AALBORG UNIVERSITET

Semester description for 1st semester, Master in Sports Technology, Autumn 2021

Semester details
Department for Health Science and Technology
Study board for Sport Science and Public Health
Curriculum for the Master´s programme in Sports Technology

Semester framework theme
This should include an elaborated description in a prose form of the focus of the semester, activities implemented to fulfil the competence objectives and the thematic(s) of the semester. In other words, the semester description includes the "framework theme" that the students will be exposed to during the semester. The role of the semester and its contribution to students' academic progression should also be described.

The theme of this semester is instrumentation and performance assessment in sports and exercise. The students will be provided with knowledge and skills about measurement techniques and their application in the field of sports technology. There are 4 compulsory courses which will cover the basic technologies used for performance measurements, fundamental information on data analysis and interpretation, 'Signal processing techniques' and 'modelling of human function' as indicated in the respective course descriptions. These courses will be mainly taught in the first two months of the semester coupled with practice and seminar sessions later in the semester. .

Semester organisation and time schedule
This must be a short description the of the different activities of the semester, their mutual connections and the way in which they support each other and also support students in reaching their goals; such activities may be study trips, internship periods, project modules course modules, including laboratory activities, cooperation with external stakeholders, possible cross-disciplinary cooperation relations, any guest lectures and other events.

All courses will comprise several activities in which lectures and practice tasks are combined. These practice units will include laboratory or applied demonstrations including data collection and analysis on small applications. Wherever relevant, more extensive laboratory sessions will be included which require more complex data analysis, e.g., with synchronized data collection from multiple systems. The analysis of these data and interpretation of results will be conducted in groups and be discussed in plenum together with the teachers to be presented at a final seminar session around halfway through the semester.
Due to the construct of learning outcomes in each of the courses, the students will experience that they use their gained knowledge and skills in more than one course. Even though this may seem overlapping content between the two courses, this overlap is deemed important for reinforcing the learning in providing the whole picture in applied scenarios. Nevertheless, the teaching curriculum is planned to minimize an unnecessary overlap between courses.
It is part of the project module to learn how to present results in a scientifically concise manner and to discuss these results within a broad background and to critically reflect on the implications of these results.

Semester coordinator and secretariat assistance
Names of anchor person (teaching staff), course coordinator, semester coordinator (or similar title) and secretariat assistance provider(s).

Semester coordinator: Afshin Samani, afsamani@hst.aau.dk, Department of Health, Science and Technology.
Semester secretary: Susanne Kragelund Hansen, skha@hst.aau.dk, Department of Health, Science and Technology.
Student representative: Check Moodle-site of this semester.

Module description (description of each module)

Module title, ECTS credits (and possibly STADS code)
Instrumentation and Physical Performance
10 ECTS project module

Location
Master, Sports Technology, 1st semester
Study Board for Sport Science and Public Health

Module coordinator
The academic staff member responsible for the organisation and execution of the module.
The module leader may be the same person as the semester coordinator. If a person responsible for exam is pointed out, please state name and e-mail address here.

Module coordinator: Afshin Samani, afsamani@hst.aau.dk, Department of Health, Science and Technology
Responsible for individual projects: the respective supervisor/co-supervisor.

Type and language
Module type (e.g. study subject module, course module, project module etc.)
Language of instruction.

Project module.
The project report (including in-depth worksheets) can be communicated in Danish or English language. Presenting the project results in form of a scientific article is supported however, it is not mandatory as the project is only a 10 ECTS module. the students are to consult with their supervisor regarding the scientific presentations. The supervisors and students are advised to discuss ways (lower number of required subjects in the project, facilitate the reporting of the results, etc.) how to adjust the workload in the project such that the students do not spend too much more time on the project than what is expected of a 10 ECTS project. In any case, it is not expected that the students do a very wide literature survey in their project.

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site.

From curriculum:

Students who complete this project module:

Viden

- Har viden om teknologier, der anvendes i forbindelse med idrætsudøvelse
- Kan redegøre for videnskabelige kommunikationsprocesser i forbindelse med præsentationer på videnskabelige konferencer
- Kan redegøre for processen og kriterierne for videnskabelig kommunikation med peer review

Færdigheder

- Kan identificere eller afgrænse en idrætsteknologisk problemstilling og italesætte denne
- Kan anvende relevante teknikker til analyse af bevægelse i forbindelse med fysisk præstationsevne
- Kan gennemføre biomekaniske eksperimenter og anvende processeringsmetoder med relation til fysisk præstationsevne
- Kan demonstrere evne til at kommunikere de vigtigste elementer i et forskningsprojekt gennem et skriftligt abstract til brug i videnskabelige sammenhænge
- Kan demonstrere anvendelse af ny idrætsteknologi
- Kan demonstrere evne til at strukturere en præsentation af ny videnskabelig viden på skrift og i tale

- Kan tilrettelægge og planlægge projektarbejde som en del af studiet, herunder anvende metoder til planlægning og organisering af projektarbejdet og evaluering af processen.

