	Hoorcollege, Computerpracticum
Niveau	500

Doel vak
In this course the student will upgrade their mostly 2D biomechanical knowledge to the 3D world and they will learn to apply this new knowledge to perform biomechanical analyses in the context of Sport and Health. Examples of concepts included are joint angles, joint moments, energy (work, power), angular (and linear) momentum.

Students will learn to analyze laboratory measurements using a 3D inverse dynamics model. Furthermore, they will learn how to work with more simple measurement techniques, such as accelerometers found in phones. They will also learn how these complex and simple measurement tools can be applied in biomechanical research in both the laboratory and the field settings. Lastly, they will learn to think about what measurements are sufficient for a given problem; in other words; what are the most efficient ways to solve your problem, and at what cost

(i.e. decrease in precision) does this come?

Inhoud vak
Every week consists of lectures and Matlab practicals. During the lectures the theory will be explained. During the Matlab practicals, the biomechanical theory will be applied to analyze different applied research questions. In the last weeks of the course, students will start working on a research proposal to combine the things they've learned over the course. During the penultimate week, there will be a personalized feedback moment for these project proposals.

All content will be targeted on hands-on applied biomechanical questions as examples for the theory to be studied; examples of questions studied are; What is the ankle load during a basketball jump landing? Is squat lifting really better for your back? How come field hockey players can give so much speed to a ball during a drag flick? How can gymnasts improve their jumps? How can we use mobile phones to gather meaningful data about human movement?

Every week, the motion to be analyzed will become more complex (few segments full-body).

Measurement using the following systems will be covered in this course:
• Laboratory grade 3D motion registration (Optotrak, Force plate)
• A wearable multi-inertial sensor suit for 3D full body motion capture
• Simple wearable accelerometers
• Mobile phones
• Kinect (demo)

Onderwijsvorm
21 hours of Lectures
48 hours of practicals
90 hours of self-study (preparing lectures, Writing assignments etc)

Toetsvorm
Weekly practical report + research proposal

Literatuur
Will appear on blackboard

Vereiste voorkennis
It is recommended, although not required, to have completed the following courses:
• Biomechanics
• Mechanische analyse van het menselijk bewegen (2D inverse dynamics)
If you did not take these courses, you should have at least some affinity with biomechanics. Furthermore, it is advisable to be familiar with Matlab since all biomechanical modeling will be done with this program.

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Clinical Exercise Physiology

Vakcode	B_CLINEXERC (900670)

Periode	Periode 3
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. J.J. de Koning
Examinator	prof. dr. C.C. Foster Jr.
Docent(en)	dr. J.J. de Koning
Lesmethode(n)	Hoorcollege, Practicum, Werkcollege
Niveau	400

Doel vak
To provide the student with the fundamental knowledge of clinical exercise physiology as a variant of normal exercise physiology, which will enable the student to apply this knowledge in preventive and rehabilitative exercise programs.

Inhoud vak
Basic didactic information and laboratory experiences of the effect of pathophysiologic conditions on human energy metabolism and health. The focus will be on organ systems and their linkage to ATP generating pathways and on how this influences skeletal muscle performance. The application is to the use of exercise both diagnostically and as a therapeutic tool. After this course the student will have the fundamental knowledge and skills to use exercise in patients with cardiopulmonary/metabolic disease and to work cooperatively with other health care providers.

Onderwijsvorm
Lecture
Practical laboratory exercises
Directed reading

Toetsvorm
multiple choice

Literatuur
A selection of articles and practical guide on BlackBoard

Vereiste voorkennis
Toegepaste Inspanningsfysiologie.

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Concepts in HMS

Vakcode	B_CONCEPTS ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. T.W.J. Janssen

Examinator	prof. dr. T.W.J. Janssen
Docent(en)	prof. dr. J.H. van Dieen, prof. dr. J.B.J. Smeets
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak
The student is able to report the key behavioral concepts in contemporary HMS, to apply these concepts in describing research outcomes, and to judge the (dis)advantages of using a particular concept in a particular situation. The student knows the mechanical concepts that apply to control of joint position and movement, in particular equilibrium, stability, robustness, performance, and observability. The student understands these concepts and can explain how they are related to clinical problems and to motor control in patients with joint disorders. The student knows the physiological concepts of exercise intensity and workload in sports and clinical research and training, in particular, (sub-) maximal force/power generation, (sub)maximal energy expenditure, anaerobic threshold and critical power. The student understands these concepts and can explain how they are related to sports and rehabilitation research and practice.

Inhoud vak
In this course, the students are acquainted with biophysical and behavioural concepts that underlie current debates in HMS. One part of this course deals with behavioural concepts of HMS.
Human movement is a complex behavior. To interpret this complex behavior, the scientific literature uses concepts that are rather complex themselves. Examples of such concepts are information, stability, synergy, internal representation and motor programs. In this course, questions such as "What do these concepts mean exactly?" and "How do these concepts help us to understand the behavior we observe?" will be addressed. A second part of the course deals with biomechanical concepts in particular with (in-)stability of joints and joint movement. Instability is often used in the clinical setting to describe the state of the joint after injury or in degenerative disorders. The term is often poorly defined, which leads to confusion in the communication between disciplines, e.g. between physiotherapists and orthopedic surgeons. Mechanics and control theory provide a rigorous framework for describing joint function. The relevance of this conceptual framework for the clinical context and the implications for diagnosis and treatment will be discussed. A third part of the course deals with physiological concepts in particular with the use of exercise intensity and relative workload. Relative workload is often used to induce similar loading of persons in sports and clinical studies, either to measure endurance or to induce a certain training stimulus. Relative workloads as percentage of maximal force/power or energy utilization (oxygen uptake) are used in various circumstances. While the choice for a given variable is essential for the result, it will be discussed whether the proper variables are chosen for the specific goals.

Onderwijsvorm
45 contact hours, divided in:
Lectures 21 * 2 hours
Exam 3 hours
115 hours self study
The course consists of 3 series of 7 lectures dealing with biomechanical, physiological, and behavioural concepts respectively. In

the first lecture of each series a general introduction will be given. In subsequent lectures, the formal concepts will be introduced and explained and related to the applications in sports and health. In the 7th lecture of each series, questions by the students will be discussed.

Toetsvorm
Written test with open-ended questions, with equally weighted questions on the 3 parts of the course content.

Literatuur
Research articles, review papers and a syllabus will be made available at the start of the course.

Vereiste voorkennis
The student should have a basic knowledge and understanding of the human musculoskeletal anatomy as described for example in Human Anatomy. EN Marieb, J. Mallatt, Benjamin Cummings, 3rd edition, ISBN: 0-8053-5335-6, chapters 1.1-1.16; 4.88-4.102; 4.99-4.102; 9.212-9.239; 10.244-10.253;11.266-11.270.

The student should have a basic knowledge and understanding of biomechanics as described for example in: Fundamentals of Biomechanics. Equilibrium, Motion and Deformation. M. Nordin and N. Ozkaya; Human Kinetics, ISBN 0387982833, chapters 1-5.

