Inhalt

06-MA-HMA-01 – Applied Mathematics

06-MA-HMA-01	**Applied Mathematics**	6 CP
	Angewandte Mathematik	
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	1. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:
Students will be able to
- explain the central concepts of linear algebra and analysis,
- apply these concepts to typical problems in biomechanics, motor control and movement analysis,
- implement and execute mathematical analyses with the adequate software packages (e.g. Matlab, Python, R).

Module content:
- Linear algebra: matrix operations and their applications such as vector operations, solving sets of linear equations, coordinate system transformations.
- Analysis: functions, differential and integral calculus (including numerical methods), frequency analysis, differential equations.

Frequency and duration: Winter term, 1 sem.

Module coordinator: Chair for Exercise Science

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Class format	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar	30	60
Total:	180	

Module examination:
- Form(s) of assessment: written examination
- Duration of examination: 120 min
- Components of final grade: 100% written examination
- Form of module retake examination: written examination

Language of instruction/Language of examination: English

Notes: It is recommended to simultaneously complete the module “Computer Programming”.

06-MA-HMA-02 – Biomechanics I

06-MA-HMA-02	**Biomechanics I** **Biomechanik I**	6 CP
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2010/2011	1. Sem.

Learning outcomes:
Students will be able to,
- describe and explain the physics underlying biological motion,
- describe and calculate
  - the kinematics and kinetics of the human body,
  - technical biomechanics,
  - engage in biomechanical modelling,
- describe, analyse and relate human movement and the stresses and strains that occur as physical events.

Module content:
- biomechanical values and concepts
  - spatial coordinates, speeds, accelerations, forces, moments of inertia
  - Coordinate systems, inertial systems
  - implementation of differential equations
  - multibody systems, biomechanical models
- mechanical properties of biological materials
- biomechanics of locomotion
- sports biomechanics

Frequency and duration: Winter term, 1 semester

Module coordinator: Chair for Human Movement Science and Sportpsychology

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	15	75
Seminar	30	60
Total:	180	

Module examination:
- Final module examination
- Method of assessment: written examination or oral examination
- Duration of examination: written examination (60 min) or oral examination (45 min)
- Final grade: 100% written examination or 100% oral examination
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-03 – Computational Principles of Motor Control

06-MA-HMA-03	**Computational Principles of Motor Control** **Komputationale Prinzipien der Motorischen Kontrolle**	6 CP
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2010/2011	1. Sem.

Learning outcomes:
Students will be able to
- reproduce in-depth knowledge of computational principles governing sensorimotor control,
- present, explain, and reflect theoretical positions on sensorimotor control based on a wider range of empirical studies,
- engage in critical discussions about the state-of-the-art knowledge in the field of sensorimotor control.

Module content:
- Core problems in sensorimotor control, such as noise and delays in signal transduction, uncertainty, redundancy, non-linearity
- Computational principles for solving these problems, such as optimal control theory, Bayesian estimation, impedance control, predictive learning, internal models,
- Discussion of prolific experimental studies on computational principles of motor control and their possible neural implementation in the central nervous system

Frequency and duration: Winter term, 1 semester

Module coordinator: Chair for Experimental Sensomotorics

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar	30	60
Total:	180	

Module examination:
- Final module examination
- Method of assessment: written examination or oral examination
- Duration of examination: written examination (90 min) or oral examination (45 min)
- Final grade: 100% written examination or 100% oral examination
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-04 – Metrological Basics of Movement Analysis

06-MA-HMA-04	**Metrological Principles of Human Movement Analysis**	6 CP
	Messtechnische Grundlagen der Bewegungserfassung	
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	1. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:
Students will be able to

- select suitable measurement components for a movement measurement task, set up an adequate chain of measurement components and interpret the measurement signal,
- describe and explain principles and procedures of measurement systems for the analysis of human movements and their characteristics,
- recognize typical measurement errors and to estimate their magnitude by appropriate error calculations.

Module content:

- The lecture addresses central terms and concepts of electrical measurement technology (e.g. layout and properties of measurement chains, properties and measurement principles of different sensors for movement acquisition, measurement errors).
- In the hands-on training the contents are applied, reflected and deepened on the basis of measurement tasks.