Kompetencer

- Kan evaluere valg af teknologiske metoder og idrætsteknologier i relation til en forskningsmæssig problemstilling
- Kan reflektere over, hvordan tidligere læring kan integreres i/med et konkret idrætsteknologisk projekt
- Kan identificere faktorer i det konkrete projekt, som påvirker den studerendes egen læring positivt og negativt

Academic content and conjunction with other modules/semesters
A brief and general description of the academic content of the module as well as the basis and motivation for the module; i.e. a brief review of the content and foundation of the module.
The intention is to provide students with an overview of each module and to create understanding of the module in relation to the semester and the entire programme.

The project module provides the students the opportunity to apply the knowledge and skills obtained in the course modules of this semester to a specific problem within the theme of this semester. What to apply depends on the project proposal and the choice of methods in the project work.
A project catalogue is provided in Moodle to inform the students about relevant problems to address within the scope of the project module learning objectives. The project supervisors are academic staff of the Department of Health Science and Technology and the Department of Materials and Production.

The project must be submitted in the form of an article with accompanying work sheets or a monograph written either in English or Danish. The article should meet the criteria for common scientific publications (check one of the relevant journals for details regarding format, word count, figures etc.). The additional work sheets should underpin and deepen elements of the article and cover other learnings from the module, not addressed in the article (see the section Dimensions). Even though the PBL learning outcomes should be addressed in supervisory meetings, no requirement on including a process analysis document together with the project delivery is imposed. The students should expect to be evaluated on PBL learning outcomes.

Scope and expected performance
The expected scope of the module in terms of ECTS load. This comprises number of teaching hours, exercises, preparation time, travel activity (if applicable) etc.

The ECTS load for this module is 10 ECTS, corresponding to appr. 300 hrs of work for each student. This includes all components of project work including supervisory meetings, reading, experimental work, data analysis, report writing, preparation of project presentation.
Estimated time consumption (the following times for individual components are estimates and only serve for orientation; in practice these times will depend on the type and character of the project, the group size and other factors):

- Project planning/experimental design (within groups)/supervisory meetings: 50 hrs
- Reading: 45 hrs
- Pilot testing: 30 hrs
- Data collection: 50 hrs
- Data analysis: 65 hrs
- Report writing: 40 hrs
- Exam preparation/exam: 20 hrs

Participants
Indication of the participants in the module, particularly if they include several year groups, programmes or another type of co-teaching.

All students enrolled in the Master program in Sports Technology.

Prerequisites for participation
Description of the prerequisites for students' participation in the course, i.e. previous modules/courses in other semesters etc. The overall intention is to emphasise the coherence of the programme. This may be a transcript of the text in the study regulations and curriculum.

Students should have a BSc degree in sports science, engineering or other related degrees; eligibility will be assessed by the study board prior to enrolment into the program.

Module activities (course sessions etc.)

The project module is conducted as a group work based on problem-based learning (http://www.aau.dk/digitalAssets/62/62747_pbl_aalborg_modellen.pdf).

A catalogue with project proposals will be published in Moodle approx. two weeks prior to semester start and presented by the semester coordinator on the first day of the semester. The proposals are made by the supervisors.
Students are expected to use the project catalogue for inspiration and to form groups. The process of group formation will be initiated on the first day of the semester and completed in a seminar organised during week two of the semester,
Thereafter, students will work as a group on outlining a project plan, select measurement methods, derive and apply methods for data analysis, compile the results to be presented in the project report and to critically discuss these findings and their implication in a bigger context. Part of the planning process is to book access to laboratories. More information is available in Moodle.
The conduction of this project will be based on and linked to the contents of the courses of this semester and feedback from a supervisor.

During the semester, a status seminar will be organised, where the students receive and provide feedback regarding their project works according to specific learning outcomes. Criteria will be published in Moodle.

Examination

The project exam is held according to ”Guide to group based project exams” as regards to the form. The examination is based on the learning outcomes from the curriculum and the interpretation in the semester description.

Further, the exam plan is available at https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/

Module description (description of each module)

Module title, ECTS credits (and possibly STADS code)
Applied Technology and Measurement Techniques in Sports
5 ECTS course module

Location
Master, Sports Technology, 1st semester
Study Board for Sport Science and Public Health

Module coordinator
The academic staff member responsible for the organisation and execution of the module.
The module leader may be the same person as the semester coordinator. If a person responsible for exam is pointed out, please state name and e-mail address here.