The student should have a basic knowledge and understanding of exercise and muscle physiology as described in for example W.D. McArdle, F.I. Katch, V.L. Katch: Exercise Physiology: energy, nutrition & human performance, 7th edition (2010) Lippincott Williams & Wilkins, ISBN 1608318591, chapters 7-11, 15-17, 21.

Coordination Dynamics: principles and applications

Vakcode	B_CLINCORDYN (900666)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. M. Roerdink
Examinator	dr. M. Roerdink
Docent(en)	dr. M. Roerdink
Lesmethode(n)	Hoorcollege, Computerpracticum, Practicum, Bijeenkomst, Deeltoets extra zaalcapaciteit
Niveau	400

Doel vak
The coordination dynamics approach is pursued to study how patterns of coordinated movement come about, persist and change as a function task constraints, expertise and pathology. The student is acquainted with the key principles, concepts and methods of coordination dynamics. The student can explain these aspects in a qualitative manner. The student is able to indicate how these aspects may contribute to assessments and interventions in the context of sports and rehabilitation. The student can interpret, present and discuss scientific literature in the area of coordination

dynamics. The student can design new coordination dynamics experiments. Students can critically evaluate the usefulness of coordination dynamics literature for science and education.

Inhoud vak
Coordination dynamics is governed on the one hand by principles of self-organization, and on the other hand by intentionality, perceptual information and explicit knowledge. Coordination patterns exist at multiple levels: 1. dynamics within or between body segments of a moving person; 2. dynamics between moving segments of multiple persons and 3. dynamics between person and external events, as well as between persons. Coordination dynamics provides a framework to study the nature of pathological, normal and expert movements by assessing stability and loss of stability of coordination patterns as a function of training and rehabilitation.
The first part of the course provides an overview of the key principles, concepts and methods of coordination dynamics by adopting a 3-stage empirical approach: 1. gaining background theoretical information through lectures and literature, 2. gaining hands-one experience by participating in experiments, formulating hypotheses and analyzing the so-obtained data, 3. gaining a thorough understanding of the key aspects of coordination dynamics by linking theory and practice.
The second part of the course focuses on the application of coordination dynamics in sports and rehabilitation, again by adopting a 3-stage empirical approach. In the context of rehabilitation, specific emphasis will be placed on interventions based on environmental coupling aimed at facilitating desired coordination patterns and/or stabilizing existing unstable coordination patterns. In the context of sports, the nature of interactions between two or more athletes will be the focal point, including their cooperative and competitive effects on pattern formation and coordinative stability.
Throughout the course, students will work individually and in small groups on journal club assignment using (relatively) new coordination dynamics literature from one of the 5 proposed areas of interest. Core aspects of the assignment are 1) highlighting the central concepts of the coordination dynamics framework employed in the paper, 2) presenting and discussing the novel insights obtained, 3) describing the next step(s) in terms of experimental research, and 4) elaborating on the suitability of the selected papers as reading material for next year's course.

Onderwijsvorm
Amount of contact hours (36 hrs), divided in:
Lectures: 10 * 1.75 hrs
Laboratories and journal club workshop: 2 * 2.00 hrs
Computer Practicals: 5 * 2.00 hrs
Optional Midterm Exam: 1 * 1.75 hrs
Final Exam: 2.75 hrs

Self study: 132 hrs

Toetsvorm
Journal club assignments (presentation and writing assignment) and two written closed-book exams with open-ended questions (optional mid-term exam and compulsory final exam). The final grade is established with an accuracy of 0.5 and is determined by the optional midterm exam (35%), the final exam (35%), the journal club presentation (10%) and the journal club writing assignment (20%). However, in case the grade of the optional midterm exam is lower than that of the compulsory final exam,

only the grade obtained for the Final Exam will count (i.e., Midterm Exam [0%], Final Exam [70%], Journal Club [30%]). The same holds for students who did not complete the midterm exam.

Literatuur
A selection of relevant book chapters and articles.

Vereiste voorkennis
Basic understanding of statistics (What is a standard deviation?), sine waves (What is the amplitude, offset, frequency and phase?), integral and differential calculus (What is the derivative of a sine wave?) and Matlab (Can you run a script?). Please note that Matlab scripts and functions are provided and so programming skills are not required for the computer practicals. Computer practicals are included to become acquainted with the handling and interpretation of the experimental data and associated coordination dynamics outcome measures).

Intekenprocedure
For more info on journal club workshops, laboratories, (computer) practicals etc.
please see Blackboard.

Electromyography

Vakcode	B_ELECTROMYO (900815)
Periode	Periode 5
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. J.H. van Dieen
Examinator	prof. dr. J.H. van Dieen
Docent(en)	prof. dr. J.H. van Dieen
Lesmethode(n)	Hoorcollege, Practicum, Computerpracticum
Niveau	400

Doel vak
- The student has a basic knowledge of electrophysiology and the background of electromyographical signals;
- the student has a basic knowledge of the different ways; of collecting electromyograpical data in various fields of application;
- the student can choose the appropriate method for collecting and analyzing EMG data in a kinesiological study;
- the student knows the possibilities and limitations of EMG data;
- the student can interpret EMG data in relation to motor control, force and fatigue;
- the student can identify contamination in EMG data and can apply methods to reduce its effects;

Inhoud vak
In this course, the students are introduced to the electrophysical background of electromyography (EMG). Subsequently, the course focuses on methodological aspects of EMG acquisition and analysis, addressing the potential of this method as well as its pitfalls.

Onderwijsvorm
lectures 6 x 2 hours
practical 2 x 3 hours
The lectures introduce the following topics:
- electrophysiology;
- motor control (motor unit recruitment and firing);
- instrumentation and electrodes;
- HD- EMG and spatio- temporal information;
- onset determination;
- amplitude estimation;
- force estimation;
- cocontraction and cross- talk;
- motor unit firing and decomposition;
- frequency content, conduction velocity and fatigue.
Practicals concern analyzing EMG data.

Toetsvorm
2 hours; written test with equally weighted open- ended questions

Literatuur
Research articles and lecture handouts

Vereiste voorkennis
- knowledge of and skills in programming in MATLAB at the level described for example in ‘Verwerken van digitale signalen’.
- basic knowledge and understanding of the physiology of muscles and their control.

Energy Flow Models

Vakcode	B_ENERFLOW (900675)
Periode	Periode 1
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. J.J. de Koning
Examinator	dr. J.J. de Koning
Docent(en)	dr. J.J. de Koning
Lesmethode(n)	Hoorcollege, Computerpracticum
Niveau	500

Doel vak
To provide the student with knowledge about energy flow models, and so to enable the student to apply this knowledge in the modelling of human endurance performance.

Inhoud vak
Research in which exercise physiology and biomechanics are combined as a 'toolbox' is apparently unique and successful. This course familiarizes the student with one branch of this approach. Energy flow models, based on power equations, will be used to study performance determining factors in endurance sports. This course explains the technique of modelling, how parameter values are obtained from experiments and how simulations with the model can be done. The student will construct a model of an endurance athlete to study the effect of parameter values on

performance in cycling, speed skating and running. The models will be made in MATLAB. Knowledge of MATLAB is necessary to be successful in this course.

Onderwijsvorm
Lectures and guided practical;
84 hours (from which 28 practical, 6 lecture, 2 exam and 48 self study).

