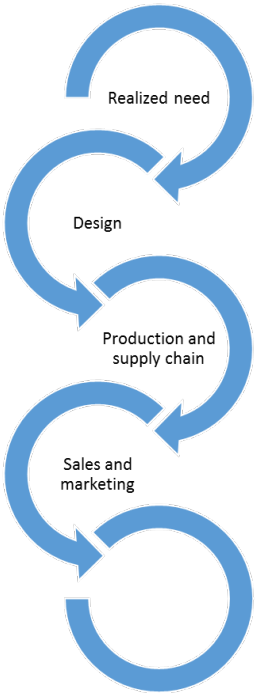
AALBORG UNIVERSITET

Semesterbeskrivelse for 2. semester bachelor/kandidat Idrætsteknologi – forår 2020

Oplysninger om semesteret
Institut for Medicin og Sundhedsteknologi
Studienævnet for Sundhed, Teknologi og Idræt
Studieordning for Idrætsteknologi

Semesterets temaramme
Herunder en mere udfoldet redegørelse i prosaform for semesterets fokus, arbejdet med at indfri lærings- og kompetencemål og den eller de tematikker, der arbejdes med på semesteret. Semesterbeskrivelsen rummer altså den "temaramme", som de studerende arbejder under, og endvidere beskrives semesterets rolle og bidrag til den faglige progression.



The focus is on sports equipment, innovation and products. The semester progresses the athlete-focus of the first semester to sports products used by the athlete. "Product" should be understood in a broad sense and can be tangible products like shoes or rackets, or it can be software and services such as play analysis tools or GPS tracking. Relevant products can target athletes in their direct performance or enhance human performance in other senses, for instance as rehabilitation products or even medical devices or devices for research into sports science.

The understanding of a "product" pertains to its lifecycle from conception over design to manufacture and sales. This means that the semester views products in a technical context as well as from a business and entrepreneurship perspective as illustrated in the figure to the right.

The reality of sports product companies in the Western world is that they must outsource production to low-cost countries while retaining the engineering close to the market of the products. This creates a need for technical engineering skills, product documentation skills, testing skills and the ability to manage very long supply chains.

The modules of the semester reflect this broad view of products in presenting methods for technical analysis and design and for life cycle management, i.e. computer-aided design, computer-aided engineering and products with merged technologies such as mobile electronic devices. Projects are typically inspired by real-life product trends and often in cooperation with the sports equipment or rehabilitation industry.

Semesterets organisering og forløb
Kortfattet beskrivelse af hvordan de forskellige aktiviteter på semesteret (såsom studieture, praktik, projektmoduler, kursusmoduler, herunder laboratoriearbejde, samarbejde med eksterne virksomheder, muligheder for tværfaglige samarbejdsrelationer, eventuelt gæsteforelæsere og andre arrangementer med videre) indbyrdes hænger sammen og understøtter hinanden samt den studerende i at nå semesterets kompetencemål.

Definitions of course activities
Lecture – a 30-90 minutes presentation by teacher
Workshop/Exercise – a scheduled activity allowing students to solve and discuss problems in small groups with the option of feedback from teachers
Discussion – a scheduled time-slot for discussion of specific subjects among students and teacher(s)
Student presentation – short presentations prepared by students typically presenting how they have solved a specific problem
Problem solving – students solve problems defined by the teacher and related to a subject
Self-Study – Student is responsible for reading up on a selected topic of interest that is not covered during lectures that will assist them in their case presentations.
Case exercises – Question-driven discussions and evaluation of content for selected readings, including

journal articles and patient case examples.
Case presentations – Presentation of a journal article or patient case example
Seminar – skemalagt studieaktivitet, hvor studerende præsenterer den opgave, de er i gang med, med henblik på feedback fra undervisere og medstuderende

A catalogue of project proposals is collected from potential supervisors by the semester coordinator prior to the beginning of the semester. This catalogue is published in the semester room on Moodle and is presented to the students in an introductory meeting in the beginning of the semester. Proposers of projects are invited to perform an oral presentation if they wish. Students subsequently have the opportunity to select projects and supervisors. Students are also welcome to propose their own projects; it is then the responsibility of the student group with assistance from the semester coordinator to find a supervisor, who will take on the project. In case this fails, the students are requested to select a proposal from the catalogue.

