

Module handbook

M.Sc. Human Technology in Sports and Medicine [M.Sc. TSM]

Valid for first-year students: Winterterm 2014/15 onward



**Deutsche
Sporthochschule Köln**
German Sport University Cologne

The central aim of the M.Sc. Human Technology in Sports and Medicine is to provide students with the essential skills required to assess, develop and improve sport equipment as well as medical technologies. The understanding of the interaction of the human neuro-musculo-skeletal system with sports and medical technology and with other external physical variables is the fundamental aspects in the program. Students will gain skills in problem-solving and innovative thinking along with extensive knowledge in developing sports and medicine products as well as special skills in developing methods and tools for the improvement of training and performance assessment.

The following learning outcomes are at the core of the entire program:

Professional competence

A. Knowledge and Comprehension

Graduates will

- gain fundamental knowledge to understand the mechanical behavior of material, technology and specific devices in sports and medicine
- gain fundamental knowledge to facilitate tests, data collection and analysis
- gain fundamental knowledge to understand the behavior of the human neuro-musculo-skeletal system and its response to mechanical load variations
- gain fundamental knowledge to understand the interaction of the human neuro-musculo-skeletal system and technology

B. Application and realization

Graduates will

- apply and transfer their knowledge to general and specific challenges in the field of human movement, loading of the human neuro-musculo-skeletal system as well as sports and medical technology
- apply their knowledge in specific research questions
- apply their knowledge in research projects

C. Analysis and Evaluation

Graduates will

- be able to conduct analyses of loading and loading response of the human neuro-musculo-skeletal system and technology
- be able to conduct analyses of the mechanical properties and mechanical behavior of materials, structures and devices of technology in sports and medicine

D. Development and improvement

Graduates will

- learn basics in construction of technological devices
- learn to conceive and develop tests, test designs and laboratories for technology in sports and medicine
- learn to conceive, develop and improve existing diagnostic tools

Methodological competence

A. Knowledge and Comprehension

Graduates will

- gain fundamental knowledge to facilitate analyses of complex data sources
- gain fundamental knowledge to conduct scientific and industrial research
- gain fundamental knowledge to design and conduct scientific research studies in the broader field of technology in sports and medicine
- gain fundamental knowledge for indirect quantification of loading situations of the human musculo-skeletal system

B. Application and realization

Graduates will

- apply their methodological knowledge in specific research projects
- apply their methodological knowledge in industrial and "real life" settings

- C. Analysis and Evaluation
- D. Development and improvement

Social competence

- A. Knowledge and Comprehension
- B. Application and realization
Graduates will
 - apply their individual skills in group situations
 - apply their individual skills in team work projects
- C. Analysis and Evaluation
- D. Development and improvement
Graduates will
 - develop and improve skills in team work projects
 - develop and improve skills in group situations

Self-competence

- A. Knowledge and Comprehension
- B. Application and realization
- C. Analysis and Evaluation
- D. Development and improvement

Considering the size of rapidly growing global sports and medicine market, graduates will be able to work as leading sports and medical technology specialists in multi- and trans-disciplinary teams in the global industry, research organizations and universities. The M.Sc. Human Technology in Sports and Medicine degree allows for consecutive postgraduate studies earning a doctor's degree.

Module:

Basics I - Mathematics & Physics

Study Programm:

M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)

Valid for first-year students:

Winter term 2014/15 onward

German module title	Mathematics and Physics
Abbreviation	TSM1
Subject related semester / Duration	1. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Mathematics and Physics 2 SHW / 30 h / 60 h / 1. SRS / SE / English / no</p> <p>b) Mathematics and Physics 2 SHW / 30 h / 60 h / 1. SRS / TUT / English / no</p>
Key competencies / Learning outcomes	The students will learn, expand and deepen basics in mathematics and physics in order to plan, construct and evaluate devices and technologies sports and medicine. They will be enabled to advance methods of evaluation and diagnostics. The lab exercises serve to deepen and practically experience the theoretical content of teaching.
Central contents	<p>Equations and Inequalities</p> <ul style="list-style-type: none"> Linear and quadratic equations Equations of third and higher level, root equations, inequalities, systems of linear equations <p>Vector algebra</p> <ul style="list-style-type: none"> Vectors in the 2- and 3-dimensional space Applications in geometry <p>Functions and curves</p> <ul style="list-style-type: none"> Transformations of coordinates, limit and continuity of a function Rational and broken rational functions, algebraic and trigonometric functions Exponential, Hyperbolic and Inverse Hyperbolic functions <p>Differential and integral calculus</p> <ul style="list-style-type: none"> Differentiability of a function, derivation rules, applications of differential calculus Integration Methods <p>Linear Algebra</p> <ul style="list-style-type: none"> Matrices and determinants, eigenvalues and eigenvectors <p>Differential equations</p> <ul style="list-style-type: none"> Differential Equations 1 and 2 organization Numerical integration <p>Deviation and equalization calculus Mechanics of rigid bodies</p> <ul style="list-style-type: none"> Kinematics and kinetics of the center of mass, relative motion of the center of mass Kinematics and kinetics of the rigid body, translation and rotation of the rigid body multi body systems Vibration and shock