Toetsvorm
Written examination and practical report (30%/70%).

Literatuur
A selection of articles and practical guide on Blackboard.

Vereiste voorkennis
900104: Biomechanica (Students are expected to have sufficient knowledge of this subject);

900215: Mechanische analyse van het menselijk bewegen (Students are expected to have sufficient knowledge of this subject)

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Entrepreneurship in Human Movement Sciences

Vakcode	B_ENTREPREN (65412020)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. E. Masurel
Examinator	prof. dr. E. Masurel
Docent(en)	prof. dr. E. Masurel
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak
Students obtain knowledge about and insight in the relevance of entrepreneurship and innovation for their own discipline. Students learn about the processes which are involved in the recognition and exploitation of opportunities, about creating economic and social value and about the nature and role of networks. In addition students gain knowledge of different entrepreneurial processes and the importance of valorization of findings and business ideas for a knowledge- based economy.

Inhoud vak
This course consists of two tracks: a theoretical track and a practical track. These two tracks run simultaneously.

In the first track you learn about entrepreneurship. Answers are found on questions such as: what is entrepreneurship? What defines an entrepreneur? What are entrepreneurial opportunities? What is the role

of innovation in entrepreneurship? What is corporate social responsibility (CSR)? How can we judge the feasibility of entrepreneurial ambitions?

Simultaneously you work on an assignment (second track). In the first week of this course you search for an innovation in your own discipline (product, service, process etc.). Your choice must be approved by the lecturers. The first part of the assignment consists of a description of the innovation which you have chosen. Subsequently, you make a SWOT analysis and a network analysis of the innovation. Also a paragraph of CSR should be added. The final part of the assignment is your own feasibility study: how would you valorize the innovation to the market.

Onderwijsvorm
Lectures and workshops. Each week scientific lectures or practical workshops are given. These lectures are both the basis for the exam and for the assignment.

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

Literatuur
The course manual contains a list of online available articles.

Overige informatie
Optional course for Master students 'Human Movement Sciences' 'Sport, Exercise & Health', 'Fundamental and Clinical Movement Sciences'.

Exercise and Clinical Immunology

Vakcode	B_EXCLINIM ()
Periode	Periode 1
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. R.T. Jaspers
Examinator	dr. R.T. Jaspers
Docent(en)	dr. R.T. Jaspers, dr. ir. T.J. de Vries, prof. dr. W.F. Lems
Lesmethode(n)	Hoorcollege, Bijeenkomst
Niveau	400

Doel vak
The purpose of the course Exercise and Clinical Immunology is to introduce students into the etiology of major chronic diseases in which local or systemic inflammation and/or a compromised adaptive immune response plays a substantial role. Students will be acquainted with the basic principles and working mechanisms of the immune system and how dysregulation thereof is involved in the etiology of chronic diseases. Since evidence shows that exercise may impact on the functioning of the immune system, students will get acquainted with the mechanisms via which the physical exercise may affect cells of the immune system directly or indirectly by modulation the function of other organ systems. Students will explore and report by literature research the

current state of knowledge on the role of the immune system and exercise in the development of the diseases discussed.

Inhoud vak
Chronic diseases such as Metabolic Syndrome, Diabetes II, Alzheimer, Periodontitis, Cancer, Osteoporosis, Osteoarthritis, Ankylosing spondylitis, Chronic low back pain as well as aging related frailty. The 8-10 chronic diseases are selected because they all have a high prevalence and high morbidity (and some of them are also associated with an increased mortality), low grade local or systemic inflammation plays a role, and evidence is available that exercise has positive effects in the majority of these diseases.
The course consists of a series of lectures in which clinical signs and symptoms of the diseases and the role of the immune system will be explained and discussed based on general knowledge as well as state of the art results.
In order to prepare students with sufficient knowledge to understand the role of the immune system in the different diseases, two introduction lectures will be provided on general elements of the immune system, innate immunity, adaptive immunity and vaccination. As physical exercise seems to improve morbidity and reduce mortality is of patients suffering from the above mentioned chronic diseases, questions will be addressed whether and how physical exercise may affect immunocompetence and development/progression of the disease. Exercise stimulates the production of growth factors and cytokines in bones, skeletal muscle and cardiorespiratory systems which may have paracrine and endocrine effects on the cell and organs which are critically involved in development and progression of one or more the diseases.

Onderwijsvorm
(30 hrs / 15 lectures, 8 hrs / 2 sessions with presentations, 120 hrs preparation for contact hours and exam.
1. The course consists of a series of lectures in which either clinicians with special clinical expertise and scientific background in the disease or pre- clinical researchers will introduce the immune system, major symptoms and etiology of the disease on which they are professionally working and how the immune system and exercise are involved in this. Since these lectures cover a wide range of aspects of the disease they need extensive preparation by reading the papers.
2. During the course, students will write a research essay about one of the diseases that will be discussed in the lectures.
3. At the end of the course each student will give a presentation about the disease to which they were assigned and present the outcome of their literature research. After each presentation there is room for a group discussion. The contact hours and presentations are intended to support the learning process and have the following goals:
• To obtain an introduction into 8-10 clinical diseases
• To place immunology and exercise within a clinical context of chronic diseases.
• To accentuate importance of the content
• To identify content importance for the movement sciences
• To discuss content difficulties that may arise after independent study of assigned literature
• To practice knowledge obtained during the course.

Toetsvorm
The assessment consists of three parts:
- Short essay questions
- Writing a research essay

- Oral presentation about the topic of the research essay.

Literatuur
The reading material consists of lecture notes, power point slides and scientific papers and lecture notes, which will all be made available at Black Board.

Vereiste voorkennis
The student should have basic knowledge and understanding of physiology, molecular biology and exercise physiology.

Maximal Neuromuscular Performance

Vakcode	B_MAXNEUR ()
Periode	Periode 1
Credits	3.0
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. C.J. de Ruiter
Examinator	dr. C.J. de Ruiter
Docent(en)	dr. C.J. de Ruiter
Lesmethode(n)	Hoorcollege
Niveau	400

Doel vak
The student has knowledge of the role of muscle activation and (changing) muscle properties on maximal human neuromuscular performance during high intensity exercise and the student has knowledge of the relevant research methods.
The student can apply this knowledge to questions regarding testing and improving of maximal neuromuscular performance in sports (and rehabilitation).
The student is able to evaluate the validity and relevance of basic scientific literature for neuromuscular performance in a sport (rehabilitation) related context.
The students will learn to critically read scientific papers on neuromuscular performance published in international journals. The student will be able to communicate (‘translate’) the implications of basic scientific knowledge of neuromuscular performance to practical issues raised by coaches and therapists in the field of sports (and rehabilitation).
Students will not learn how to do research, or how to test athletes, or how to design exercise programs in sports or rehabilitation etc.
Students will learn what underlying factors/mechanisms they should be aware of while designing muscle function tests and exercise programs.