The courses support the project work and the general theme of the semester. Courses cover relevant tools and technologies for sports product development as well as production processes and supply chain management. This means that the course activities span widely. All courses have an element of lectures but also contain significant self-study, exercises with software tools, mini projects, laboratory work and theoretical assignments. Scheduling aims to concentrate courses as much as possible in the beginning of the semester, but limitations exist because some courses are progressions of others.

Two courses are mandatory, i.e. “Mechanics of Materials” and “Manufacturing Processes”. In addition, the students must choose one of two elective courses, namely “Numerical Methods” (focusing mainly upon CAD and finite element analysis) and “Embedded/mobile Systems and Their Applications in Sports”.

Semesterkoordinator og sekretariatsdækning
Angivelse af ankerlærer, fagkoordinator, semesterkoordinator (eller tilsvarende titel) og sekretariatsdækning

Semester coordinator: John Rasmussen, jr@mp.aau.dk, Department of Materials and Production
Semester secretary: Berit Lund Sørensen, blc@hst.aau.dk, Department of Health Science and Technology
Student representative: Please check semester details on Moodle.

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse
Interplay Between Athlete and Equipment / Samspil mellem idrætsudøver og udstyr
15 ECTS project module

Placering
Master, Sports Technology, 2nd semester
Study board for Health, Technology and Sports Science

Modulansvarlig
Angivelse af den ansvarlige fagperson for modulets tilrettelæggelse og afvikling. Den modulansvarlige kan være identisk med semesterkoordinatoren. Såfremt der udpeges en eksamensansvarlig nævnes vedkommende her.

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

Type og sprog
Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.
Angivelse af sprog.

Project module, Language of instruction is Danish or English depending on the participants. In the presence of non-Danish-speaking members of a project group, the project report is written in English. The report can take the form of either a monograph or a scientific paper with additional work sheets.

Mål
Kursets indhold og målsætninger beskrives i forhold til, hvad den studerende skal lære i forbindelse med modulet. Dette indbefatter gengivelse af studieordningens beskrivelse af viden, færdigheder og kompetencer. Der kan suppleres med kortfattet beskrivelse/uddybning af den metodiske, praktiske viden og kunnen, som den studerende opnår. Der kan evt. henvises til uddybninger på Moodle og/eller pensumbeskrivelser på studienævnets hjemmeside (gældende for MedIS og Medicin).

Fra Studieordningen:

Students who complete this project module:

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

Skills
- Can apply the theory of mechanics of materials on sports equipment
- Can apply an appropriate numerical method for a given case or can apply an embedded technology in relation to sports
- Can analyze the function of a sports product in connection with the human body
- Can demonstrate the ability to qualitatively assess production costs

Competences
- Can analyze the needs of an athlete and the added value of a sports product (e.g. enhanced performance, added comfort, minimized injuries)
- Can discuss about sports products (e.g. design, quality, costs) with relevant professionals in science or industry (e.g. engineers, product analysis specialists, equipment producers)

Fagindhold og sammenhæng med øvrige moduler/semestre
Herunder beskrives det kort og generelt, hvad modulets faglige indhold består i, samt hvad baggrunden og motivationen for modulet er, hvilket vil sige en kort redegørelse for modulets indhold og berettigelse. Hensigten er at skabe indsigt i det enkelte modul for den studerende og at skabe mulighed for at forstå modulet i forhold til det øvrige semester og uddannelsen som helhed.

Compared with previous project modules in the Sports Science BSc education and the previous Sports Technology semester, the academic content of the typical project on this semester follows a more analytical and engineering-oriented paradigm. The project can contain collection of empirical data and execution of experiments with humans, but it is more usual that the main contents of the work is focused on development and models of – and experiments with materials, devices, software and other artefacts.

Omfang og forventet arbejdsindsats
Forventninger om den konkrete udmøntning af modulets ECTS-belastning, hvilket omfatter antallet af konfrontationstimer, øvelsesarbejde, tid til forberedelse, eventuel rejseaktivitet med videre.

The expected student work load is 15 ECTS corresponding to 450 hours of work per student. This includes all components of project work including supervisory meetings, reading, experimental work, data analysis, report writing, preparation of the exam. The division of work into different activities depends somewhat on the nature of the project.