	Fluid mechanics Aerodynamics
Key qualifications	<ul style="list-style-type: none">• Knowledge enhancement• Mathematical expertise
Teaching and learning methods	<ul style="list-style-type: none">• Frontal teaching• Group work
Recommended literature	Papula (2009): Mathematik für Ingenieure und Naturwissenschaftler. Vieweg + Teubner. Wiesbaden Bergmann, Schaefer (1990): Lehrbuch der Experimentalphysik - Mechanik, Akustik, Wärme. De Gruyter. Berlin, New York
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Written exercises and written test examination
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Subject to change

Module:	Basics II – Biomechanics
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Biomechanics and Mechanobiology
Abbreviation	TSM2
Subject related semester / Duration	1. SRS / 1
Total Workload/ Total ECTS points	300 h / 10
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Biomechanics 2 SHW / 30 h / 45 h / 1. SRS / SE / English / no</p> <p>b) Mechanobiology 2 SHW / 30 h / 45 h / 1. SRS / SE / English / no</p> <p>c) Ergonomics 2 SHW / 30 h / 45 h / 1. SRS / SE / English / no</p> <p>d) Biomechanics and Mechanobiology 2 SHW / 30 h / 45 h / 1. SRS / TUT / English / no</p>
Key competencies / Learning outcomes	<p>The students should gain and improve fundamental skills in biomechanics, mechanobiology and ergonomics. They learn how to plan, to design, and to evaluate sport equipment and other technologies in sport and medicine with regard to the mechanical loading of the musculoskeletal system. They should be prepared to understand and to develop methods of biomechanical evaluation and diagnostics. The students will receive the anthropometric and ergonomic requirements and background information for an independent development, construction and evaluation of sport related apparatus and technologies, orthopaedic aids and other medical technologies with respect to the geometry of the human body, the human body's joints, the biological structures and tissues, the kinematics and kinetics of the muscular drives and their motor control capacity. Students will be enabled to evaluate sports and medical equipment, apparatus or playing grounds and apparel from an ergonomic, a biomechanical and a biological standpoint. The purpose of the tutorial is to apply the acquired knowledge on practical examples.</p>
Central contents	<ul style="list-style-type: none"> • Kinematics of human motion • Kinetics of human motion • Muscle biomechanics • Anthropometry of the human body and its segments • Age and gender-specific body geometry and anthropometry Inertial characteristic of the human body and the body segments • Joint mechanics (joint kinematics, joint stiffness, intraarticular loading) • External contact forces in sports, activities of daily life

	<p>and rehabilitation</p> <ul style="list-style-type: none"> • Joint moments and forces, joint power • Local biological effects of contact forces • Stress and strain in biological tissues • Mechanical properties of biological tissues: bone, cartilage, ligaments, tendons and muscles • Measurement techniques: direct kinetics, optical kinetics, dynamics, electromyography
Key qualifications	<ul style="list-style-type: none"> • Knowledge enhancement • Scientific expertise
Teaching and learning methods	Teacher-centered teaching, presentations, group work
Recommended literature	
Type of module (compulsory / elective)	Compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Yes, details will be given at the beginning of the courses
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Subject to change

Module:

Basics III - Data management & -analysis

Study Programm:

M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)

Valid for first-year students:

Winter term 2014/15 onward

Titel	Data management and data analysis
Identification	MA-TSM3
Semester of study / Duration (Semester)	1 (only fall/winter) / 1
Overall Workload (h) / ECTS-Points (in total)	240 / 8
Courses of the module hours per week / Workload (contact time) / Workload (independent learning) / Semester of study / type of class / credit points / compulsory attendance	<p>a) Data management /programming 2 / 30 h / 60 h / 1 / seminar / 3 / No</p> <p>b) Advanced statistics 2 / 30 h / 60 h / 1 / seminar / 3 / No</p> <p>c) Data management /programming 2 / 30 h / 30 h / 1 / tutorial / 2 / No</p>
Key competencies / Learning outcomes	<p>The students will receive an introduction to the most relevant models, procedures and methods of data management and data analysis. Modern statistical techniques and models will improve the competency in statistical data analysis.</p> <p>Students will learn to design computer programs for data management and further data analysis. They will be trained to apply statistical tools for multi factorial data analysis, functional data analysis, time dependent non-conventional statistical approaches, and pattern recognition techniques. The purpose of the tutorial is to apply the acquired knowledge on practical examples.</p>
Central contents	<p>Structured programming and object oriented programming</p> <p>Different computer programming languages:</p> <p>Compiler, interpreter and assembler</p> <p>Different integrated development environments (IDE)</p> <p>Data types, variables and constants</p> <p>Basic control structures (statements and loops)</p> <p>Computer programming:</p> <ul style="list-style-type: none"> - Operators - Exceptions - Classes, objects and methods - Events and properties - Threads - Designing, testing and debugging source code <p>Algorithms:</p> <ul style="list-style-type: none"> - Sorting algorithms - Searching algorithms <p>Software engineering</p> <p>Revision of basic statistical principles, techniques and terminology</p> <p>Theory and application of statistical modeling techniques (linear models, advanced statistical modeling approaches)</p> <p>Functional data analysis (functional data theory, functional</p>

	descriptive statistics, principle component analysis, advanced functional data analysis techniques) Pattern recognition and classification techniques (unsupervised learning algorithms: e.g. cluster analysis techniques, neuronal network techniques; supervised learning algorithms: e.g. discriminate analysis, support vector machine techniques)
Teaching and learning methods	Teacher-centered teaching, project orientated learning, group work
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	
Assessment	Written examination
Weight of module	
Module commissioner	See Overview Module Commissioners

Subject to change

Module:

Basics IV - Material & construction

Study Programm:

M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)

Valid for first-year students:

Winter term 2014/15 onward

German module title	Material & construction
Abbreviation	TSM4
Subject related semester / Duration	1. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Material and construction 2 SHW / 30 h / 60 h / 1. SRS / SE / English / no</p> <p>b) Material and construction 2 SHW / 30 h / 60 h / 1. SRS / TUT / English / no</p>
Key competencies / Learning outcomes	<p>The students will learn the most important materials and fundamentals of the construction apprenticeship. Materials, design features and construction forms which are used in sports devices and athletic aids, in orthopaedic aids, joint replacement and implants will be questioned critically. Properties of different materials and above all potential failure spots and hazard points as well as corresponding solutions will be worked out and developed. Opportunities of inspection and testing are explained in detail and deepened by practical exercises. The students should be enabled to independently evaluate and examine the material and constructions of devices in sports and medicine from a material, constructional and user point of view. By regarding specific examples the practice allows deepening and practical rehearsing of the previous lesson.</p>
Central contents	<p>Materials</p> <ul style="list-style-type: none"> • Types of material • Structure, properties, processing • Surroundings and material performance <p>Atomic structure of solid bodies Failure of the atomic structure of solid bodies Diffusion of atoms in solid bodies Control of the microstructure and the mechanical properties of materials</p> <ul style="list-style-type: none"> • Mechanical testing methods and properties • Cryo solidification and relaxation <p>Technical materials</p> <ul style="list-style-type: none"> • Ferrous alloys • Non-ferrous metals • Ceramic material • Polymers • Composite materials <p>Physical properties of materials</p> <ul style="list-style-type: none"> • Electric properties • Magnetic properties • Optical properties • Thermal properties <p>Material failure and precaution</p>

	General construction apprenticeship Special construction of articulated connections Construction of drives
Key qualifications	Knowledge enhancement Problem solving
Teaching and learning methods	Teacher-centered teaching, group work
Recommended literature	Information will be given at start of term
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Written exercises and written test examination
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Subject to change