Inhoud vak
During the course, a critical overview will be given of the current knowledge of maximal neuromuscular performance during relatively high intensity exercise of short duration (40 ms up to 5 min). Most examples will be provided from own research. The emphasis will be on the coupling between basic knowledge of muscle activation and (changing) muscle properties during human movement and their consequences for testing and training. This is a fundamental sports related muscle physiology course, not an applied sports course.
The following subjects will be addressed:

• Voluntary activation;
• Explosive force/power;
• Influence of temperature (incl. warm-up);
• Potentiation;
• (Low frequency) fatigue;
• Shortening deficit and lengthening force enhancement;
• Recruitment of motor units.
• Muscle oxygenation

Onderwijsvorm
The course will consist of a series of nine lectures condensed in a three week period (September 5th- September 23rd), during which relevant practical questions will be used as a starting point. Subsequently the focus will be on fundamental neuromuscular properties as studied in a series of accompanying scientific papers.

Toetsvorm
2 hours 15 minutes exam with open-ended questions in the week immediately following the three week lecture period (most likely on Wednesday September 28th).

Literatuur
The course will mainly use research papers. Basic background information is derived from Chapters 1-10 of: Skeletal muscle: from molecules to movement. A textbook of muscle physiology for sport, exercise, physiotherapy and medicine. Jones, D.A., Round, J. and A. de Haan, Edinburgh: Churchill Livingstone, Elsevier Science Limited, 2004. ISBN 0 443 07427 5

Vereiste voorkennis
Sufficient knowledge of the basics of Muscle Physiology is absolutely necessary. In order to successfully participate, the students have to understand the following concepts: anatomy of skeletal muscle, sarcomere function, twitch, tetanus, length-force, force- and power-velocity, and stimulation frequency-force relations, the size principle of motor unit recruitment, rate coding, EMG, electrical stimulation, fibre type related differences in contractile properties, cross-bridge kinetics, excitation contraction coupling, the basic metabolic changes during exercise (changes in ATP and CrP, glycolysis, oxidative phosphorylation)
.

Mechanical and Adaptive Myology

Vakcode	B_MECHADMYO (900813)
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. R.T. Jaspers
Examinator	dr. R.T. Jaspers
Docent(en)	dr. R.T. Jaspers
Lesmethode(n)	Hoorcollege, Werkcollege, Practicum
Niveau	500

Doel vak
At the end of this course, the student has detailed knowledge and understanding of the principles of functional morphology and physiology of the muscular system embedded within a connective tissue context as well as of the mechanical load induced adaptations thereof. The student is able to apply and discuss this knowledge with respect to problems and questions related to locomotion, movement, training induced muscle adaptation and orthopeadic interventions.

Inhoud vak
During the course, a critical evaluation is made of the current knowledge of how muscle structure and function are related and how these properties adapt in response to mechanical loading.
This involves the subjects indicated below:
- force exertion by sarcomeres, muscle fibers, muscle and muscle tendon- complexes;
- elasticity;
- functional morphology and determinants of the muscle length- force-velocity characteristics;
- heterogeneity in mechanical properties and functional consequences;
- force transmission between muscle fiber, tendon and fascia;
- adaptation of muscle due to growth, immobilization, training and surgical interventions;
- mechanotransduction and cellular signaling in the regulation of adaptation of muscle size.

Onderwijsvorm
lecture
practical
tutorial
The course consists of a series of lectures and tutorials. In this combination, the relevant topics will be addressed, explored and discussed. One practical is included in which the analysis of gene expression in muscle in reponse to mechanical loading will be introduced.

Toetsvorm
Exam
The assessment consists of:
- written examination (essay questions including calculations) - 90%;
- practical report - 10%.

Literatuur
Lecture notes, book chapters, research articles and review papers which will be made available before the course.

Vereiste voorkennis
The student should have basic knowledge and understanding of the muscle anatomy and physiology as well as molecular biology.

Molecular Cell Biology

Vakcode	B_MOLECULBIO (900801)
Periode	Periode 4
Credits	3.0
Voertaal	Engels

Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. ir. T.J. de Vries
Examinator	dr. ir. T.J. de Vries
Docent(en)	dr. D. Deng, dr. ir. T.J. de Vries
Lesmethode(n)	Hoorcollege, Practicum
Niveau	400

Doel vak

1.General overview of molecular biology and its relevance for movement, faculty: prof.dr. V. Everts, format: lecture;
2.Omics and molecular biology, faculty: dr. B.P. Krom and dr. B.W. Brandt, format: lecture and workgroup;
3.Technical approaches in molecular biology, faculty: dr.ir. T.J. de Vries, A.M. Schoenmaker, format: lecture, workings groups, practical course.

Inhoud vak

This course provides an overview and insight into (1) general aspects of molecular biology, (2) molecular biology in relation to movement (muscles, nerves, bone, tendon), and (3) use of modern molecular biological techniques.
A general overview of molecular biology will be presented. Topics will be discussed like structure and function of DNA, RNA, siRNA, transcription and translation. In addition interference with gene expression will be discussed (e.g., gene transfection, deletion).
Molecular aspects of movement will be discussed with an emphasis on the
functioning of muscles, nerves, bones and tendon, as well as other tissues in relation to movement and non-movement. A central issue will be the question how movement or the lack of movement affects the activity and protein expression of the cells associated with these tissues.
Finally an in-depth insight in modern biological strategies for the analyses of (defects in) the above mentioned molecular aspects of movement and the tissues involved will be presented.
The following techniques and their applications in cell biology will be highlighted:
1.mutation detection, important for understanding effects of genomic mutations on cellular functioning;
2.RT-PCR, a breakthrough technique developed in the 1980's, which enables the study of gene expression and its relevance for physiological or pathological processes in minute biological samples;
3.DNA-sequencing, DNA-microarrays, transcriptomics and proteomics, elegant and valuable tools for studying gene-variations and gene-expression of a large number of genes in one biological sample;
4.RNA interference, a technique of the last decade with which you can inhibit the expression of specific RNA's, used to study the function of different genes;
5.Bioinformatics, the development, validation and application of computational techniques to the management, analyses and understanding of biological information.
Ultimate learning objective is to know more about molecular biology and its role in answering movement related research projects.

Onderwijsvorm

The course will include:
1.Tutorials/lectures for 4 hours on general aspects of Molecular Biology and transcription and translation (V. Everts);
2.Tutorials/lectures for 8 hours on molecular biological strategies, bioinformatics, next-generation
sequencing, DNA-microarrays, genomics and proteomics (B. Krom and B. Brandt);
3.Practicals for 3 days on qPCR (T. de Vries, T. Schoenmaker).
4.1 hour question time

Toetsvorm
Open-ended questions (2/3 of the final grade) and written report of the practicals (1/3 of the final grade)

Literatuur
Molecular Biology. Principles and Practice by Michael.M. Cox, Jennifer A. Doudna and Michael O'Donnell Publisher: W.H. Freeman and Company.ISBN-13: 978-0-7167-7998-8. ISBN-10: 0-7167-7998-6. Edition of 2012.
Teun de Vries: Chapters 2.4; 11,12; 15-19.
Bastiaan Krom: Chapters 7-8.
Bernd Brandt: Sequence tagged sites (STSs), 261
Expressed sequence tags (ESTs), 261
Ensembl & NCBI website, paralogs, orthologs, Comparative genomics 264, 266
Genome sequencing, 260-263
BLAST (annotation), 263
databases for, 266-271
genome annotation, 263-266
for modern humans, 269-271
Single nucleotide polymorphisms (SNPs), 271,272
Comparative genomics phylogenetic profiling (computational approaches), 281-282
Biological Literature Mining, 282
Sectie 12.1: Types of DNA mutation, 410-416
Appendix Model Organisms, A1-A2

Vereiste voorkennis
No entry requirements.

