Curriculum for the Master’s Program in
Sports Technology
Preface:

Pursuant to Act 985 of October 21, 2009 on Universities (the University Act) with subsequent changes, the following curriculum for the Master's program in Sports Technology is stipulated. The program also follows the Framework Provisions and the Examination Policies and Procedures for the Faculty of Engineering and Science and The Faculty of Medicine at Aalborg University.
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Chapter 1: Legal Basis of the Curriculum, etc.

1.1 Basis in ministerial orders
The Master’s program in Sports Science is organized in accordance with the Ministry of Science, Technology and Innovation’s Ministerial Order no. 814 of June 29, 2010 on Bachelor’s and Master’s Programs at Universities (the Ministerial Order of the Study Programs) and Ministerial Order no. 857 of July 1, 2010 on University Examinations (the Examination Order) with subsequent changes. Further reference is made to Ministerial Order no. 181 of February 28, 2010 (the Admission Order) and Ministerial Order no. 250 of March 15, 2007 (the Grading Scale Order) with subsequent changes.

1.2 Faculty affiliation
The Master’s program falls under The Faculty of Medicine, Aalborg University.

1.3 Board of Studies affiliation
The Master’s program falls under the Board of Studies for Health, Technology and Sports Science.
Chapter 2: Admission, Degree Designation, Program Duration and Competence Profile

2.1 Admission
Admission to the Master’s program in Sports Technology requires a Bachelor degree in Sports Science from a Danish university.

Upon application to the Board of Studies, students with a Bachelor's degree different from the above will be admitted after a specific academic assessment, if the applicant is deemed to have comparable educational prerequisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree designation in Danish and English
The Master’s program entitles the graduate to the designation “cand.scient.techn. (candidatus/candidata scientiarum technologiae) i idræt”. The English designation is: Master of Science (MSc) in sports technology.

2.3 The program’s specification in ECTS credits
The Master’s program is a 2-year, research-based, full-time study program. The program is set to 120 ECTS credits.

2.4 Competence profile on the diploma
The following competence profile will appear on the diploma:

A graduate of the Master’s program has competencies acquired through an educational program that has taken place in a research environment.

The graduate of the Master’s program can perform highly qualified functions on the labour market on the basis of the educational program. Moreover, the graduate has prerequisites for research (a Ph.D. program). Compared to the Bachelor’s degree, the graduate of the Master’s program has developed her/his academic knowledge and independence, so that the graduate can independently apply scientific theory and method in both an academic and occupational/professional context.

2.5 Competence profile of the program
Technology has become an inherent part of sports and the democratization of sports and leisure activities has opened possibilities for the integration of technology not only for elite sportsmen but also for the population in general. Simultaneously, the acceptance of sports activities as an important factor for the general health has been fully recognized. This has made sports a significant field of interest for the industry.

In order to integrate technology in sports, basic knowledge in human biomechanics, physiology and psychology is required in combination with skills within human performance assessment, technology, product design and manufacturing.
The graduate of the Master’s program:

Knowledge and comprehension

• has knowledge of scientific communication and methods (including experimental design and modelling) and of the following key areas within Sports Technology, based on the highest international level of research within the areas,
  • Modelling of human function
  • Measurement techniques and signal processing
  • Applied technology in sports
  • Manufacturing processes
  • Numerical modelling
  • Mechanics of materials
• has knowledge within the selected key areas of Sports Technology and is able to reflect on a scientific basis about this knowledge, and is able to identify scientific problems related to basic, experimental and clinical research within the area;

Skills

• masters the scientific methods and tools relevant in Sports Technology, and masters general skills related to jobs within Sports Technology, either within the public sector or in the industry,
• is able to assess and choose from the discipline’s scientific theories, methods, tools and general skills, and is able, on a scientific basis, to propose new models for analysis and problem solving within Sports Technology,
• is able to communicate research-based knowledge and is able to discuss professional and scientific problems with engineers and designers, as well as users;

Competences

• is able to control and administrate situations that are complex, unpredictable and which require new solutions,
• is able to independently initiate and to perform collaboration within the discipline and interdisciplinary as well, and to take professional responsibility,
• is able to independently take responsibility for his or her own professional development and specialization.
Chapter 3: Content and Organization of the Program

The program is structured in modules and organized as a problem-based study. A module is a program element or a group of program elements, which aims to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluding with one or more examinations within specific exam periods. Examinations are defined in the curriculum.