Deltagere
Her angives deltagerne i modulet, det vil sige først og fremmest en angivelse af deltagere, hvis der er flere årgange/retninger/samlæsning. Hvis der er tale om valgfag, angives den/de pågældende studieretning(er).

Participants are students of the second semester Sports Technology MSc programme. Student groups have the opportunity to establish cooperation with students on other educations, for instance through the interdisciplinary AAUracing racing project (http://aauracing.dk/).

Group sizes should be 4-6 persons in accordance with the guidelines from the study board.

Deltagerforudsætninger
Herunder beskrives den studerendes forudsætninger for at deltage i kurset, det vil sige eksempelvis tidligere moduler/kurser på andre semestre etc. Beskrivelsen er overvejende beregnet på at fremhæve sammenhængen på uddannelsen. Dette kan eventuelt være i form af en gengivelse af studieordningsteksten.

Students of this module must be familiar with the body-oriented scientific approaches covered by the first semester of the Sports Technology programme and the BSc programme in Sports Science. The engineering and science focus of the project module makes knowledge of the bachelor education's biomechanics classes particularly important.

Modulaktiviteter

This module is a group project, which is to be carried out according to the 'Aalborg Model' of problem-based learning (http://www.aau.dk/digitalAssets/62/62747_pbl_aalborg_modellen.pdf).

Supervisors for this project module are primarily recruited from the Department of Materials and Production (MP) and from the Department of Health Science and Technology (HST).

Students are expected to coordinate the work as a team in close collaboration with their project supervisor and to cooperate on outlining and executing a project plan. This involves activities such as selection of investigation methods, derivation and application of methods for data analysis, compilation and presentation of the results, and discussion of the findings and their implications in a bigger context. Students working with external business partners have a special obligation to review the problem and its possible solutions in the context of the business.

Eksamen

Project exams are held according to Vejledning for projekteksamen på SUND as to the form. The content is based on the learning objectives from the curriculum and the interpretation of those in the semester description.

Further information including exam dates is available at the exam web page: https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse
Mechanics of Materials / Styrkelære
5 ECTS course module

Placering
Master, Sports Technology, 2nd semester
Study board for Health, Technology and Sports Science

Modulansvarlig
Angivelse af den ansvarlige fagperson for modulets tilrettelæggelse og afvikling. Den modulansvarlige kan være identisk med semesterkoordinatoren. Såfremt der udpeges en eksamensansvarlig nævnes vedkommende her.

Jørgen Asbøll Kepler, jk@mp.aau.dk, Department of Materials and Production.

Type og sprog
Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.
Angivelse af sprog.

Course Module (English)
The study plan is laid out as a mix of lectures and student work, the purpose of which is to enable the students to learn individually and in groups with frequent teacher confrontation opportunities.
Fourteen lectures are organized as full morning or afternoon sessions, primarily arranged as a 2 x 45 minutes' theoretical lecture sessions with examples followed by a 2 x 45 minutes student assignment sessions with teacher assistance. Notice that deviations from this template may occur. It is very important that the students are well-prepared for all lectures, spending 1-2 hours in preparation.

Mål
Kursets indhold og målsætninger beskrives i forhold til, hvad den studerende skal lære i forbindelse med modulet. Dette indbefatter gengivelse af studieordningens beskrivelse af viden, færdigheder og kompetencer. Der kan suppleres med kortfattet beskrivelse/uddybning af den metodiske, praktiske viden og kunnen, som den studerende opnår. Der kan evt. henvises til uddybninger på Moodle og/eller pensumbeskrivelser på studienævnets hjemmeside (gældende for MedIS og Medicin).

Fra Studieordningen:

Knowledge
- Have knowledge about stress-strain relationships of different kind of materials (e.g. metals, textile, biological tissues)
- Have knowledge about the tensorial nature and interdependence of stresses and strains
- Have knowledge about 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)
- Have knowledge about the fact that different failure models exist depending on the choice of material and stress multi-axiality
- Have knowledge about the distinction between static loading, time varying (repeated) loading, and impact loading

Skills
- Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure
- Can assess primary criteria for choices of structural layout and material (e.g. maximum load, permissible deformation, energy absorption)
- Can assess the number of loading cycles to failure for comparison with endurance curves

Competences
- Are able to evaluate combined structures through discretization into elementary structural types (beams, rods, columns etc.)