Module:	Technology I - Orthopaedic technologies
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Orthopaedic technologies
Abbreviation	TSM5
Subject related semester / Duration	2. SRS / 2
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Orthopaedic aids, prostheses, orthoses, exo skeletons, robots 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no</p> <p>b) Joint replacements and implants 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no</p>
Key competencies / Learning outcomes	The students will get to know the most important orthopaedic aids with special consideration of prostheses and orthoses, total joint replacements and implants critically discussing used materials, design elements and shapes of the different aids as well as their fields of application. The coupling of the orthopaedic devices with the human body and the interaction of assistive devices and neuromuscular drives receive special attention. Principles of a bionic approach to joint replacement and / or joint support and guidance are discussed, as well as robotics strategies for limb replacement. The use of orthopaedic devices in sports and the resumption of sports participation after joint replacement will receive special consideration. Technical vulnerabilities are identified and potential solutions are discussed. Examination and testing methods are explained in detail and deeply discussed in practical exercises.
Central contents	<p>Endoprotheses, exoprotheses, orthoses, insoles:</p> <ul style="list-style-type: none"> • Structure and properties • Design and material behaviour/properties • Used materials and components • Sport-specific biomechanical requirements • Test methods and risk analysis • Production and Development • Other orthopaedic aids
Key qualifications	<ul style="list-style-type: none"> • Knowledge enhancement • Scientific expertise • Problem management
Teaching and learning methods	<ul style="list-style-type: none"> • Teacher-centered teaching • Processing of scientific papers • Guest lectures
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Oral presentation of scientific papers
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners



Subject to change

Module: Technology II – Footwear, apparel and playing surfaces
Study Programm: M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students: Winter term 2014/15 onward

German module title	Footwear, apparel and playing surfaces
Abbreviation	TSM6
Subject related semester / Duration	2. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Footwear and playing surfaces (sports and rehabilitation) 2 SHW / 30 h / 30 h / 2. SRS / SE / English / no</p> <p>b) Apparel (sports and rehabilitation) 2 SHW / 30 h / 30 h / 2. SRS / SE / English / no</p> <p>c) Management 2 SHW / 30 h / 30 h / 2. SRS / SE / English / no</p>
Key competencies / Learning outcomes	<p>Students will learn about the most important technologies of athletic footwear and sport surfaces and critically revise regarding the used materials and design features, forms and functionalities. Next to sports surfaces in general (wood, PVC,...) natural playing surfaces and pitches will be analysed as well as artificial turf systems as well as different skating grounds surfaces (snow, ice...). Weak technical points and risk points will be highlighted and possible solutions will be developed. Different options of testing and diagnosis will be evaluated. Lab exercises are designed to deepen and practically experience the acquired knowledge to concrete examples. Similar to footwear and playing surfaces apparel for sport and rehabilitation will be critically discussed from a physiological, biomechanical and aerodynamic standpoint. The module is complemented by studies of used materials and design features as well as testing methods for most kinds of apparel. The seminar on project management round the module. The students will learn and understand the principle pathway from generating a project idea to formulating project aims, developing the project structure, optimize project related work flow and time scheduling, resource planning and finally budget planning.</p>
Central contents	<p>Athletic and rehabilitative shoe technologies</p> <ul style="list-style-type: none"> • structure and properties • design and material behavior • raw materials • sport-specific technologies, biomechanical requirements • mechanical testing methods and properties, practical equipment based testing <p>Technologies of sport and playingsurfaces</p> <ul style="list-style-type: none"> • physical properties of materials and construction elements (electrical, magnetic, optical, thermal) • sport-specific technologies, biomechanical requirements • risk analysis • testing and inspection • production and development <p>Technologies of apparel</p> <ul style="list-style-type: none"> • physical properties of materials and design elements

	<p>(thermal, aerodynamic)</p> <ul style="list-style-type: none"> • sport-specific apparel, biomechanical requirements • testing and inspection <p>Project management</p> <ul style="list-style-type: none"> • definition of aims, verbalization of aims • stakeholder analysis • risk management • work breakdown structure (object-orientated, function-orientated, mixed) • phase model, GANTT diagram, critical path method • budget planning, budget management (cost-time-history, cost-sum-history) • controlling (milestone-trend-analysis)
Key qualifications	<ul style="list-style-type: none"> • Expertise • Knowledge enhancement • Problem management
Teaching and learning methods	<ul style="list-style-type: none"> • teacher centered teaching • Group work
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	oral presentations
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Subject to change