The program is based on a combination of academic, problem-oriented and interdisciplinary approaches and organized based on the following work and evaluation methods that combine skills and reflection:

- project work
- lectures
- workshops
- exercises (individually and in groups)
- feedback (from teachers and fellow students)
- academic reflection
### 3.1 Overview of the program

All modules are assessed through individual grading according to the 7-point scale or Passed/Not passed. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the teacher / supervisor only).

<table>
<thead>
<tr>
<th>Semester</th>
<th>Module</th>
<th>ECTS</th>
<th>Assessment</th>
<th>Exam</th>
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<tbody>
<tr>
<td>1st</td>
<td>Instrumentation and physical performance</td>
<td>15</td>
<td>7-point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Modelling of human function</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Measurement technique and signal processing</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Continuous, internal</td>
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<tr>
<td></td>
<td>Applied technology in sports</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Internal</td>
</tr>
<tr>
<td>2nd</td>
<td>Interplay between athlete and equipment</td>
<td>15</td>
<td>7-point scale</td>
<td>External</td>
</tr>
<tr>
<td></td>
<td>Manufacturing processes</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Numerical modelling</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Mechanics of materials</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Internal</td>
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<tr>
<td>3rd</td>
<td>Scientific methods in sports technology</td>
<td>25</td>
<td>7-point scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>Scientific methods and communication (SMAC)</td>
<td>5</td>
<td>Passed/Not passed</td>
<td>Continuous, Internal</td>
</tr>
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<td>4th</td>
<td>Master's thesis</td>
<td>30</td>
<td>7-point scale</td>
<td>External</td>
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<td>Total</td>
<td></td>
<td>120</td>
<td></td>
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</table>
3.2 Descriptions of modules

Title: Instrumentation and physical performance / Instrumentering og fysisk præstationsevne

Prerequisites: Bachelor degree in Sports Science or a relevant Bachelor degree in Science or Technology.

Objective: Students who complete the module:

Knowledge
- Have knowledge about the technologies used in Sports
- Is able to use pertinent instrumentation techniques and signal processing methods in relation to physical performance
- Is able to model and simulate musculoskeletal function as well as verify and validate such models and simulations

Skills
- Is able to apply recent technology in Sports
- Is able to evaluate biomechanical recordings and processing methods
- Is able to critically apply musculoskeletal modelling techniques within Sports Science

Competences
- Is able to choose technologies, record, analyze and critically evaluate real and simulation results in relation to physical performance.

Type of instruction: Project.

Exam format: Oral exam, assessment by 7-point scale, internal.

Title: Modelling of human function / Modellering af funktioner i kroppen

Prerequisites: Bachelor degree in Sports Science or a relevant Bachelor degree in Science or Technology. The biomechanics part of the curriculum of the bachelor education.

Objective: Students who complete the module:

Knowledge

- Have knowledge about a variety of simulation methods useful in sports
- Know the general principles of modelling, simulation, verification and validation
- Are aware of the assumptions and limitations of the methods
- Know about how the human body and its interaction with the surroundings can be analyzed by means of modelling and simulation technology
- Are aware of the connection between the model and the anatomic/physiological reality

Skills

- Are able to apply musculoskeletal modelling techniques on problems within Sports Science
- Are able to import and use experimental data processed in the courses on measurement technique and signal processing into musculoskeletal modelling systems
- Are able to apply techniques of experimental validation of models

Competences

- Are able to analyze and critically evaluate simulation results.

Type of instruction: Lectures and Exercises.

Exam format: Oral or written exam, assessed by Passed/Not passed, Internal.

Title: Measurement technique and signal processing / Måleteknik og signalbehandling

Prerequisites: Bachelor degree in Sports Science or a relevant Bachelor degree in Science or Technology. The biomechanics and physiology parts of the curriculum of the bachelor education.