Neuromechanics

Vakcode	B_NEUROMECH ()
Periode	Periode 5
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. H. Maas
Examinator	dr. H. Maas
Docent(en)	dr. H. Maas
Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	400

Doel vak
- The student is able to explain the principles of neuromechanics and the mechanisms of the different subsystems of the motor system involved.
- The student is able to describe the possibilities and limitations of the state-of-the-art experimental methods and analytical approaches.
- The student is able to identify and critically evaluate scientific papers on neuromechanical topics.
- The student has knowledge about current research questions and research projects at the Department of Human Movement Sciences and the MOVE research institute Amsterdam.

Inhoud vak
In this course, students are introduced to the principles of neuromechanics, current knowledge about its main components and the methods applied to study it. To produce coordinated movements, skeletal muscles, sensory receptors and the central nervous system need to interact. This involves the bi-directional transformation of information between neural structures and the musculoskeletal system. Neuromechanics is the study of such interactions and transformations that give rise to coordinated movements. Questions addressed are for example, what is the relative contribution of musculoskeletal and neural mechanisms in the regulation of limb stiffness, how do such contributions change with environmental conditions, motor learning disease or ageing.
Besides introductory lectures on the various subsystems, the following specific subjects will be addressed:
- Contribution of muscle anatomical and mechanical properties to limb stiffness
- Proprioceptive feedback and reflex pathways
- System identification: introduction and (clinical) applications
- Adaptations to changes in the mechanical and/or neural circuitries.
- Topics related to articles selected for Journal Clubs by students.

Onderwijsvorm
The course consists of a series of lectures and Journal Club discussions.
- Lectures (14 hrs)
- Reading Journal Club articles and writing evaluation (15 hrs)
- Preparation presentation of Journal Club article (3 hrs)
- Preparations for lectures and exam (52 hrs)

Toetsvorm
The assessment consists of two parts:
- Written exam with short essay questions (70%)
- Oral presentation and written evaluation of Journal Club paper (30%)

Literatuur
The reading material consists of lecture notes, power point slides and scientific papers, which will all be made available or specified on Black Board.

Vereiste voorkennis
The student should have basic, BSc degree level knowledge and understanding of musculoskeletal anatomy, biomechanics and (neuro)physiology, as described for example in:
- Human Anatomy. E.N. Marieb & J. Mallatt (Eds.), Benjamin-Cummings Publishing Company, 3rd edition, Chapters 1.1-1.16; 4.88-4.102; 4.99-4.102; 9.212-9.239; 10.244-10.253; 11.266-11.270.

- Kinetics of Human Motion. V. M. Zatsiorsky (Ed.), Human Kinetics, 1st ed. 2002, Chapters 1-5.
- Biomechanics of Skeletal Muscles. V. M. Zatsiorsky, B.I. Prilutsky (Eds.), Human Kinetics, Chapters 1-3.
- Physiology of Sport and Exercise, J.H. Willmore & D.L. Costill (Eds.), Human Kinectics, Chapters 2-3.
- Neuroscience. D. Purves et al. (Eds.), Sinaur Associates, INC., ISBN: 978-0-87893-695-3. Chapter 16.

Doelgroep
The course is an optional part of the Research Master program Fundamental and Clinical Human Movement Sciences and Master program Human Movement Sciences: Sport, Exercise & Health, but also open to students from other master specializations provided that the entry requirements are met. Within the Research Master there are links to the courses Neurosciences, 3D Kinematics, Biophysics of Locomotion and Mechanical and Adaptive Myology.

Neurosciences

Vakcode	B_NEUROSC (900804)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. A. Daffertshofer
Examinator	prof. dr. A. Daffertshofer
Docent(en)	prof. dr. A. Daffertshofer
Lesmethode(n)	Hoorcollege, Computerpracticum, Practicum, Werkcollege
Niveau	400

Doel vak
• The student understands the basic structure and function of the neuromuscular system as a model for neuronal communication and interaction
• The student understands the relation between the electric activity at nerve and muscle cell level and macroscopic electrophysiological non-invasive EEG, MEG, and EMG measurements.
• The student understands the interpretation of the brain as a dynamic network and can use basic computer simulation techniques to interpret mechanisms.
• The student knows how to collect encephalographic data and to interpret such data also in relation with external events.
• The student knows the important mechanisms behind central nervous diseases and how these are reflected in abnormal brain activity.
• The student is confronted with neuromuscular disease states and the diagnostic tools to do basic differential diagnostics.
• The student knows principles and applications of the most often used techniques for (functional) brain imaging like (f)MRI, PET, TMS.

Inhoud vak
This course will approach the function of the human nervous system from different angles. Students will be familiarized with basic approaches to neural communication and interaction. We then will deal with the functional background of mass activity in the central nervous system.

The student will become familiar with the general principles of electrophysiology and other neurophysiological imaging techniques. The possible roles of oscillatory neuronal dynamics will be explained. The use of relevant methods in the diagnostic process of central nervous disorders and in the recent developments around brain-computer interfaces will then be considered.

Onderwijsvorm
Lectures 17´2 hours, computer practical 3´4 hours, excursion (practical Nijmegen) 1´4 hours. The course is build around three main themes: (i) Neurons and neural network behavior, (ii) Signals from the brain and their interpretation and (iii) Peripheral neuromuscular systems

Toetsvorm

2.75 hours (including dyslexia time); written exam with open questions

Literatuur

Research articles and lecture handouts will be provided before the course.

Vereiste voorkennis
Basic knowledge and understanding of the neurophysiology of brain processes and neuromuscular control concerning membrane potential, ion channels, ion pumps, between neuron communication, function of different brain structures, movement control, spinal cord circuits and motor units.
Knowledge of and skills in programming in Matlab at the level used in, e.g., the FBW bachelor course ‘Meten van Fysische Grootheden’.

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Perception for Action

Vakcode	B_PERCACTION (900810)
Periode	Periode 4
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. J.B.J. Smeets
Examinator	prof. dr. J.B.J. Smeets
Docent(en)	prof. dr. J.B.J. Smeets
Lesmethode(n)	Hoorcollege, Computerpracticum
Niveau	500

Doel vak
The student is able to:
- describe the functioning of the sensory systems relevant for motor control;
- interpret scientific literature in the area of perception and apply it to the field of motor control.

Inhoud vak
The topic of this course is the question: how is sensory information processed to guide ones action? More specific: how do we know where a target and (a part of) our body is? The answers to these questions require knowledge about the sensory organs, their signals, and how these signals are processed and combined in order to be used to control our actions. The focus will be on quantitative analysis of perception, using the psychophysical method. Each topic (e.g. proprioception, motion perception) is introduced by a lecture, but he focus of the course is on the discussion
of papers of the last decade The discussion will be about both the phenomenology and the mechanisms.