Afshin Samani, afsamani@hst.aau.dk, Department of Health Science and Technology

Type and language
Module type (e.g. study subject module, course module, project module etc.)
Language of instruction.

Course module. Instruction may be in English and Danish.

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site.

From curriculum:

Students who complete this module:

Knowledge
- Have knowledge about performance assessment methods used in sports
- Have knowledge about the general principles behind the sensors and transducers used to assess performance
- Have knowledge about the sources and magnitudes of error in relation to assessment methods
- Have knowledge about how technology has contributed to the development of sports
- Have knowledge about ethical implications of using or misusing technology in sport

Skills
- Can design an experimental protocol in regard to given research question or practical problem
- Can transfer series of raw data into meaningful quantities
- Can critically discuss the appropriate use of sport technology

Competences
- Can compare and critically evaluate measurement results on technical interventions
- Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society

Academic content and conjunction with other modules/semesters
A brief and general description of the academic content of the module as well as the basis and motivation for the module; i.e. a brief review of the content and foundation of the module.
The intention is to provide students with an overview of each module and to create understanding of the module in relation to the semester and the entire programme.

This course is intended as an introductory course to the sports technology program. It will provide an overview of relevant topic areas with particular focus on measurement technology ranging from standard laboratory techniques to applied mobile data sensor technology. The students will be confronted with a spectrum of applications for sports technology ranging from sports technology and performance to sports

technology and society. In parallel, measuring principles and data analysis techniques will be reviewed, applied and structured in a general context.

Scope and expected performance
The expected scope of the module in terms of ECTS load. This comprises number of teaching hours, exercises, preparation time, travel activity (if applicable) etc.

The ECTS load for this module is 5 ECTS, corresponding to 150 hrs of work. This includes contact hours, reading, solving of questions and tasks for practice parts of mini-modules as well as data analysis and presentation preparation for student-teacher seminars.

Estimated times for course components:
Confrontation/lectures & practice sessions: 35 hours
Preparation: 10 hours
Reading: 50 hrs
Data analysis and presentation preparation: 35 hours
Presentation & exam: 20 hours

Participants
Indication of the participants in the module, particularly if they include several year groups, programmes or another type of co-teaching.

Students in the course are from the first semester of the Sports Technology MSc program.

Prerequisites for participation
Description of the prerequisites for students' participation in the course, i.e. previous modules/courses in other semesters etc. The overall intention is to emphasise the coherence of the programme. This may be a transcript of the text in the study regulations and curriculum.

The module requires pre-qualifications corresponding to the curriculum in biomechanics at the BSc education in sports science.

Module activities (course sessions etc.)

Definition of activities

- **Lecture** – a 30-90 minutes presentation by teacher, potentially including small exercises or tasks to be solved in small groups
- **Student/teacher seminar** – a scheduled activity where students present a task or review on a specific topic where they discuss and receive feedback from fellow students and teachers
- **Laboratory demonstration/data collection in groups** – a practical session held in one of the laboratories to introduce the students to equipment and laboratory rules and to perform example data collections
- **Mini project** – a more comprehensive task or topic to prepare a presentation and short report on a predefined topic
- Case presentation- A journal club activity consisting of presenting the results of recently published articles within the field of sport technology
- **Data analysis** – block-period of data analysis to apply and practice the skills needed for project work; typically self study
- **Self study** – a period where the students are asked to review contents or work on a given subject area to gain or make sure to have the necessary prerequisites to be able to fulfil a planned task/section of the course; it is to the students choice and own responsibility if this is done individually or in groups.

The order of the course modules may be altered due to organisational constraints. For the most detailed and updated information about the content please have a look at the Moodle page at all times.

Activity - type and title	**Planned instructor***	**Learning goals from curriculum**
Lecture: Overview on sports technology and performance	Anderson Oliveira/ Afshin Samani / Uwe Kersting	Have knowledge about performance assessment methods used in sports