Module: Technology III – Sports equipment and instrumentation
Study Programm: M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students: Winter term 2014/15 onward

German module title	Sports equipment and instrumentation
Abbreviation	TSM7
Subject related semester / Duration	2. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Instrumentation technology 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no</p> <p>b) Sports and rehabilitation equipment 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no</p>
Key competencies / Learning outcomes	<p>Students will learn about sustainable design and manufacturing of products and technologies in sports and rehabilitation. They discuss modern instrumentation technologies (smart devices, instrumentation of athletes and patients, instrumentation of technical aids and equipment) and elaborate advantage and disadvantages, strengths, weaknesses and technical limitations. From that students will derive first ideas and concepts for further and innovative instrumentation technologies. Student will study the most important technologies of sport and rehabilitation related equipment and will learn to critically revise the used materials and design features, forms and functionalities. Next to defined sport devices (e.g. gymnastics tools, climbing devices, strength training apparatus, ...) mobile devices and different vehicles will be analyzed. Weak technical points and aspects with risk potential will be highlighted and possible solutions will be developed. Different testing procedures are explained in detail and practically experienced.</p>
Central contents	<p>Testing designs Mechanical testing and mechanical properties, practical equipment tests Analysis of risk and hazard Physical properties of materials and structural elements of sports equipment and instrumentation</p> <ul style="list-style-type: none"> • Electrical properties • Magnetic Properties • Optical Properties • Thermal Properties <p>Technologies of sports equipment</p> <ul style="list-style-type: none"> • Structure and properties • Design and material behavior • Structure and properties • Design and material behavior
Key qualifications	<ul style="list-style-type: none"> • Knowledge enhancement • Technical expertise • Problem management
Teaching and learning methods	Teacher based teaching, group work
Recommended literature	
Type of module	compulsory



Prerequisites	See Overview Prerequisites
Intermediate assessment	Project presentations
Assessment / extent / share of the module grade	Term paper
Module commissioner	See Overview Module Commissioners

Subject to change

Module:	Technology IV - Modeling and simulation
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Modeling and simulation
Abbreviation	TSM8
Subject related semester / Duration	2. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	a) Multi body modeling 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no b) Finite element modeling 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no
Key competencies / Learning outcomes	The module is intended to bring the students to model dynamic systems and use them for simulation. After an introduction to the basic steps of the modeling method, deepening the mathematical foundations will help to get access to modelling of human (sub-)movement. The methods used range from forward dynamics and inverse dynamics methods to finite element and multi-body dynamics.
Central contents	Model Categories <ul style="list-style-type: none"> • Mathematical and physical models • Structural and statistical models Steps of the modeling method: <ul style="list-style-type: none"> • From description to the application of the model (simulation) Advantages and disadvantages of modeling methods Special mathematical methods: <ul style="list-style-type: none"> • Differential Equations • Euler-Cauchy method • Runge-Kutta method Forward dynamics Inverse dynamics Finite Elements Multi-body dynamics
Key qualifications	<ul style="list-style-type: none"> • Knowledge enhancement • Methodological Expertise • Problem management
Teaching and learning methods	<ul style="list-style-type: none"> • Frontal teaching • Group work
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Written exercises and written test examination
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Module: Technology V - Performance diagnostics in sport, medicine and rehabilitation

Study Programm: M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)