Can conduct a qualified dialogue with engineers on the material of sports products

Fagindhold og sammenhæng med øvrige moduler/semestre
Herunder beskrives det kort og generelt, hvad modulets faglige indhold består i, samt hvad baggrunden og motivationen for modulet er, hvilket vil sige en kort redegørelse for modulets indhold og berettigelse. Hensigten er at skabe indsigt i det enkelte modul for den studerende og at skabe mulighed for at forstå modulet i forhold til det øvrige semester og uddannelsen som helhed.

Mechanics of materials is the discipline through which structural geometry, load state and material parameters are connected to form a quantifiable basis of evaluation of a given mechanical component. Generally, the aim is to predict the deformation state, whereupon strains and stresses may be derived and compared with acceptable values.
The course will review and build upon certain previously lectured topics on (bio-)mechanics, aiming to apply these to specific design problems of a non-trivial nature. Furthermore, the course will introduce several new topics, e.g., multiaxial stress, stress concentrations, repeated loading, and failure criteria. Several of these topics are fundamental to the course on Numerical Methods.

Omfang og forventet arbejdsindsats
Forventninger om den konkrete udmøntning af modulets ECTS-belastning, hvilket omfatter antallet af konfrontationstimer, øvelsesarbejde, tid til forberedelse, eventuel rejseaktivitet med videre.

A 5 ECTS course represents an *average* student workload of 150 hours. A *rough* estimate of the workload distribution is as follows:

- Active participation in 14 lectures = 56 hours.
- Thorough preparation for the 14 lectures = 28 hours
- Subsequent processing of the 10 lectures = 14 hours.
- Subsequent home study and exam preparations = 52 hours.

Deltagere
Her angives deltagerne i modulet, det vil sige først og fremmest en angivelse af deltagere, hvis der er flere årgange/retninger/samlæsning. Hvis der er tale om valgfag, angives den/de pågældende studieretning(er).

Students enrolled at the 2nd semester of the Master's programme in Sports Technology.

Deltagerforudsætninger
Herunder beskrives den studerendes forudsætninger for at deltage i kurset, det vil sige eksempelvis tidligere moduler/kurser på andre semestre etc. Beskrivelsen er overvejende beregnet på at fremhæve sammenhængen på uddannelsen. Dette kan eventuelt være i form af en gengivelse af studieordningsteksten.

Knowledge, skills and competences corresponding to the Bachelor degree in Sports Science at Aalborg University.

M**odulaktiviteter**

Definition of activities :
Lecture – a 30-90 minutes presentation by teacher followed by 60-90 minutes problem solving, which are small exercises or tasks to be solved in small groups
Workshop – a scheduled event in the lecture room or lab in which the students try out the acquired skills
The order of the course modules and schedules are subject to change due to organisational constraints. For the most detailed and updated information about the content, please refer to the Moodle page.

Aktivitet - type og titel	**Planlagt undervi-ser***	**Læringsmål fra studieordning**
L1: Structure elements + Statics review. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the distinction between static loading, time-varying (i.e. repeated) loading, and impact loading. Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure
L2: Stress concept.Tensile, compressive and shear stresses. Axially	Jørgen Kepler	Have knowledge about the tensorial nature and interdependence of stresses and strains Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure.

loaded members. (Lectures + Problem solving)		
L3: Extension of bars, Bending of beams and stresses in beams. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the tensorial nature and interdependence of stresses and strains. Have knowledge about the general line of reasoning from the macroscopic state (i.e. geometry, materials and loads) through the deformation state to the local state (stresses and strains at a point, failure prediction). Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure.
L4: Deflections of beams. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the general line of reasoning from the macroscopic state (i.e. geometry, materials and loads) through the deformation state to the local state (stresses and strains at a point, failure prediction). Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure. Can conduct a qualified dialogue with engineers on the material of sports products
L5: Buckling of columns. (Lectures + problem solving)	Jørgen Kepler	Have knowledge about the general line of reasoning from the macroscopic state (i.e. geometry, materials and loads) through the deformation state to the local state (stresses and strains at a point, failure prediction). Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure. Can conduct a qualified dialogue with engineers on the material of sports products
L6: Torsion. (Lectures + Problem solving) Section 3.1 – 3.3, p282-290	Jørgen Kepler	Have knowledge about the general line of reasoning from the macroscopic state (i.e. geometry, materials and loads) through the deformation state to the local state (stresses and strains at a point, failure prediction). Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure. Can conduct a qualified dialogue with engineers on the material of sports products
L7: Analysis of stress and strain – inclined section. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the tensorial nature and interdependence of stresses and strains. Have knowledge about different failure models and their dependency on the choice of material and stress multi-axiality. Can assess the primary criteria for the choice of a structural layout and material (e.g. maximum load, permissible deformation or energy absorption).
L8: Analysis of stress and strain – plane stress and Hooke´s law. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the tensorial nature and interdependence of stresses and strains. Have knowledge about different failure models and their dependency on the choice of material and stress multi-axiality. Can assess the primary criteria for the choice of a structural layout and material (e.g. maximum load, permissible deformation or energy absorption).
L9: Materials science and materials selection in engineering. Categorization and proper application of structural elements (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about different kind of materials and their mechanical properties. Have knowledge about the general line of reasoning from the macroscopic state (i.e. geometry, materials and loads) through the deformation state to the local state (stresses and strains at a point, failure prediction).