Mini project: Contribution of technology to advance of sport	Self study	Have knowledge about how technology has contributed to the development of sports
Student-teacher seminar : presentation of mini project	Afshin Samani/ Anderson Oliveira	Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society Have knowledge about ethical implications of using or misusing technology in sport
Lecture: Measurement chain: Sensors, Amplifiers, Filters (analogue) Processing, digital filters, etc. EMG - measurement and data treatment	Afshin Samani/Pascal Madeleine	Have knowledge about the general principles behind the sensors and transducers used to assess physical performance Have knowledge about the sources and magnitudes of error in relation to assessment methods
Lecture: Programming (data types (e.g. vectors, arrays), flow of data recording, flow control, functions and error handling)	Pascal Madeleine	Can load, save and transfer series of raw data into meaningful quantities Can critically discuss the appropriate use of sport technology
Laboratory demonstration/data collection in groups	Anderson Oliveira /Afshin Samani	Have knowledge about the general principles behind the sensors and transducers used to assess performance Have knowledge about the sources and magnitudes of error in relation to assessment methods
Data analysis: Work on the example data collected during lab demonstration	Self study – prepare report for assignment	Can transfer series of raw data into meaningful quantities
Student-teacher seminar: Data presentation using computer tools -I (this module is relevant for both compulsory courses in this semester)	Anderson Oliveira/Afshin Samani	Can transfer series of raw data into meaningful quantities Can compare and critically evaluate measurement results on technical interventions
Student-teacher seminar: Data presentation using computer tools - II (this module is relevant for both compulsory courses in this semester)	Anderson Oliveira/Afshin Samani	Can transfer series of raw data into meaningful quantities Can compare and critically evaluate measurement results on technical interventions
Lecture: Selected sport specific sensors and sensor applications	Afshin Samani	Have knowledge about the general principles behind the sensors and transducers used to assess performance Can critically discuss the appropriate use of sport technology Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society
Lecture/Seminar: Sports technology in societal and industrial contexts	John Rasmussen	Have knowledge about how technology has contributed to the development of sports Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society

		Have knowledge about ethical implications of using or misusing technology in sport
Case presnetaion: Report on recently published articles within sport technology	Afshin Samani	Can compare and critically evaluate measurement results on technical interventions Can critically discuss the appropriate use of sport technology Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society
Student/teacher seminar: Presentation of Mini project	Afshin Samani	Can evaluate sports technology findings in regard to their importance for individual athletes, the sport and the society Have knowledge about ethical implications of using or misusing technology in sport

Examination

The examination will be written in place with helping material (Skriftlig stedprøve med hjælpemidler)

Evaluation form: passed/not passed
Exam language: Danish (the questions may be formulated in English though)
Duration: 90 min
Form: Digital

Internet connection is not allowed except for ITX invigilation during the exam.

Course notes, computers (software packages like word, excel, powerpoint, MATLAB, python), calculator and any other aids of this sort are also allowed.

The students may expect to use a digital picture/sketch/figure in formulating their answers to the questions

Examiner resp. for exam: Afshin Samani
Internal assessor: Mark de Zee/ Anderson Oliveira

The exam is a written exam where the questions will be related to any of the activities performed in this course (listed above). Within this exam task all three types learning objectives will be covered by starting with one or two questions on the background on one or two specific measurement techniques ('knowledge') and, in a second part, two more general questions on potential applications and societal impact (skills) and perspectives for practical use including limitations and contextual reflections (competencies).
It is expected that students write down their answers in a concise way and avoid lingering. The students may need to use some formula, sketch a conceptual figure to illustrate or graphically exhibit their argumentation/track of thought. In some cases, the students may be asked to demonstrate simple formula in biomechanics and/or other relevant topics in this course.

Further, please refer to the exam plan at https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/

Module description (description of each module)

Module title, ECTS credits
Movement Analysis
5 ECTS course module

Location
Master, Sports Technology, 1st semester
Study Board for Sport Science and Public Health

Module coordinator
The academic staff member responsible for the organisation and execution of the module.
The module leader may be the same person as the semester coordinator. If a person responsible for exam is pointed out, please state name and e-mail address here.

Mark de Zee, mdz@hst.aau.dk, Department of Health Science and Technology.

Type and language
Module type (e.g. study subject module, course module, project module etc.)
Language of instruction.

Course module. Instruction may be in English and Danish.

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum.

From curriculum:

Students who complete this module:

Knowledge
- Have knowledge about the methods used to assess movement on humans
- Have knowledge about the methods used to assess movement on humans
- Have knowledge about the general principles of sensor-based motion capture equipment
- Have an overview on applications of movement analysis

Skills
- Can design, plan and prepare a motion capture session using an optical system
- Can compare different technological solutions to motion capture in regard to minimal requirements and error sources
- Can collect and analyse data from motion capture systems by applying general tracking and data filtering techniques
- Can prepare raw data for further data analysis in modelling software

Competences
- Can critically evaluate the limitations of motion capture data and the possible effects of these limitations on analysis results
- Can integrate motion capture analyses with other movement related data (e.g., force and electromyography) and interpret these results within the context of the research problem

Academic content and conjunction with other modules/semesters
A brief and general description of the academic content of the module as well as the basis and motivation for the module; i.e. a brief review of the content and foundation of the module.
The intention is to provide students with an overview of each module and to create understanding of the module in relation to the semester and the entire programme.

Movement analysis is one of the core topics in sports technology as the effect of technology on human body mechanics implies the use of such technology. Further, it is a technology having a great market value which

has been driven by the demands of sports and sports researchers. In particular, it provides the foundation for collecting input data for modelling.