Onderwijsvorm
Amount of contact hours:
Lectures (‘hoorcolleges’) 7
Tutorials (‘werkcolleges’) 7
Assignments & self study 68
Practicals 2

Each meeting will be a combination of tutorial consisting of a discussion of the previous assignment (1 hour), and a lecture introducing to the topic of the next assignment (1 hour)

In the practical, the students will compare two psychophysical techniques and discuss their effectiveness in answering the question what perceptual information is available.

Toetsvorm
After each lecture, students receive an assignment. Six of them have to be handed in before the next meeting. These assignments are graded, and count for 10 % of the final grade. The assignment after the final lecture will contribute 35 %: the remaining 5% on completion of the practical.

Literatuur
Literature needed for the course will be distributed during the course.

Vereiste voorkennis
No entry requirements. Basic knowledge of the nervous system is expected (e. g. function of various brain areas).

Overige informatie
- The maximum number of participants in this course is limited to 40

Perceptual-motor Learning

Vakcode	B_PERCML (900682)
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. G.J. van der Kamp
Examinator	dr. G.J. van der Kamp
Docent(en)	dr. G.J. van der Kamp

Lesmethode(n)	Hoorcollege, Werkcollege
Niveau	500

Doel vak
Knowledge and understanding: The student is capable of describing and summarizing the main tenets and concepts of contemporary theories of perceptual-motor learning (i.e., motor programming approach, common-coding approach, neuropsychological approaches, ecological approach, dynamic systems and nonlinear pedagogical approach), including their experimental methods and the key empirical evidence supporting them.
Applying knowledge and understanding: The student is capable of applying the knowledge and ideas emanating from contemporary theories of perceptual-motor learning to provide insight into existing habits and questions related to perceptual-motor learning in the practices of sports, rehabilitation and physical education.
Making judgments: The student is capable of critically assessing and evaluating the underlying assumptions and empirical evidence for the contemporary theories of perceptual-motor learning. The student is capable of evaluating the applied value of the contemporary theories for the practice of perceptual-motor learning in sports, rehabilitation and physical education. The student is capable of distinguishing between scientific theories and empirical facts on the one hand, and habits, routines and conventions in practice on the other.
Communication: The student is capable of presenting (orally and in writing) a concise summary of the main contributions of contemporary theories of perceptual-motor learning for applications in practice of sports, rehabilitation and physical education. The student is capable of contributing to discussions regarding the applied value of contemporary theories for the practice of sports, rehabilitation and physical education.

Inhoud vak
The course provides a capita selecta of contemporary theories of perceptual- motor learning, such as the motor programming approach, common-coding approach, neuropsychological approaches, the ecological approach and nonlinear pedagogy approach to perceptual-motor learning. Among others, the following topics will be addressed; variability of practice, video-feedback, self-controlled feedback, gaze-training, education of attention, anticipation, internal & external focus of attention, motor familiarity, observational learning, implicit & explicit learning, analogy learning, errorless learning, re-investment, constraints-led learning, transfer of learning. On the one hand, the course aims to deepen the understanding of contemporary theories and concepts with respect to learning of perceptual-motor skills. On the other hand, the course tries to bridge the gap between findings from theory-driven and experimental research and practices of training and (re-)learning of perceptual-motor skills in sports, rehabilitation and physical education.

Onderwijsvorm
Six lectures provide the student with an introduction into the contemporary approaches to perceptual- motor learning. The lectures give a short background to the theories and provide a critical discussion of the key concepts and empirical evidence. During the tutorials the students (in groups) apply the contemporary theories to the practice of perceptual- motor learning in sports, rehabilitation and physical education by proposing theory- derived solutions to 'problems from practice'. Finally, in the practical students practice a new

perceptual motor skill, and use the learning experience to reflect upon the explanatory value and limitations of the scientific approaches to perceptual-motor learning. Lectures 12 hours, tutorials 10 hours practical 4 hours, self study 142 (preparation lectures etc. 80 hours and assessments 60 hours).

Toetsvorm

Written exam (open-end question) 50%;
Essay (50%),
Evaluation report (pass/no pass)

Literatuur
A collection of recent theoretical and experimental papers from the scientific literature (details to be announced).

Vereiste voorkennis
The student is familiar with the type of problems and questions that are addressed in theories and research of perceptual- motor coordination, control and learning. The student is able to independently search for, acquire and report knowledge from contemporary scientific papers.

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Research Internship Research Master

Vakcode	B_RIRM (900800)
Periode	Ac. Jaar (september)
Credits	60.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. A. Daffertshofer
Examinator	dr. D.L. Mann
Niveau	600

Doel vak
During the research internship, students conduct scientific research in a 'master - pupil relationship'.
The research project must be:
- aimed at a suitably challenging research question;
- conducted in a methodologically correct way;
- related to and based on the theory.

The aim the internship is to learn to perform under supervision the components of the research process (formulating a research question, creating a hypothesis, planning and conducting experiments, processing the data, interpretation of the results and reporting) and to gain insight in the connection between these components.

Onderwijsvorm
The student conducts the research internship within one of the research programs of MOVE, under the supervision of one of more MOVE members

within the programme. The subject of the internship is chosen in consultation with the coordinator. Students are advised to participate in the meetings of at least one of the MOVE research programs (www. move. vu. nl) during the first year of the MSc program, to prepare the choice of a research topic. Once the subject and the internship supervisor(s) have been established, the student writes a proposal, comprising research question, hypothesis(es), methods statistics and planning. In addition to a time schedule, the latter should include choices for equipment and indications for organization of the work. After the proposal has been approved by the supervisor(s), it is presented during a meeting of the research group. The time available for supervision is in the order of 80 hrs.

The student can opt to divide the internship in two parts, a major internship (36 EC) to which the above applies and a second internship in another research institute, preferably abroad (24 EC). For these minor internships a MOVE member will be appointed as supervisor (by the coordinator). The main responsibilities for supervision will be delegated to the external supervisor.

Toetsvorm
The evaluation of the research internship is performed using a standardized form (available on the course blackboard site) and is based on the following elements:
- the research proposal (originality, relevance and methodological quality);
- actual performance of the study, quality of data collection and processing;
- the report (this should contain a description of the work preferably in the format of a journal paper and a detailed description data acquisition, data analysis and data storage);
- The oral presentation of the report during the work group meeting.

The proposal and overall performance of the student during the internship are judged by the internschip supervisor(s). The report and the oral presentation are judged by both the internship supervisor(s) and a second assessor from the same research program but not directly involved in the project. The quality of the proposal and the performance of the study make up 40 % of the mark, the report makes up 50 % and the oral presentation makes up the final 10 %.

For minor internschips performed outside MOVE, the role of the internal supervisor can be limited to that of assessor of the report. In all cases, the external supervisor advises the MOVE supervisor with respect to the mark on all elements mentioned above, but the MOVE supervisor decides on the final mark.

Scientific Communication

Vakcode	B_SCCOMMUN ()
Periode	Periode 6
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. J.B.J. Smeets
Examinator	prof. dr. J.B.J. Smeets

Docent(en)	prof. dr. J.B.J. Smeets
Lesmethode(n)	Werkgroep
Niveau	400

Doel vak
After this course the student will be able to communicate scientific results in an effective way to colleagues and laymen.