		Can assess the primary criteria for the choice of a structural lay-out and material (e.g. maximum load, permissible deformation or energy absorption). Are able to evaluate combined structures through discretization into elementary structural types (e.g. beams, rods and columns).
L10: Stress concentrations. Failure. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about different failure models and their dependency on the choice of material and stress multi-axiality. Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure.
L11: Dynamical effects on loading. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the distinction between static loading, time-varying (i.e. repeated) loading, and impact loading. Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure.
L12: Repeated loading and fatigue. (Lectures + Problem solving)	Jørgen Kepler	Have knowledge about the fact that different failure models exists depending on the choice of material and stress multi-axiality Have knowledge about the distinction between static loading, timevarying (repeated) loading, and impact loading Can assess the number of loading cycles to cause failure and can compare with endurance curves. Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure.
L13: Application in project work (workshop)	Jørgen Kepler	Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure. Can conduct a qualified dialogue with engineers on the material of sports products.
L14: Course review and exam preparation	Jørgen Kepler	Can apply the methodology to simple cases (e.g. beams and rods) in order to evaluate deformations and risk of failure. Can conduct a qualified dialogue with engineers on the material of sports products.

**Forbehold for ændringer under semestrets forløb ved f.eks. sygdom, aflysninger m.v*.

Exam

The exam will be a 4 hour written, individual exam, conducted at a location and time determined as the semester planning permits

The written exam will permit unambiguous evaluation of the specific skills and competences covered by the course. The exam assignments resemble the problems solved during the course work and therefore simultaneously test knowledge of the basic concepts, skills to solve problems and competencies to analyze problems and interpret them into the pertinent structural elements.

For the exam, the following aids/items are permitted: The curriculum textbook, separate notes handed out during the course, personal notes, pocket calculator, apart from the obvious (pencils, eraser, ruler).

Further information including exam dates is available at the exam web page: https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse
Manufacturing Processes / Produktionsprocesser
5 ECTS course module

Placering
Bachelor/kandidat
Master, Sports Technology, 2nd semester
Study board for Health, Technology and Sports Science

Modulansvarlig
Angivelse af den ansvarlige fagperson for modulets tilrettelæggelse og afvikling. Den modulansvarlige kan være identisk med semesterkoordinatoren. Såfremt der udpeges en eksamensansvarlig nævnes vedkommende her.

Thomas Ditlev Brunø, Department of Materials and Production, tdp@mp.aau.dk

Type og sprog
Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.
Angivelse af sprog.

Course Module (English)
The course is organized as a series of lectures given to the students, which have a duration of typically 2 x 45 minutes. After these lectures, an assignment is given to the students, which they are asked to solve in their project groups. Most of the assignments are formulated in relation to product development, and the students are encouraged to use the product in focus in their semester project as an example or case in the exercises. If they do not have a suitable product for the exercise, a predefined assignment is given to them. During the exercises, the teacher will circulate the group rooms to help and challenge the students.

One topic is typically covered in one session (morning or afternoon, 2x45 minutes lecture + exercises).

A list of primary and supplementary literature is provided in Moodle, and a curriculum for each lecture is stated. It is expected that the students read this literature prior to attending the lectures.