Frequency and duration: Winter term, 1 semester

Module coordinator: Chair for Exercise Science and Chair for Human Movement Science and Sportpsychology

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	15	60
Hands-on seminar	30	75
Total:	180	

Module examination:

- Final module examination
- Method of assessment: written examination or oral examination or portfolio
- Duration of examination: written examination (60 min) or oral examination (45 min) or portfolio (25-35 pages)
- Final grade: 100% written examination or 100% oral examination or 100% portfolio
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-05 – Computer Programming in Human Movement Analytics

06-MA-HMA -05	**Computer Programming in Human Movement Analytics** **Computer Programmierung in der Bewegungsanalyse**	6 CP
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2021/2022	1. Sem.

Learning outcomes:
Students will be able to
- explain core concepts of programming and apply these in code development
- use a selected programming language (e.g. Python, R, MATLAB) to develop software routines to analyze movement related data

Module content:
- Core elements of programming: (Loops, if-condition, data-types, functions, etc.)
- Application: algorithms, data structures, and best-practice solutions

Frequency and duration: Winter term, 1 semester

Module coordinator: Chair for Exercise Science

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Seminar	30	60
Tutorial	30	60
Total:	180	

Module examination:
- Final module examination
- Method of assessment: Project in code development and data analysis or portfolio or written examination
- Duration of examination: code development and written report (15-20 pages), portfolio (solving 4-8 tasks of code development) or written examination (60-90 min)
- Final grade: 100% project or 100% portfolio or 100% written examination
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-06 – Specific Data Analysis

06-MA-HMA-06	**Specific Data Analysis** **Spezifische Datenanalyse**	6 CP
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2010/2011	2. Sem.

Learning outcomes:
Students will be able to
- master specific challenges in the analysis of movement related data sets,
- select appropriate methods in data pre-processing and apply these adequately,
- tailor inference statistical methods to the requirements defined by specific problems in data analysis,
- implement suitable algorithms into own software.

Module content:
- filter and smooth functions
- inference statistical logic
- variance and covariance
- statistical estimates
- distribution characteristics of statistical parameters

Frequency and duration: Summer term, 1 semester

Module coordinator: Chair for Exercise Science

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	30	60
Seminar	30	60
Total:	180	

Module examination:
- Final module examination
- Method of assessment: code development and written report on application in data analysis
- Duration of examination: code development and written report (ca. 15 pages)
- Final grade: 100% code development and written report
- Module retake examination: Code development and written report on project in data analysis (15 pages) or oral examination (45 min)

Language of instruction/Language of examination: English

Notes: We recommend completing modules 06-MA-BMB-01 and 06-MA-BMB-05.
Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-07 – Biomechanics II

06-MA-HMA-07	**Biomechanics II**	9 CP

	Biomechanik II	
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	2. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:
Students will be able to

- identify, describe, analyse and model human movement in relevant contexts, such as:
  - findings, movement and stress assessment in a clinical context, especially in technical orthopaedics (orthotics, prosthetics, etc.),
  - sports and exercise,
  - ergonomics,
  - task and performance analysis.
- compare and evaluate existing and alternative approaches and use this to develop new proposals in biomechanical movement and load detection and biomechanical modelling.

Module content:
Characteristic examples from the clinical, orthopaedic context, sport or related fields of application are worked on with changing concrete contents. Fields of action include, for example:

- clinical gait analysis (determination of physical stresses and strains),
- movement and stress analysis for sports-specific problems and
- biomechanical modelling for specific applications.

Frequency and duration: Summer term, 1 semester

Module coordinator: Chair for Human Movement Science and Sportpsychology

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	15	75
Seminar	30	150
Total:	270	

Module examination:

- Final module examination
- Method of assessment: written examination or oral examination
- Duration of examination: written examination (60 min) or oral examination (45 min)
- Final grade: 100% written examination or 100% oral examination
- Module retake examination: identical to first exam

Language of instruction/Language of examination: English

Notes: We recommend completing modules 06-MA-BMB-02. Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-08 – Cognitive Neuroscience of Action

06-MA-HMA-08	**Cognitive Neuroscience of Action**	6 CP
	Kognitive Neurowissenschaft der Handlung	
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	2. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:
Students will be able to
- explain and reflect on the role of higher cognitive functions in the context of human action control,
- analyze complex neurophysiological data sets pertaining to cognitive aspects of motor behavior