Scope and expected performance
The expected scope of the module in terms of ECTS load. This comprises number of teaching hours, exercises, preparation time, travel activity (if applicable) etc.

The ECTS load for this module is 5 ECTS, corresponding to appr. 150 hrs of work for each student. This includes contact hours, reading, solving of questions and tasks for practice parts of mini-modules as well as data analysis and presentation preparation for student-teacher seminars.

Estimated times for course components:
Confrontation/lectures & practice sessions: 35 hours
Preparation: 10 hours
Reading: 50 hours
Data analysis and presentation preparation: 35 hours
Presentation, exam preparation and exam: 20 hours

Participants
Indication of the participants in the module, particularly if they include several year groups, programmes or another type of co-teaching.

Students in the course are from the first semester of the Sports Technology MSc program.

Prerequisites for participation
Description of the prerequisites for students' participation in the course, i.e. previous modules/courses in other semesters etc. The overall intention is to emphasise the coherence of the programme. This may be a transcript of the text in the study regulations and curriculum.

The module requires pre-qualifications corresponding to the curriculum in biomechanics at the BSc education in sports science.

Module activities (course sessions etc.)

Definition of activities

- **Lecture** – a 30-90 minutes presentation by teacher, potentially including small exercises or tasks to be solved in small groups
- **Student/teacher seminar** – a scheduled activity where students present a task or review on a specific topic where they discuss and receive feedback from fellow students and teachers
- **Laboratory demonstration/data collection in groups** – a practical session held in one of the laboratories to introduce the students to equipment and laboratory rules and to perform example data collections
- **Mini project** – a more comprehensive task or topic to prepare a presentation and short report on a predefined topic
- **Self study** – a period where the students are asked to review contents or work on a given subject area to gain or make sure to have the necessary prerequisites to be able to fulfil a planned task/section of the course; it is to the students choice and own responsibility if this is done individually or in groups.
- **Data analysis** – block-period of data analysis to apply and practice the skills needed for project work; typically self study

The order of the course modules may be altered due to organisational constraints. For the most detailed and updated information about the content please have a look at the Moodle page at all times.

Activity - type and title	**Planned instructor***	**Learning goals from curriculum**
Lecture: Overview of the field and the rest of the course	Mark de Zee	Have knowledge about the methods used to assess movement on humans Have knowledge about the methods used to assess movement on humans

		Have knowledge about the general principles of sensor-based motion capture equipment
Self study: Repetition of basic biomechanics		Have an overview on applications of movement analysis Can prepare raw data for further data analysis in modelling software
Student/teacher seminar: Repetition of basic biomechanics	Mark de Zee	Have an overview on applications of movement analysis Can prepare raw data for further data analysis in modelling software
Lecture: Intro in Motion capture based on optical systems (passive markers, active markers, markerless) and force plates	Uwe Kersting/Anderson Oliveira	Have knowledge about the general principles of optical motion capture systems
Lab demo Qualisys system + data collection	Mark de Zee /Anderson Oliveira	Have knowledge about basic methods of image analysis and data reduction Can collect and analyse data from motion capture systems by applying general tracking and data filtering techniques Can prepare raw data for further data analysis in modelling software
Lecture: Intro to motion capture based on intertial sensors + lab demo	Mark de Zee/Anderson Oliveira	Have knowledge about the general principles of sensor-based motion capture equipment Have an overview on applications of movement analysis
Data collection in groups – practical laboratory guidelines	Self study (Mark de Zee/Anderson Oliveira)	Can collect and analyse data from motion capture systems by applying general tracking and data filtering techniques Can prepare raw data for further data analysis in modelling software
Student-teacher seminar: Data presentation using computer tools -I (this module is relevant for both compulsory courses in this semester)	Anderson Oliveira	Can transfer series of raw data into meaningful quantities Can compare and critically evaluate measurement results on technical interventions
Student-teacher seminar: Data presentation using computer tools - II (this module is relevant for both compulsory courses in this semester)	Anderson Oliveira	Can transfer series of raw data into meaningful quantities Can compare and critically evaluate measurement results on technical interventions
Lecture: Kinematic models and data processing Introduction to the assignment.	Mark de Zee	Have knowledge about the methods used to assess movement on humans Have an overview on applications of movement analysis
Lecture: Classical Inverse dynamics plus intro forward dynamics	John Rasmussen	Have knowledge about the methods used to assess movement on humans
Self study: 2D inverse dynamics in MatLab	Self study in groups	Can integrate motion capture analyses with other movement related data (e.g., force and electromyography) and interpret these results within the context of the research problem
Lecture: Data Interpretation - output parameters	Uwe Kersting/Anderson Oliveira	Have knowledge about the methods used to assess movement on humans

and energetic calculations		Can integrate motion capture analyses with other movement related data (e.g., force and electromyography) and interpret these results within the context of the research problem
Student teacher seminar: Further 2D processing in MatLab	Mark de Zee / Anderson Oliveira	Can design, plan and prepare a motion capture session using an optical system Can compare different technological solutions to motion capture in regard to minimal requirements and error sources