Objective: Students who complete the module:

Knowledge

- Have knowledge about the technologies used to record and process biomechanical signals
- Know how to apply such knowledge for 3-D recordings of human movement
- Have the basic knowledge and understanding concerning the measurement principles behind the methods used to quantify human performances
- Know how to apply a number of methods for the quantification of human performances
- Know how to process and analyze measured data and present them in a relevant physiological context

Skills

- Have knowledge about the used techniques precision and accuracy
- Are able to apply recording and processing techniques on biomechanical data
- Are able through critical reading of original sports science studies to analyses and evaluate the usefulness of the techniques used and the signals analyzed

Competences

- Are able to record, process and critically evaluate the recorded data.

Type of instruction: Lectures and Exercises.

Exam format: Continuous evaluation, assessment by Passed/Not passed, Internal.

Title: Applied Technology in Sports / Anvendt idrætsteknologi

Prerequisites: Bachelor degree in Sports Science or a relevant Bachelor degree in Science or Technology.

Objective: Students who complete the module:

Knowledge

- Have a good overview of the field of Sports Technology and its relation to Sports Engineering
- Have knowledge about how technology has contributed to the development in sports in the context of:
  - Performance optimization
  - Physical activity for health
  - Physical activity for entertainment and adventure
  - Injury prevention
- Have knowledge about the most recent technological developments with relation to sports

Skills

- Are able to combine knowledge about sports and technology in the process of identifying potential new developments

Competences

- Are able to communicate with persons with a technical background concerning technology in relation to sports.

Type of instruction: Lectures and Exercises.

Exam format: Oral or written exam, assessment by Passed/Not passed, Internal.

Title: Interplay between athlete and equipment (Samspil mellem idrætsudøver og udstyr)

Prerequisites: The courses on Modelling of Human Function, Mechanics of Materials, and Measurement Technique and Signal Processing

Objective: Students who complete the module:

Knowledge

- Have gained knowledge about the sports product industry
- Have knowledge of a product lifecycle from conception over design and manufacture to use and recycling
- Have knowledge of available analysis methods and their advantages and limitations
- Are able to understand technical specifications of products
- Have knowledge of production processes typical for sports equipment

Skills

- Are able to choose appropriate analysis methods for a given case
- Are able to analyse the function of a sports product in connection with the human body
- Are able to qualitatively assess production costs

Competences

- Are able to assess the value a sports product provides to its user.
- Are able to have a dialogue with equipment producers about methods, quality, cost and delivery
- Are able to have a qualified dialogue with engineers and product analysis specialists
- Are able to consider a problem of sufficient complexity to prescribe the use of advanced analytical, numerical or experimental tools for predicting its quality and performance.

Type of instruction: Project.

Exam format: Oral exam, assessment by 7-point scale, external.

Title: Manufacturing Processes (Product, process and production design)

Prerequisites: Elementary Mechanics of Materials, Numerical analysis, Statics and Dynamics Processing.

Objective: Students who complete the module:

Knowledge

- Are able to apply product analysis, processes and production for improved solutions
- Are able to understand the basic concepts of manufacturing including common manufacturing processes
- Know how to progress from conceptual idea/product to the realization of prototype as well as specifying the manufacturing set-up
- Understand the interplay between design, material, processing and cost and quality

Skills

- Are able to choose suitable analysis tools and methods for the application of interest
- Are able to communicate and manufacturing analysis results
- Are able to choose material, process and manufacturing set-up.

Competences

- Know how to handle the design process in sports science and engineering
- Are able to contribute value adding to an industrial design and realization project.

Type of instruction: Lectures and Exercises.

Exam format: Oral or written exam, assessed by Passed/Not passed, Internal.