Module content:
- Higher cognitive functions in the context of human action control, such as performance monitoring, decision-making, mental imagery, problem-solving, planning, memory formation
- Methods in Cognitive Neuroscience, such as single-cell recordings, electroencephalography, functional magnetic resonance imaging, transcranial magnetic stimulation

Frequency and duration: Summer term, 1 semester

Module coordinator: Chair for Experimental Sensomotorics

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Preparation and follow-up work
Lecture	15	75
Seminar	30	60
Total:	180	

Module examination:
- Final module examination
- Method of assessment: written examination or oral examination
- Duration of examination: written examination (90 min) or oral examination (45 min)
- Final grade: 100% written examination or 100% oral examination
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-09 – Movement Specific Measurement Methods

06-MA-HMA-09	**Movement Specific Measurement Methods** / **Spezifische Messverfahren**	9 CP
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	2. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:
Students will be able to

- describe measurement methods used in the field of biomechanical based movement analysis,
- select and adapt the various kinemetric, dynamometric and electrophysiological measurement methods for specific problems and applications,
- capture, process and visualise motion analysis data with different measuring systems,
- evaluate and interpret the detected measurement data according to common standards.

Module content:

- measurement methods for the detection of external forces, pressure distribution and accelerations
- optical measurement methods (2D and 3D motion analysis to determine kinematic parameters)
- surface electromyography (recording of muscle activity during various movement tasks)
- time measuring method (recording of reaction and movement times)

Frequency and duration: Summer term, 1 semester

Module coordinator: Chair for Human Movement Science and Sportpsychology

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Self-study, Preparation and follow-up work
Lecture	15	75
Seminar	15	75
Hands-on Seminar	30	60
Total:	270	

Examination prerequisites: 3 measurement reports during hands-on seminar

Module examination:

- Final module examination
- Method of assessment: written examination
- Duration of examination: written examination (60 min)
- Final grade: 100% written examination
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: We recommended completing module 06-MA-BMB-04. Modul consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-10 – Profile Module I: Specialization in Theoretical, Methodological or Applied Topics

06-MA-HMA-10	**Profile Module I: Specialization in Theoretical, Methodological or Applied Topics** **Spezialisierung zu theoretischen, methodischen und angewandten Themen**	9 CP
PROFILE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2022/2023	3. Sem.

Learning outcomes:
Students will be able to
- develop research skills,
- conduct subject-specific literature review,
- apply methods in a specific context,
- reflect modelling methods in different subject areas,
- present their results in written and oral form.

Module content:
- Measurement project
- Profile building Neuroscience
- Profile building Biomechanics
- Profile building Sensorimotor Control
- Profile building Mathematical and Statistical Methods

Frequency and duration: Winter term, 1 semester

Module coordinator: Professorship of the course

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Self-study, Preparation and follow-up work
Advanced Seminar	30	240
Total:	270	

Module examination:
- Final module examination
- Method of assessment: written examination or oral examination or assignment and colloquium
- Duration of assessment: written examination (90 min) or oral examination (45 min) or assignment (ca. 20 pages) and colloquium (20 min)
- Final grade: 100% written examination or 100% oral examination or 100 % assignment and colloquium
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: We recommend completion of courses in Sem 1 and 2, on which the Profile Module is built. Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-11 – Profile Module II: Specialization in Theoretical, Methodological or Applied Topics

06-MA-HMA-11	**Profile Module II: Specialization in Theoretical, Methodological or Applied Topics** **Spezialisierung zu theoretischen, methodischen und angewandten Themen**	9 CP
PROFILE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science Offered for the first time: WS 2022/2023	3. Sem.

Learning outcomes:
Students will be able to
- develop research skills,
- conduct subject-specific literature review,
- to apply methods in a specific context,
- reflect modelling methods in different subject areas,
- present their results in written and oral form.