Valid for first-year students: Winter term 2014/15 onward

German module title	Performance diagnostics in sport, medicine and rehabilitation
Abbreviation	TSM9
Subject related semester / Duration	2. SRS / 1
Total Workload/ Total ECTS points	180h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Biomechanical and physiological diagnostics 2 SHW / 30 h / 60 h / 2. SRS / SE / English / no</p> <p>b) Biomedical diagnostics 2 SHW / 30 h / 60 h / 2. SRS / TUT / English / no</p>
Key competencies / Learning outcomes	<p>Students should acquire knowledge about the most important methods for athletic testing and biomechanical and physiological diagnoses. This includes the usage of appropriate devices and tools from motion capturing techniques via gas exchange analyses to isokinetic strength measurements.</p> <p>Students should get to know diagnostic tools for physical performance to use in sports and clinical environments. The accompanying tutorial provides the opportunity to familiarize themselves with the practical and effective application of the introduced testing methods and diagnostic tools.</p>
Central contents	<p>Physical measurement technologies</p> <ul style="list-style-type: none"> distance, time, velocity, acceleration, temperature, air-pressure, atmospheric humidity, concentration of oxygen, carbon dioxide and nitrogen, force, pressure <p>Electronic measurement technologies</p> <ul style="list-style-type: none"> voltage, current, resistance electric fields isolation, conductivity <p>Material properties</p> <ul style="list-style-type: none"> stiffness, hysteresis <p>Physiological measurement technologies</p> <ul style="list-style-type: none"> electrical potentials: EMG, ECG, EEG medical imaging methods: pQCT, Micro-CT, Ultrasound muscle strength measurements: isometric, isokinetic and dynamic blood count, blood gas, hormones, enzymes Spiroergometry (gas exchange analysis)
Teaching and learning methods	teacher-centered teaching, problem based learning group work, project work
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	
Assessment / extent / share of the module	Written examination



grade	
Module commissioner	See Overview Module Commissioners

Subject to change

Module:	Research methods and application
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Research methods and application
Abbreviation	TSM10
Subject related semester / Duration	3. SRS / 1
Total Workload/ Total ECTS points	180 h / 6
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Ethics, technology and research in humans 2 SHW / 30 h / 60 h / 3. SRS / SE / English / no</p> <p>b) Research methods 2 SHW / 30 h / 60 h / 3. SRS / SE / English / no</p>
Key competencies / Learning outcomes	<p>The students should elaborate ethical problems in the human technology interaction, will discuss models of an ethical evaluation of socio-technological arrangements and learn how to deal with serious moral questions in recent and future technological changes. These objectives will strongly focus the medical and the sport fields both from a perspective of technical assistance in daily life or recreational activity and a perspective of technically induced performance enhancement in competitive sport or even at the workplace.</p> <p>The students will learn or consolidate the most relevant research methods from natural science, medical and biological science and sport science. They acquire competence in descriptive, experimental and modeling methods. Furthermore research plans and study designs of descriptive and experimental approaches will be elaborated.</p>
Central contents	<ul style="list-style-type: none"> Models to evaluate socio-technological arrangements Ethical problems in the human-technology-interaction Moral questions in recent and future technological changes Technical assistance and performance enhancement Research methods (description, experiment, model) Research plans and study designs Prospective and retrospective design
Teaching and learning methods	teacher-centered teaching, problem based learning
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Oral presentation
Assessment / extent / share of the module grade	Written examination
Module commissioner	See Overview Module Commissioners

Module:	Sports technology project – applied research methods
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Analysis and Diagnostics
Abbreviation	TSM11-I
Subject related semester / Duration	3. SRS / 1
Total Workload/ Total ECTS points	360 h / 12
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	<p>a) Applied research methods 2 SHW / 30 h / 90 h / 3. SRS / SE / English / no</p> <p>b) Sports technology 6 SHW / 90 h / 150 h / 3. SRS / SE / English / no</p>
Key competencies / Learning outcomes	<p>The students learn to transfer and adapt the research methods to a given research project. Based on the research question they learn how to derive the hypotheses and the related methods. The applied research methods are related to the project design, the measuring techniques and the statistical or analytical methods.</p> <p>A given project from the field of sports should develop a new or modify an existing sports equipment or assistive technology or evaluate an existing technical solution. This includes the design of the product, the choice of appropriate materials and design elements, the construction and finally the evaluation. This entire process should exemplarily be carried out by groups of 3 to 6 students within a student's project.</p> <p>Besides acquiring the competence in developing a product the students practice project management (planning, controlling), collaboration, communication, critical thinking and presentation skills.</p> <p>The necessary theoretical background for the projects is acquired in the accompanying seminar Properties of a variety of materials and design elements are tested and failure risks are evaluated.</p>
Central contents	<ul style="list-style-type: none"> • Development of new or modification of an existing sports equipment or assistive technology • Realization of an idea • Design and construction of a product • Evaluation of the product • Generating a report of the results
Key qualifications	
Teaching and learning methods	project and problem based learning, group work
Recommended literature	
Type of module	elective
Prerequisites	See Overview Prerequisites
Intermediate assessment	Oral presentation
Assessment / extent / share of the module grade	Project report and documentation
Module commissioner	See Overview Module Commissioners