Mål
Kursets indhold og målsætninger beskrives i forhold til, hvad den studerende skal lære i forbindelse med modulet. Dette indbefatter gengivelse af studieordningens beskrivelse af viden, færdigheder og kompetencer. Der kan suppleres med kortfattet beskrivelse/uddybning af den metodiske, praktiske viden og kunnen, som den studerende opnår. Der kan evt. henvises til uddybninger på Moodle og/eller pensumbeskrivelser på studienævnets hjemmeside (gældende for MedIS og Medicin).

Fra Studieordningen:

Students who complete the module:

Knowledge
- Have knowledge about product attributes, user need clarification and product specifications and understand the product development process as a whole
- Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing
- Have knowledge about the progress from conceptual idea/product to the realization of prototype as well as specifying the manufacturing set-up
- Have knowledge about the interplay between design, material, processing and cost and quality
- Have knowledge about the economics of manufacturing and product development

Skills
- Can choose suitable analysis tools and methods for the application of interest within product development and manufacturing
- Can communicate analysis results from the product development towards the manufacturing department
- Can choose material, process and manufacturing set-up

- Can apply economic analysis tools on product development problems

Competences
- Can discuss the design process in sports science and engineering
- Can evaluate the added value to an industrial design and realization project
- Can conduct qualified negotiations with offshore manufacturers on sports product fabrication

Fagindhold og sammenhæng med øvrige moduler/semestre
Herunder beskrives det kort og generelt, hvad modulets faglige indhold består i, samt hvad baggrunden og motivationen for modulet er, hvilket vil sige en kort redegørelse for modulets indhold og berettigelse. Hensigten er at skabe indsigt i det enkelte modul for den studerende og at skabe mulighed for at forstå modulet i forhold til det øvrige semester og uddannelsen som helhed.

This course focuses on a wide range of topics related to developing and producing a product. The intention of the course is to enable the students to participate in product development projects starting from identification of customer requirements, through developing a concept, selecting materials, to participate in establishing a production domestically or outsourced.

More specifically, in relation to basic product development, the students learn about product properties and how they contribute to customer satisfaction, how to identify customer requirements, prioritize them and translate them into a requirements specification, and generate product concepts. In relation to manufacturing, the students receive an introduction to various types of manufacturing processes, assembly systems, and how to consider the manufacturing processes during the product design phase (design for manufacturing). Lectures are also given in basic project economy – how to identify cash flows, and how to make an aggregate calculation for an entire project assessing the profitability of the product development project as a whole.

Also, the students are introduced to how to structure a product in a bill of materials allowing systematic production. Also, in relation to manufacturing, the students learn basic techniques of forecasting sales using historic data and basic techniques for production planning and inventory management.

In order to focus on collaboration with external manufacturing resources, the students also learn about supply chain management and basic principles of outsourcing, and the risks and benefits of in-shoring and offshoring. Also, a lecture is given on entrepreneurship.

Finally, the students learn more specifically about design and sizing of products for populations, material properties and manufacturing processes related to polymers composition, structure and thermo-mechanical properties, polymer composites, stainless steel, aluminum and their extrusion and forging processes.

In order to put the topics taught in the course into context, a case of a bicycle company is introduced during the first lecture in the course. This is done so that every lecture in the course can be related to the specific context of this company. A previous entrepreneur from a bicycle company is invited to do a guest lecture to motivate the students. As far as possible, the exercises in every lecture are related to the bicycle case in order to get a clear line through the course.

Omfang og forventet arbejdsindsats
Forventninger om den konkrete udmøntning af modulets ECTS-belastning, hvilket omfatter antallet af konfrontationstimer, øvelsesarbejde, tid til forberedelse, eventuel rejseaktivitet med videre.

A 5 ECTS course represents an *average* student workload of 150 hours. A *rough* estimate of the workload distribution is as follows:

- Active participation in 12 lectures including exercises = 45 hours.
- Preparation for the 12 lectures = 36 hours
- Subsequent processing of the 12 lectures and completion of the exercises = 24 hours.
- Exam preparations = 45 hours.

Deltagere
Her angives deltagerne i modulet, det vil sige først og fremmest en angivelse af deltagere, hvis der er flere årgange/retninger/samlæsning. Hvis der er tale om valgfag, angives den/de pågældende studieretning(er).

Students enrolled at the 2nd semester of the Master's programme in Sports Technology.