Inhoud vak
Five aspects of scientific writing will be treated.
1) General aspects of writing: shaping paragraphs, active/passive writing, building a story.
2) Abstract
3) Introduction
4) Results
5) Layman communication

Onderwijsvorm
The core of this course are writing assignments. These will be introduced by a lecture, peer reviewed and discussed

Toetsvorm
Writing assignment

Time Series Analysis

Vakcode	B_TIMESERANA (900814)
Periode	Periode 5
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. A. Daffertshofer
Examinator	prof. dr. A. Daffertshofer
Docent(en)	prof. dr. A. Daffertshofer
Lesmethode(n)	Hoorcollege, Werkcollege, Computerpracticum
Niveau	500

Doel vak

Students will learn various techniques for the analysis of time series. A brief sketch of the mathematical background will enable students to select and apply proper methods for the study of signals typically found in the movement sciences. As examples range from kinematic and (neuro-) physiological signals students will get well-equipped to analyze and interpret their own experimental recordings.

Inhoud vak

Recent advances in recording techniques and increasing data storage capacity render time series analysis a challenge. In this course various uni-, bi-, and multivariate methods for the study of experimental data will be outlined and critically discussed. Statistical time-domain approaches go hand in hand with Fourier analysis, Hilbert and Gabor transforms, wavelet decomposition, et cetera. For the multivariate ex-

tension primary focus will be on principal and independent compo-nent analysis and on investigating recordings of whole-body kinemat-ics and electromyographic signals. All techniques will be discussed based on current research articles and implemented by means of nu-merical exercises (Matlab).

Onderwijsvorm

36 contact hours (14 seminars, 12 practicals, 10 lectures); 124 hours self-study

A mixture of lectures, seminars, and computer practicals. At the com-puter students will analyze typical examples of movement-related, temporal data like kinematic or electromyographic signals. During the seminars, research articles on the analysis of movement dynamics will be discussed on the basis of brief summaries written by the students (writing assignment).

Toetsvorm

60% of the grade is determined by the written exam (essay questions). 20% is determined by the quality of the written summaries and/or oral presentations (depends on the number of participating students but will be announced in time via BlackBlack), and 20% by the quality of solu-tion of the computer practicals.

Literatuur

• C. Chatfield, The analysis of time series. An introduction, Chapman & Hall, London, 1987 (or newer edition); advised
• Several research articles that will be provided

Vereiste voorkennis
Basic knowledge of Matlab is mandatory.

Aanbevolen voorkennis
Basic knowledge of Matlab is mandatory

Overige informatie
Basic knowledge of Matlab is mandatory
none

Tissue Engineering and Mechanobiology

Vakcode	B_TISSUEENG (900806)
Periode	Periode 6
Credits	3.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. M.N. Helder
Examinator	dr. M.N. Helder
Docent(en)	dr. M.N. Helder
Lesmethode(n)	Hoorcollege, Werkcollege

Niveau	400

Doel vak
At the end of the course, the student is able to:
• Describe and understand the principles of tissue engineering and regenerative medicine
• Describe and understand the clues derived from embryogenesis, and how these may be implemented in tissue engineering and regenerative medicine
• use the knowledge provided in this course to formulate strategies to translate and clinically implement the principles of tissue engineering (“from bench to bedside”)

Inhoud vak

This course addresses regenerative medicine, also referred to as reparative medicine or tissue engineering, which is the regeneration and remodeling of tissue in vivo in order to repair, replace, maintain or enhance organ function, as well as to engineer and grow functional tissue substitutes in vitro for implantation in vivo as biological substitutes for damaged or diseased tissues and organs. Regenerative medicine is a multidisciplinary field involving biology, medicine, and engineering. Regenerative medicine will revolutionize surgical disciplines, and is expected to become the surgical golden standard of the upcoming decade by supporting and activating the body’s natural healing.

The course will address:
- the general build-up of organisms (organs, tissues, and their basic building blocks: the cells and the matrices surrounding them) and the various modes/levels of communication and organization.
- lessons to be learned from embryogenesis and epimorphic regeneration (regeneration of entire tissues and organs, e.g. observed in amphibians)
- basics of cell biology and mechanobiology
- the main regenerative medicine building blocks: biomaterials, biologics (inductive stimuli) and (stem) cells.
- how to “translate” basic regenerative medicine/tissue engineering principles from fundamental research via translational research towards clinical implementation (“from bench to bedside”)
- examples of tissue engineering research on the VU campus

Onderwijsvorm
lectures: 18h
tutorials/presentations/discussions: 14h
Exam: 2.5h

Toetsvorm

Written exam (multiple choice + open questions)

Literatuur
Research articles, lectures (including notes) uploaded on blackboard

Topics in Rehabilitation

Vakcode	B_TOPICS ()
Periode	Periode 1

Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. T.W.J. Janssen
Examinator	prof. dr. T.W.J. Janssen
Docent(en)	dr. A. Ledebt, prof. dr. T.W.J. Janssen, dr. J.H.P. Houdijk, dr. E.E.H. van Wegen, prof. dr. G. Kwakkel
Lesmethode(n)	Hoorcollege, Practicum, Computerpracticum
Niveau	500

Doel vak
This course provides an overview of contemporary insights, methods and research questions in the field of rehabilitation from a human movement sciences perspective. The topics range from normal- and abnormal motor development in children to rehabilitation after physical or neurological impairments. After this course students should be able to identify, summarize, critically evaluate and expand upon topics regarding these issues. Specifically, students get acquainted with different types of qualitative motor assessments, instruments and methods to quantify motor performance. The students become capable to understand the relevant issues, terms, concepts, mechanisms, and models in the restoration of mobility within the context of rehabilitation. They learn to appreciate and understand various aspects of motor development, functional recovery, adaptation, compensation, training and learning of function and activities in the framework of restoration of mobility and upper-limb performance in persons with neurological and musculoskeletal impairments. They understand the contexts as well as the practical process of scientific research and communication in the combined fields of rehabilitation and human movement sciences. They also appreciate clinical decision making and acknowledge the importance of the ICF-framework (International Classification of Functioning, Disability and Health) in rehabilitation medicine.

Inhoud vak
During a part of this course, the understanding of normal and abnormal motor development and developmental disorders in fetuses, infants and young children is deepened. Lectures and tutorials provide insight into actual problems in the research and practice of perceptual-motor development, particularly in the area of health sciences. Disorders in which motor problems are either defining characteristics (i.e., cerebral palsy) or form part of a larger spectrum of difficulties (i.e., autism, ADHD) will be discussed and the main rehabilitation methods will be related to theories on development.
Being the key issue in physical rehabilitation of adults, this course subsequently concentrates on the ‘restoration of mobility’ and upper-limb performance, and its underlying mechanisms, at the different levels of the International Classification of Functioning, Disability and Health (WHO 2001). Primarily a biophysical approach is taken: biomechanical, motor control and exercise (neuro)physiological principles, techniques and research findings will be discussed in specific patient populations, such as those with stroke, spinal cord injury, lower-limb amputation, Parkinson’s disease, and multiple sclerosis. Aspects of functional recovery, neuroplasticity, adaptation, compensation as well as concepts of learning and training mechanisms will be addressed. Research in this field will be presented and discussed in the format of ‘Capita Selecta’.