Examination

Exam type: individual oral.
The students have the opportunity to hand in a mini project report about the 2D inverse dynamics assignment in MatLab. The student must hand in the report for review before a deadline announced in the course in digital exam. If a mini project report is handed in, the examination will be a discussion particular related to the work presented in the report and also the learning objectives in general. Note that the exam questions will not be about MatLab, but about the theory behind your calculations. In the absence of a mini project report, the student will be examined in randomly chosen learning objectives.

Evaluation form: Passed/not passed
Examiner resp. for exam: Mark de Zee
Internal assessor: probably Uwe Kersting and/or /Anderson Oliveira

The student identification card must be presented.

Additional information:
Notes, computers and other aids are allowed.
20 minutes examination – no time for preparation.

Further, please refer to the exam plan at https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/

Module description (description of each module)

Module title, ECTS credits (and possibly STADS code)
Modelling of Human Function
5 ECTS course module

Location
Master, Sports Technology, 1st semester
Study Board for Sport Science and Public Health

Module coordinator
The academic staff member responsible for the organisation and execution of the module.
The module leader may be the same person as the semester coordinator. If a person responsible for exam is pointed out, please state name and e-mail address here.

John Rasmussen, jr@mp.aau.dk, Department of Materials and Production.

Type and language
Module type (e.g. study subject module, course module, project module etc.)
Language of instruction.

Course module. Instruction may be in English and Danish.

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site.

From curriculum:

Students who complete this module:

Knowledge
- Have knowledge about simulation methods useful in sports
- Have knowledge about the assumptions and limitations of the methods
- Have knowledge about the connection between the model and the anatomic/physiological reality
- Can explain the general principles of modelling, simulation, verification and validation
- Can explain how the human body and its interaction with the surroundings can be analysed by means of modelling and simulation technology

Skills
- Can apply musculoskeletal modelling techniques on problems within Sports Science
- Can apply kinematic data as input to musculoskeletal models (e.g. motion capture data)
- Can apply experimental model validation techniques

Competences
- Can analyse a given sports technology problem to select appropriate simulation methods and tools
- Can critically evaluate simulation results

Academic content and conjunction with other modules/semesters
A brief and general description of the academic content of the module as well as the basis and motivation for the module; i.e. a brief review of the content and foundation of the module.
The intention is to provide students with an overview of each module and to create understanding of the module in relation to the semester and the entire programme.

This course focuses on rigid body dynamics and its applications for kinesiology, muscle modeling and performance techniques. Modelling of human function is central to the semester's focus on the athlete and also leads up to courses in subsequent semesters about simulation of the behavior of products and their interaction with the athlete.

Scope and expected performance
The expected scope of the module in terms of ECTS load. This comprises number of teaching hours, exercises, preparation time, travel activity (if applicable) etc.

The ECTS load for this module is 5 ECTS, corresponding to appr. 150 hrs of work for each student. This includes contact hours, reading, solving of questions and tasks for practice parts of mini-modules as well as data analysis and presentation preparation for student-teacher seminars.

Estimated times for course components:
Confrontation/lectures & practice sessions: 35 hours
Preparation: 10 hours
Reading: 50 hours
Data analysis and presentation preparation: 35 hours
Presentation, exam preparation and exam: 20 hours

Participants
Indication of the participants in the module, particularly if they include several year groups, programmes or another type of co-teaching.

Participants in the course are from the first semester of the Sports Technology MSc program.

Prerequisites for participation
Description of the prerequisites for students' participation in the course, i.e. previous modules/courses in other semesters etc. The overall intention is to emphasise the coherence of the programme. This may be a transcript of the text in the study regulations and curriculum.

The module requires pre-qualifications corresponding to the curriculum in biomechanics at the BSc education in sports science.

Module activities (course sessions etc.)

Definition of activities

- **Lecture** – a 30-90 minutes presentation by teacher, potentially including small exercises or tasks to be solved in small groups
- **Self Study** – Students study a topic as individual homework or in study groups without direct assistance from the teachers
- **Student/teacher seminar** – a scheduled activity where students present a task or review on a specific topic where they discuss and receive feedback from fellow students and teachers
- **Assisted group study** – block-period of data analysis to apply and practice the skills needed for project work; self study with assistance by teachers

The order of the course modules may be altered due to organisational constraints. For the most detailed and updated information about the content please have a look at the Moodle page for the course.