Deltagerforudsætninger
Herunder beskrives den studerendes forudsætninger for at deltage i kurset, det vil sige eksempelvis tidligere moduler/kurser på andre semestre etc. Beskrivelsen er overvejende beregnet på at fremhæve sammenhængen på uddannelsen. Dette kan eventuelt være i form af en gengivelse af studieordningsteksten.

Completion of the 1st semester of the Master's programme in Sports Technology or the like. A background in basic mechanics and mathematics.

Modulaktiviteter

Aktivitet - type og titel	**Planlagt underviser***	**Læringsmål fra studieordning**
Introduction	Gert Spender-Andersen	The purpose of this lecture is to introduce the course and the relations between the elements in the course. A guest lecturer is invited to present at case of a bicycle startup. This is used for future reference in the course and used to to frame the remaining lectures.
Lecture + exercise Product Development	Thomas Ditlev Brunø / Daniel GH Sørensen	Have knowledge about product attributes, user need clarification and product specifications and understand the product development process as a whole Can discuss the design process in sports science and engineering
Lecture + exercise Manufacturing Systems	Ann-Louise Andersen	Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing Can communicate analysis results from the product development towards the manufacturing department Have knowledge about the progress from conceptual idea/product to the realization of prototype as well as specifying the manufacturing set-up
Lecture + exercise Polymers - composition, structure and thermo- mechanical properties	Jens Henrik Andreasen	Have knowledge about the interplay between design, material, processing and cost and quality Can communicate analysis results from the product development towards the manufacturing department Can choose material, process and manufacturing set-up
Lecture + exercise Requirements & product concepts	Thomas Ditlev Brunø / Daniel GH Sørensen	Have knowledge about product attributes, user need clarification and product specifications and understand the product development process as a whole Can conduct qualified negotiations with offshore manufacturers on sports product fabrication
Lecture + exercise Production	Thomas Ditlev Brunø / Daniel GH Sørensen	Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing Have knowledge about the economics of manufacturing and product development Can communicate analysis results from the product development towards the manufacturing department Have knowledge about the progress from conceptual idea/product to the realization of prototype as well as specifying the manufacturing set-up
Lecture + exercise Polymer composites and their mechanical properties	Johnny Jakobsen	Have knowledge about the interplay between design, material, processing and cost and quality Can communicate analysis results from the product development towards the manufacturing department

		Can choose material, process and manufacturing set-up
Lecture + exercise Product Development Economics	Thomas Ditlev Brunø	Have knowledge about the economics of manufacturing and product development Can apply economic analysis tools on product development problems Can evaluate the added value to an industrial design and realization project
Lecture + exercise Metals	Jens Henrik Andreasen	Have knowledge about the interplay between design, material, processing and cost and quality Can communicate analysis results from the product development towards the manufacturing department Can choose material, process and manufacturing set-up
Lecture + exercise Outsourcing	Ann-Louise Andersen	Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing Can communicate analysis results from the product development towards the manufacturing department Can conduct qualified negotiations with offshore manufacturers on sports product fabrication
Lecture + exercise Supply Chain Management	Ann-Louise Andersen	Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing Can conduct qualified negotiations with offshore manufacturers on sports product fabrication
Lecture + exercise Size customization by anthropometrics and principal component analysis	John Rasmussen	Have knowledge about product attributes, user need clarification and product specifications and understand the product development process as a whole. Can choose suitable analysis tools and methods for the application of interest within product development and manufacturing. Can discuss the design process in sports science and engineering.
Lecture + exercise Production Management	Amila Thibbotuwawa	Have knowledge about the basic concepts of manufacturing including common manufacturing processes, manufacturing planning, supply chains and outsourcing. Can choose suitable analysis tools and methods for the application of interest within product development and manufacturing.

**Forbehold for ændringer under semestrets forløb ved f.eks. sygdom, aflysninger m.v*.

Eksamen
Eksamen afvikles som en skriftlig stedprøve på 3 timer.

Eksamen er skriftlig fordi læringsmålene i dette kursus er formuleret bredt og der er deltagelse af flere undervisere. Yderligere indgår der en del aktiviteter i undervisningen og dermed også eksamen, der omfatter opstilling af modeller samt beregninger.

Eksamensopgaver udleveres og besvarelser indleveres gennem Digital Eksamen.