Title: **Numerical Modelling / Numerisk modellering**


Objective: Students who complete the module:

**Knowledge**

- Are able to understand how numerical methods can be applied to obtain approximate solutions to physical problems governed by partial differential equations and their applications and limitations
- Are able to understand the basic concepts for displacement-based finite element method such as elements, stiffness, displacement, force, interpolation and degrees of freedom, etc
- Know how to set up a finite element model of a static structural problem – from computer-aided design model to finite element model
- Understand the compromise between accuracy and simulation time, and understand validation of finite element models
- Know the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses
- Have a basic understanding of different criteria that may be applied when using finite element analysis for design

**Skills**

- Are able to perform linear static stress analysis using a commercial finite element program
- Are able to interpret and report results of simple finite element analyses
- Demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science viewpoint

**Competences**

- Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineering.

Type of instruction: Lectures and Exercises.

Exam format: Oral or written exam, assessed by Passed/Not passed, Internal.

Title: Mechanics of Materials / Styrkelære

Prerequisites: Basic biomechanics

Objective: Students who complete the module:

Knowledge

- Have knowledge about the tensorial nature and interdependence of stresses and strains
- Are able to understand the general line of reasoning from the macroscopic state (geometry, materials, loads) through the deformation state to the local state (stresses and strains at a point, failure prediction)
- Are aware of the distinction between failure models depending on choice of material and stress multiaxiality (i.e. there is no universally acknowledged failure model for all materials – failure models are chosen according to the specific case)

Skills

- Are able to apply the methodology of Mechanics of Materials to simple cases (beams, rods) in order to evaluate deformations and risk of failure
- Are able to evaluate combined structures through discretization into elementary structural types (beams, rods, columns etc.)
- Are able to assess primary criteria for choices of structural layout and material (maximum load, permissible deformation, energy absorption etc.)

Competences

- Are able to critically assess and independently calculate stresses in beams and rods, given sectional loads
- Are able to apply the deformation equations for rods and beams (elementary cases) to design problems

Type of instruction: Lectures and Exercises.

Exam format: Oral or written exam, assessed by Passed/Not passed, internal.

Title: Scientific methods in sports technology / Videnskabelige metoder i idrætsteknologi

Prerequisites: The students have participated actively in the first two semesters of this program.

Objective: To give the student experience in applying scientific methods or performing scientific experiments related to Sports Technology at a University Department or in a company in Denmark or abroad. With this semester the student will be able either to broaden and/or to deepen his or her experience in a specific research area.

Students who complete the module:

Knowledge

- Have knowledge of the following areas: Instrumentation and physical performance as well as interplay between athlete and equipment
- Are able to reflect on this knowledge on a scientific basis

Skills

- Are able to critically apply scientific methods and tools to research within the chosen area of knowledge
- Are able to evaluate and to choose scientific theories and methods within the chosen area of research
- Are able to communicate problems, methods and results within the scientific area, in both oral and written form

Competences

- Are able to choose technologies, record, analyze and critically evaluate real and simulation results in relation to physical performance
- Are able to independently initiate or to perform collaboration within the discipline
- Are able to take responsibility for their own professional development.

Type of instruction: Project.

Exam format: Oral exam, assessment by 7-point scale, internal.

Title: Scientific methods and communication (Videnskabelige metoder og kommunikation)

Prerequisites: None

Objective: Students who complete the module:

Knowledge

- understand the scientific communication processes related to conference presentations and related to publishing in peer-reviewed scientific journals
- are able to organize a scientific publication
- have knowledge of qualitative and quantitative research methods
- have knowledge of experimental designs
- have knowledge of validity and reliability of outcome measures
- understand bias and statistical power in experimental designs
- understand principles of epidemiological research designs
- understand evidence-based medicine
- understand and can reflect on proper conduct in scientific projects
- understand and can reflect on ethical concerns in biomedical and sports sciences

Skills

- can explain the principles of hypothesis-driven research and descriptive research
- can critically read and judge experimental protocols in scientific articles
- can design an experimental protocol in relation to a scientific project
- can discuss principles for creating new and validated knowledge
- can explain the process of and criteria for peer reviewed scientific communications
- can discuss the importance of research ethics
- can write an abstract for a scientific meeting and can respond to blind peer-review criticism
- can prepare a poster and an oral presentation for a scientific meeting
- can apply biostatistics and have practical experience in statistical software
Competences

- can set up a plan for getting an overview of existing knowledge within a scientific/technical topic
- can prioritize the validity of various sources of scientific information
- can evaluate scientific presentations from a communicative viewpoint
- can judge the validity of scientific literature

Type of instruction: Lectures and exercises

The culmination of the course is a conference, to which each student group contributes:
1) An abstract will be submitted online after which the abstract will be reviewed by an anonymous researcher. The group has to respond to the reviewers' comments and change the abstract accordingly and resubmit it for publication in the conference program.
2) A poster, to be mounted and presented on the conference day.
3) A short oral presentation.