Activity - type and title	**Planned instructor***	**Learning goals from curriculum**
Self study of scientific publications in the field	John Rasmussen/ Mark de Zee	Have knowledge about simulation methods useful in sports Have knowledge about the assumptions and limitations of the methods Can explain how the human body and its interaction with the surroundings can be analysed by means of modelling and simulation technology
Student/teacher seminar	John Rasmussen/ Mark de Zee	Can explain general principles of modelling, simulation, verification and validation. Can analyse a given sports technology problem to select appropriate simulation methods and tools
Lecture: Introduction to AnyBody	John Rasmussen/ Mark de Zee	Can apply musculoskeletal modelling techniques on problems within Sports Science. Have knowledge about the connection between the model and the anatomic/physiological reality

Self study: Modeling tutorials	John Rasmussen/ Mark de Zee	Can apply musculoskeletal modelling techniques on problems within Sports Science.
Student/teacher seminar: Human modelling workshop	John Rasmussen/ Mark de Zee	Can apply musculoskeletal modelling techniques on problems within Sports Science.
Lecture: Motion capture data processing	John Rasmussen/ Mark de Zee	Can apply kinematic data as input to musculoskeletal models (e.g. motion capture data)
Self-study: Introduction to multi body biomechanics	John Rasmussen/ Mark de Zee	Have knowledge about the assumptions and limitations of the methods.
Lecture: Verification and validation	John Rasmussen/ Mark de Zee	Can explain the general principles of modelling, simulation, verification and validation. Can apply experimental model validation techniques.
Lecture: Advanced geometrical body modeling tools: 3D scanning, medical imaging, geometrical modeling, morphing.	John Rasmussen / Mark de Zee	Have knowledge about a variety of simulation methods useful in sports
Self study: Scan and geometrically model a body part	John Rasmussen / Mark de Zee	Can apply kinematic data as input to musculoskeletal models (e.g. motion capture data)
Self study: Develop a model of human function, possibly related to the study project	John Rasmussen / Mark de Zee	Have knowledge about a variety of simulation methods useful in sports. Can explain the general principles of modelling, simulation, verification and validation.
Student/Teacher seminar: Presentation of models and results	John Rasmussen/ Mark de Zee	Can analyse a given sports technology problem to select appropriate simulation methods and tools Can critically evaluate simulation results
Assisted group study: Estimation of muscle forces from motion capture data	John Rasmussen/ Mark de Zee	Can apply musculoskeletal modelling techniques on problems within Sports Science. Can apply kinematic data as input to musculoskeletal models (e.g. motion capture data).

Examination

Exam type: individual oral. Oral examination is chosen because many learning goals are related to assessment of different simulations technologies, and such assessments are too laborious to describe in writing.
The students have the opportunity to hand in a mini project report based on the models they develop in the latter part of the course. The student must hand in the report for review before a deadline announced in the course. If a mini project report is handed in, the examination will the split into two parts, one of which is discussion related to the work presented in the report and another which is discussion of a topic related to the learning objectives randomly chosen.
In the absence of a mini project report, the student will be examined in randomly chosen learning objectives.

Evaluation form: Passed/not passed
Examiner resp. for exam: John Rasmussen
Internal assessor: Mark de Zee

The student identification card must be presented

Additional information:
Notes, computers and other aids are allowed.
20 minutes examination – no time for preparation.

Further, please refer to the exam plan at https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/

Module description (description of each module)

Module title, ECTS credits (and possibly STADS code)
Digital Processing of Biomechanical Signals
5 ECTS course module

Location
Master, Sports Technology, 1st semester
Study Board for Sport Science and Public Health

Module coordinator
The academic staff member responsible for the organisation and execution of the module.
The module leader may be the same person as the semester coordinator. If a person responsible for exam is pointed out, please state name and e-mail address here.

Pascal Madeleine, pm@hst.aau.dk, Department of Health Science and Technology.

Type and language
Module type (e.g. study subject module, course module, project module etc.)
Language of instruction.

Course module. Instruction may be in English and Danish.

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site.

From curriculum:

Students who complete this module:

Knowledge
- Have knowledge of a high level programming language
- Have knowledge about the basics of programming including data types, flow control, functions and error handling
- Have knowledge about mathematical functions used to solve sports technology problems with focus on data mining
- Have knowledge of the concepts, theories and techniques for estimating parameters of discrete stochastic processes
- Have knowledge of power spectral analysis of stationary stochastic processes and their limitations

Skills
- Can develop, debug and test a computer program (e.g. MatLab) that enables processing of measurement data
- Can export the developed programs to other platforms
- Can extract relevant data from discrete biomechanical signals and large dataset

Competences
- Can evaluate the consequences of different signal processing methods
- Can compare different signal processing methods

Academic content and conjunction with other modules/semesters
A brief and general description of the academic content of the module as well as the basis and motivation for the module; i.e. a brief review of the content and foundation of the module.
The intention is to provide students with an overview of each module and to create understanding of the module in relation to the semester and the entire programme.