Module content:
- Measurement project
- Profile building Neuroscience
- Profile building Biomechanics
- Profile building Sensorimotor control
- Profile building Mathematical and Statistical Methods

Frequency and duration: winter term, 1 semester

Module coordinator: Professorship of the course

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Courses	Contact hours	Self-study, Preparation and follow-up work
Advanced Seminar	30	240
Total:	270	

Module examination:
- Final module examination
- Method of assessment: written examination or oral examination or assignment and colloquium
- Duration of assessment: written examination (90 min) or oral examination (45 min) or assignment (ca. 20 pages) and colloquium (20 min)
- Final grade: 100% written examination or 100 % oral examination or 100 % assignment and colloquium
- Module retake examination: identical to first examination

Language of instruction/Language of examination: English

Notes: We recommend completion of courses in Sem 1 and 2, on which the Profile Module is built. Module consultation, bibliographical references, scheduled date: cf. StudIP

06-MA-HMA-12 – Optional Module I

06-MA-HMA-12	**Optional Module I**	6 CP
	Wahlpflichtmodul I	
OPTIONAL MODULE	Justus-Liebig-University Giessen	3. Sem.
	Offered for the first time: WS 2010/2011	
Learning outcomes: • cf. the respective module		
Module content: • cf. the respective module		
Frequency and duration: optional, 1 semester		
Module coordinator: Professorship of the course		
Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning		
Prerequisites: cf. the respective module		
Courses	Contact hours	Self-study, Preparation and follow-up work
Lecture/Seminar/…	…	…
Lecture/Seminar/…	…	…
Total:	180	
Examination prerequisites: cf. the respective module		
Module examination: • Final module examination or module component examinations • Method of assessment: cf. the respective module. • Duration of examination: cf. the respective module • Final grade: cf. the respective module • Module retake examination 1 and 2: cf. the respective module		
Language of instruction/Language of examination: English or German		
Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP		

06-MA-HMA-13 – Optional Module II

06-MA-HMA-13	**Optional Module II**	6 CP
	Wahlpflichtmodul II	
OPTIONAL MODULE I	Justus-Liebig-University Giessen	3. Sem.
	Offered for the first time: WS 2010/2011	
Learning outcomes: • cf. the respective module		
Module content: • cf. the respective module		
Frequency and duration: optional, 1 semester		
Module coordinator: Professorship of the course		
Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning		
Prerequisites: cf. the respective module		
Courses	Contact hours	Self-study, Preparation and follow-up work
Lecture/Seminar/…	…	…
Lecture/Seminar/…	…	…
Total sum:	180	
Examination prerequisites: cf. the respective module		
Module examination: • Final module examination or module component examinations • Method of assessment: cf. the respective module • Duration of examination: cf. the respective module • Final grade: cf. the respective module • Module retake examination 1 and 2: cf. the respective module		
Language of instruction/Language of examination: English or German		
Notes: Module consultation, bibliographical references, scheduled date: cf. StudIP		

06-MA-HMA-14 – Thesis-Module

06-MA-HMA-14	**Thesis-Module**	30 CP
	Thesis-Modul	
CORE MODULE	FB 06 / Psychology and Sport Science / Institute for Sport Science	4. Sem.
	Offered for the first time: WS 2010/2011	

Learning outcomes:

- The master thesis deepens the students' knowledge and competences in independent and scientific thinking and work.
- Essential qualifications of scientific work and specifics will be achieved and consolidated by developing the thesis. This includes skills in communication, literature search, writing of scientific papers as well as the presentation and critical evaluation of the found results.

Module content:

Students

- develop a master thesis independently,
- conduct, analyse and interpret an empirical or theoretical problem within 6 months,
- write a subject-specific thesis.

Frequency and duration: Summer and winter term, 1 semester

Module coordinator: Chair of the Examination Board and professorships of the department

Used in: M.Sc. Human Movement Analytics – Biomechanics, Motor Control, and Learning

Prerequisites: cf. § 11 SpezO

Course	Workload: 900 hours = 30 CP (Duration: 6 months)

Module examination:

- Final module examination
- Method of assessment: thesis (30-40 pages or according to instructions of an international journal) and disputation
- Duration of examination: thesis (6 months), disputation (30 min)
- Final grade: 100% master thesis
- Retake examination: Revision of the master-thesis within 3 months or preparation of a new master thesis within 6 months. Preparation of a new thesis may be conducted under a new supervisor.

Language of instruction/Language of examination: English

Notes: Module consultation: professorships of the department