Onderwijsvorm
15 lectures of 2 hrs in which the current issues and state-of-the-art research in normal and abnormal motor development and in different patient populations is discussed; 2 site visits (4 hrs each) to rehabilitation centers Reade and Heliomare; 2 tutorials of 2 hrs. Attending the site visits and tutorials is compulsory. Six 2-hr meetings in which each student-pair gives a 15-minute lecture on a current rehabilitation topic. Each student should attend at least 3 of these meetings.

Toetsvorm
Multiple choice examination counting for 80% of the final grade. The mark for the lecture determines the remaining 20%.

Literatuur
A selection of scientific papers and a reader.

Vereiste voorkennis
Students should have basic knowledge and understanding of neuro-physiology, neuroanatomy, biomechanics, and exercise physiology.

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Training, Aging and Disuse

Vakcode	B_TRAD ()
Periode	Periode 2
Credits	6.0
Voertaal	Engels
Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	dr. R.T. Jaspers
Examinator	dr. R.T. Jaspers
Docent(en)	dr. H.L. Gerrits, dr. R.T. Jaspers
Lesmethode(n)	Hoorcollege, Werkgroep
Niveau	400

Doel vak
The purpose of the course Training, Aging and Disuse is to acquaint students with physiological and molecular/cytological principles that determine (peak) power and fatigue characteristics of skeletal muscle and how these are changed by exercise training, disuse and aging. The level of knowledge that should be attained in those disciplines will allow students to understand how particular physiological conditions will affect muscle function at different levels of organizations (i.e. from whole motor unit to molecular signals in the muscle cells).

Inhoud vak
Neuromuscular performance in terms of muscle peak power and maximal steady state power is impaired during aging and with a chronic decrease in usage, such as during bed rest, diseases, injuries, neuromuscular disorders and (most extreme) after a spinal cord injury. During the course, a critical overview is given of the current knowledge of short

and long term adaptations of the neuromuscular system in response to training, aging, disuse and chronic disease, and how these relate to impaired muscle function. Underlying (molecular) processes leading to atrophy and reduced force generating capacity as well as a reduced endurance performance of the neuromuscular system are discussed. To obtain indications for how training or other interventions could effectively prevent these adverse effects and improve muscle function, a detailed overview is given of training induced changes in muscle phenotype and how these are related to molecular regulators of protein synthesis and degradation and mitochondrial biosynthesis. The content is mostly based on recent own research.

Onderwijsvorm
(20 hrs / 10 lectures, 4 hrs / 2 working lectures, 4 hrs / 2 practicals, 120 hrs preparation for contact hours and exam.

The course will consist of a series of lectures during which relevant questions are addressed and discussed. Using the literature assignments students should study the material independently (even though group work is encouraged) to attain a good understanding. In additional meetings relevant items are addressed in group discussions based on prepared questions/statements. Contact hours are intended to support that process and have the following goals:
• To accentuate importance of the content
• To place contents within a theoretical framework
• To identify content importance for the movement sciences
• To discuss content difficulties that may arise during independent study of assigned literature
• To practice solving problems using learned content.
In addition to the lectures, there are two laboratory practicals during which students get acquainted with measurement techniques of human muscle function in vivo and molecular analyses of gene expression and protein synthesis.

Toetsvorm
The course ends with a written test consisting of short essay questions.

Literatuur
Obligatory reading
- Book: Skeletal Muscle (SM)
D.A. Jones, J. Round, and A. de Haan. Skeletal Muscle from Molecules to Movement; A textbook of Muscle Physiology for Sport, Exercise, Physiotherapy and Medicine. Edinburgh: Churchill Livingstone, Elsevier Science Limited, 2004. ISBN 0 443 07427 5.
- In addition, the reading material consists of a number of scientific papers, which will be made available at Black Board.

Overige informatie
The student should have a basic knowledge and understanding of molecular biology, exercise and muscle physiology.

Treating Locomotor Disease

Vakcode	B_LOCOMOTOR (900818)
Periode	Periode 3+4
Credits	6.0
Voertaal	Engels

Faculteit	Fac. der Gedrags- en Bewegingswetensch.
Coördinator	prof. dr. J. Harlaar
Examinator	prof. dr. J. Harlaar
Docent(en)	dr. E.E.H. van Wegen
Lesmethode(n)	Hoorcollege
Niveau	500

Doel vak

1. Knowledge and Understanding:
- A general knowledge of and insight into the main clinical issues (epidemiology, pathophysiology, consequences and treatment modalities) with regard to diseases that affect the locomotor system.
- Knowledge of current research questions and translational research projects at VUmc/MOVE
2. Applying knowledge and Understanding:
- The ability to integrate knowledge from human movement sciences and medicine
- The ability to frame tentative research questions relevant to a specific locomotor disease, by applying knowledge from human movement science.
3. Making Judgments:
- The ability to reflect on ethical and practical issues that constrain the feasibility to perform applied studies in the area of locomotor diseases.
- The ability to formulate relevant hypotheses regarding research questions on translational research in locomotor diseases.
- The ability to reflect on the scientific relevance and societal value of achievements in translational research on locomotor diseases.
4. Communication:
- The ability to communicate with fellow researchers as well as clinicians, and finding ways to bridge gaps between different conceptual frameworks that are current in human movement science and medicine
5. Learning skills:
- The ability to write a research proposal that could serve as starting point for a research master thesis (i.e. a scientific report in the form of a scientific (peer-reviewed) paper).

Inhoud vak

This course provides an overview of leading innovative research and medical treatments in the field locomotor disease, rehabilitation and movement science. Each topic of this module is designed around a clinical theme, i.e. a specific disease. A general introduction will include a discussion on the main clinical problems, related to the design of possible new treatments. This discussion will be focused on how methods and techniques from the several medical disciplines as well as the movement sciences are being applied to study and treat locomotor disease. Both neurological diseases (progressive as well as non progressive) as degenerative diseases of the skeletal system will be discussed. Also general principles of clinical movement analysis and outcome measurements are part of this module.

Onderwijsvorm

Topics:
Joint Replacement
Hand Surgery
Parkinson’s Disease

Cerebral Palsy
Cerebro Vascular Accident
Clinical Movement Analysis
Rheumatoid Arthritis
Osteoarthritis
Endocrinology/Osteoporosis
Clinimetrics in Neurorehabilitation
Multiple Sclerosis
Ankylosing Spondilitis
Obstetric Plexus Brachialis Lesion
Amputation/ prosthetics
Spinal Cord Injury

Toetsvorm
paper: research proposal 100%

Literatuur
- literature to be studied: will be provided through blackboard
- additional literature: will be provided through blackboard

Vereiste voorkennis
Not applicable

Intekenprocedure
For more info on workgroups, laboratories, (computer) practicals etc. please see Blackboard.

Overige informatie
All lectures will be given by different (guest-)lecturers from the MOVE research institute, i.e. who are all practicing their profession at the interface of science and clinical practice in different areas of the neuro-musculo-skeletal system.

Please note that there is only place for 20 students in this course. If you are too late and that number has already been reached, there is nothing we can do for you.