This course focuses on digital processing of biomechanical signals and its applications in relation to the assessment of performance in sports. The use of pertinent digital techniques is central to the semester's

focus on the analysis and assessment of human performance and also leads up to courses in movement analysis and subsequent semesters, i.e., embedded or mobile systems and their applications in sports.

Scope and expected performance
The expected scope of the module in terms of ECTS load. This comprises number of teaching hours, exercises, preparation time, travel activity (if applicable) etc.

The ECTS load for this module is 5 ECTS, corresponding to appr. 150 hrs of work for each student. This includes contact hours, reading, solving of questions and tasks for practice parts of mini-modules as well as data analysis and presentation preparation for student-teacher seminars.

Estimated times for course components:
Confrontation/lectures, support & practice sessions: 30 hours
Preparation: 30 hours
Reading: 30 hrs
Data processing and presentation preparation: 40 hours
Presentation, exam preparation and exam: 20 hours

Participants
Indication of the participants in the module, particularly if they include several year groups, programmes or another type of co-teaching.

Participants in the course are from the first semester of the Sports Technology MSc program.

Prerequisites for participation
Description of the prerequisites for students' participation in the course, i.e. previous modules/courses in other semesters etc. The overall intention is to emphasise the coherence of the programme. This may be a transcript of the text in the study regulations and curriculum.

The module requires pre-qualifications corresponding to the curriculum in biomechanics at the BSc education in sports science.

Module activities (course sessions etc.)

Definition of activities

- **Lecture** – a 30-90 minutes presentation by teacher, potentially including small exercises or tasks to be solved in small groups
- **Student/teacher seminar** – a scheduled activity where students present a task or review on a specific topic where they discuss and receive feedback from fellow students and teachers

The order of the course modules may be altered due to organisational constraints. For the most detailed and updated information about the content please have a look at the Moodle page at all times.

Activity - type and title	**Planned instructor***	**Learning goals from curriculum**
Lecture: Overview of the field and Introduction to a high level programming language (Matlab)	Pascal Madeleine	Knowledge about signal processing methods useful in sports and basic data processing. Handing relevant examples to sport technology in MATLAB
Lecture: Programming (data types (e.g. vectors, arrays), flow of data recording, flow control, functions and error handling)	Pascal Madeleine	Knowledge about the basics of programming including data types, flow of data recording, flow control, functions and error handling, debugging
Lecture: Time and frequency analyses.	Afshin Samani	Knowledge about Nyquist signal sampling theorem, time and frequency analyses. Methods for estimation of power spectrum, Implementation of theoretical knowledge in MATLAB and applied examples in the field of sport technology

Lecture: System response and filter design	Afshin Samani	Knowledge about the system impulse response, transfer function, filter types (i.e. infinite impulse response, finite impulse response) Designing filters in MATLAB and applied examples in the field of sport technology
Student/teacher seminar	Pascal Madeleine/Afshin Samani	Develop, test and explain programs based on mathematical functions in relation to sports technology
Student/teacher seminar	Pascal Madeleine/Afshin Samani	Develop, test and explain programs based on mathematical functions used for time and frequency analyses. The programs have to be made in relation to sports technology

Examination

The examination will be written in place with helping material (Skriftlig stedprøve med hjælpemidler). Written examination is chosen because learning goals are related to digital signal processing of biomechanical signals and because the students are required to test, explain and eventually debug software programs. Further, this examination form ensures that the students are evaluated on the same set of exercises.

Evaluation form: Passed/not passed
Exam language: Danish (the questions may be formulated in English though)
Duration: 90 min
Format: Digital

Internet connection is not allowed except for ITX invigilation during the exam

Course notes, computers (software packages like word, excel, powerpoint, MATLAB, python), calculator and any other aids of this sort are also allowed.

The students may expect to use a MATLAB and word to process and formulate their answers to the questions

Examiner resp. for exam: Pascal Madeleine

Internal assessor: Afshin Samani

The exam is a written exam where the questions will be related to the activities performed in this course (listed above). Within this exam task all three types learning objectives will be covered by starting with one or two questions on the background on one or two specific measurement techniques ('knowledge') and, in a second part, two more general questions on potential applications and societal impact (skills) and perspectives for practical use including limitations and contextual reflections (competencies).

Further, please refer to the exam plan at https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.