Exam format: Continuous evaluation, assessment by Passed/Not passed, internal.

Title: Master thesis

Prerequisites: All exams from semesters 1, 2 and 3 must be passed.

Objective: The Master Thesis is the last element of the scientific education, and thereby an opportunity to integrate and to deepen previously acquired skills and to display the ability to perform scientific work.

Students who complete the module:

Knowledge

- have knowledge of instrumentation and physical performance as well as interplay between athlete and equipment at the highest international level of research

- are able to reflect on this knowledge on a scientific basis

Skills

- are able to critically apply scientific methods and tools to research within the chosen area of knowledge

- are able to evaluate and to choose scientific theories and methods and to identify scientific problems within the chosen area of research

- are able to communicate problems, methods and results within the scientific area, in both oral and written form

Competences

- are able to choose technologies, record, analyze and critically evaluate real and simulation results in relation to physical performance

- are able to independently initiate and to perform collaboration within the discipline and interdisciplinary as well, and to take professional responsibility

- are able to independently take responsibility for his or her own professional development and specialization.

Type of instruction: Project, individual or as a group of two or three students cf. Framework Provisions.

Exam format: Oral exam, assessment by 7-point scale, external.

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of the Faculty of Medicine and enters into force as of 1 September 2010.

In accordance with the Framework Provisions and the Handbook on Quality Management for the Faculty of Engineering and Science and The Faculty of Medicine at Aalborg University, the curriculum must be revised no later than 5 years after its entry into force.

Chapter 5: Other Provisions

5.1 Rules concerning written work, including the Master’s thesis

In the assessment of all written work, regardless of the language it is written in, weight is also given to the student’s spelling and formulation ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are taken as a basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination can be assessed as ‘Passed’ on the basis of good language performance alone; similarly, an examination normally cannot be assessed as ‘Not passed’ on the basis of poor language performance alone.

The Board of Studies can grant exemption from this in special cases (e.g., dyslexia or a native language other than Danish).

The Master’s thesis must include an English summary.¹ If the project is written in English, the summary must be in Danish.² The summary must be at least 1 page and not more than 2 pages. The summary is included in the evaluation of the project as a whole.

5.2 Rules concerning credit transfer (merit), including the possibility for choice of modules that are part of another program at a university in Denmark or abroad

In the individual case, the Board of Studies can approve successfully completed (passed) program elements from other Master’s programs in lieu of program elements in this program (credit transfer). The Board of Studies can also approve successfully completed (passed) program elements from another Danish program or a program outside of Denmark at the same level in lieu of program elements within this curriculum. Decisions on credit transfer are made by the Board of Studies based on an academic assessment. See the Framework Provisions for the rules on credit transfer.

¹ Or another foreign language (upon approval from the Board of Studies).
² The Board of Studies can grant exemption from this.
5.3 Rules for examinations
The rules for examinations are stated in the Examination Policies and Procedures published by the Faculty of Engineering and Science on their website.

5.4 Exemption
In exceptional circumstances, the Board of Studies study can grant exemption from those parts of the curriculum that are not stipulated by law or ministerial order. Exemption regarding an examination applies to the immediate examination.

5.5 Completion of the Master's program
The Master’s program must be completed no later than four years after commencement.

5.6 Rules and requirements for the reading of texts
It is assumed that the student can read academic texts in his or her native language as well as in English and use reference works etc. in other European languages.

5.7 Additional information
The current version of the curriculum is published on the Board of Studies’ website, including more detailed information about the program, including exams.