Subject to change

Module: Technology in medicine project – applied research methods
Study Programm: M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students: Winter term 2014/15 onward

German module title	Construction and Evaluation
Abbreviation	TSM11-II
Subject related semester / Duration	3. SRS / 1
Total Workload/ Total ECTS points	360 h / 12
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	a) Applied research methods 2 SHW / 30 h / 90 h / 3. SRS / SE / English / no b) Medical technology 6 SHW / 90 h / 150 h / 3. SRS / SE / English / no
Key competencies / Learning outcomes	<p>The students learn to transfer and adapt the research methods to a given research project. Based on the research question they learn how to derive the hypotheses and the related methods. The applied research methods are related to the project design, the measuring techniques and the statistical or analytical methods.</p> <p>A given project from the field of medicine should develop a new or modify an existing medicine equipment or assistive technology or evaluate an existing medical solution. This includes the design of the product, the choice of appropriate materials and design elements, the construction and finally the evaluation. This entire process should exemplarily be carried out by groups of 3 to 6 students within a student's project. Besides acquiring the competence in developing a product the students practice project management (planning, controlling), collaboration, communication, critical thinking and presentation skills.</p> <p>The necessary theoretical background for the projects is acquired in the accompanying seminar Properties of a variety of materials and design elements are tested and failure risks are evaluated.</p>
Central contents	<ul style="list-style-type: none"> • Development of new or modification of an existing medicine equipment or assistive technology • Realization of an idea • Design and construction of a product • Evaluation of the product • Generating a report of the results
Teaching and learning methods	project and problem based learning, group work
Recommended literature	
Type of module	elective
Prerequisites	See Overview Prerequisites
Intermediate assessment	Oral presentation.
Assessment / extent / share of the module grade	Project report and documentation
Module commissioner	See Overview Module Commissioners



Subject to change

Module:	Internship
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Internship
Abbreviation	TSM12
Subject related semester / Duration	3. SRS / 1
Total Workload/ Total ECTS points	360 h / 12
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	
Key competencies / Learning outcomes	The students will explore a relevant issue in the industrial sector. The industry internships and the other internships are used to collect practical experience. The internship is before 4 Semester provided.
Central contents	<ul style="list-style-type: none"> • project planning • project management • financing • practical experience • "real world problems"
Key qualifications	<ul style="list-style-type: none"> • Problem identification • Problem management
Teaching and learning methods	<ul style="list-style-type: none"> • practical work
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	
Assessment / extent / share of the module grade	written report
Module commissioner	See Overview Module Commissioners

Subject to change

Module:	Master Thesis
Study Programm:	M.Sc. Human Technology in Sports and Medicine (M.Sc. TSM)
Valid for first-year students:	Winter term 2014/15 onward

German module title	Thesis
Abbreviation	TSM13
Subject related semester / Duration	4. SRS / 1
Total Workload/ Total ECTS points	900 h / 30
Courses of the module Title Semester hours per week / Contact time / Self-study / Semester of study / Type of class / Language of instruction / Mandatory attendance	Scientific paper writing 2 SHW / 30 h / 60 h / 4. SRS / SE / English / no
Key competencies / Learning outcomes	For completing their masters degree, students will work on a scientific topic and realize their task in a publishable manner. This work will include theoretical foundation, defining a specific problem, empirical data collection, as well as an analysis and interpretation of the results. Seminars will accompany the students' work and offer relevant knowledge and skills. The preceding industrial internship should facilitate the access to relevant scientific questions, which will be dealt with in a project.
Central contents	Databases and access to literature <ul style="list-style-type: none"> - Internet research (databases, search engines, etc.) - Categories: original articles, handbooks, textbooks, scientific databases - Impact-factors Problem/Hypotheses definition Critical choice of study methods <ul style="list-style-type: none"> - Quality criteria and informative value - Availability and reliability Publishing <ul style="list-style-type: none"> - Searching for relevant journals - Adapting to the chosen journal's requirements Writing a paper
Key qualifications	<ul style="list-style-type: none"> - Independent problem definition and problem solutions
Teaching and learning methods	<ul style="list-style-type: none"> - Group work - Presentation - Discussion
Recommended literature	
Type of module	compulsory
Prerequisites	See Overview Prerequisites
Intermediate assessment	Written exercises
Assessment / extent / share of the module grade	Master Thesis (27 CP)
Module commissioner	See Overview Module Commissioners