Tilladte hjælpemidler er litteratur, slides, lommeregner, regnestok, PC, og noter. Det er ikke tilladt at kommunikere direkte med andre end eksamensvagten.

Se hjemmesiden for yderligere information om eksamen og eksamensdatoer https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse
Elective Course C: Numerical Modelling / Numerisk modellering
5 ECTS course module

Placering
Master, Sports Technology, 2nd semester
Study board for Health, Technology and Sports Science

Modulansvarlig
Angivelse af den ansvarlige fagperson for modulets tilrettelæggelse og afvikling. Den modulansvarlige kan være identisk med semesterkoordinatoren. Såfremt der udpeges en eksamensansvarlig nævnes vedkommende her.

Brian L.V. Bak, Department of Materials and Production, brianbak@mp.aau.dk.

Type og sprog
Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.
Angivelse af sprog.

Course Module (English)
The study plan is laid out as a mix of lectures and student work, the purpose of which is to enable the students to learn individually and in groups with frequent teacher confrontation opportunities.

9 lectures and 2 seminars are organized as full morning or afternoon sessions, primarily arranged as a 2 x 45 minutes theoretical lecture session with examples followed by a 2 x 45 minutes student exercise session with teacher assistance. Notice that deviations from this template may occur. The lectures are designed such that a requisite for obtaining the intended learning outcome is that the students have read the background material for each lecture. Furthermore, it is expected that the students complete the exercises provided in each lectures before the following lecture is given.

To support the competencies of the learning goals, he student groups must compose and hand in a written mini-project that will also form the basis of the exam. The mini-project must cover the basic topics from the lectures. The mini-project must not exceed 10 pages of main text, but may additionally include relevant appendices such as large stress plots and technical drawings. After the end of the lectures, the student groups are offered two teacher-assisted seminars to aid work on the mini-project. The mini project can be written in English or, in case the group has only Danish-speaking members, in Danish.

Students complete a mini-project entitled “Analysis and intuitive improvement of a […]”. The specific product/component […] to use in the mini-project will be revealed in the beginning of the course. The mini-project must at least treat the basic topics from the lectures, e.g. Design process, CAD, Technical drawing, Finite element modelling, Finite element analyses, Documentation of model and results, Brief description of theory and methods applied.

The analyses of the product/component should form the basis for improvement of the product/component with regards to criteria such as weight, stiffness, strength, stability, dynamic behavior.

The mini-project supports the learning goals by requiring the students to make choices about what is relevant to analyze, how to present the results and how much information is enough to evaluate the quality of the conducted analyses.

Mål
Kursets indhold og målsætninger beskrives i forhold til, hvad den studerende skal lære i forbindelse med modulet. Dette indbefatter gengivelse af studieordningens beskrivelse af viden, færdigheder og kompetencer. Der kan suppleres med kortfattet beskrivelse/uddybning af den metodiske, praktiske viden og kunnen, som den studerende opnår. Der kan evt. henvises til uddybninger på Moodle og/eller pensumbeskrivelser på studienævnets hjemmeside (gældende for MedIS og Medicin).

Fra Studieordningen:

Students who complete the module:

Knowledge
- Have knowledge on how to establish a geometrical specification of a product via computer based models using Computer Aided Design and Technical Drawings
- Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physical problems governed by partial differential equations
- Have knowledge about the applications, assumptions, and limitations of the Finite Element Method
- Have knowledge about the compromise between accuracy and simulation time
- Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses.

Skills
- Can establish a three dimensional parametric model of a structure or component using a commercial computer software program
- Can produce and interpret a technical drawing of a product (i.e. a structure or component)
- Can perform a linear static stress analysis using a commercial finite element program
- Can interpret and report results of simple finite element analyses
- Can demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science view point

Competences
- Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineering
- Can conduct a qualified dialogue with analysis specialists on numerical analysis of sports products

Fagindhold og sammenhæng med øvrige moduler/semestre
Herunder beskrives det kort og generelt, hvad modulets faglige indhold består i, samt hvad baggrunden og motivationen for modulet er, hvilket vil sige en kort redegørelse for modulets indhold og berettigelse. Hensigten er at skabe indsigt i det enkelte modul for den studerende og at skabe mulighed for at forstå modulet i forhold til det øvrige semester og uddannelsen som helhed.

This course focuses on numerical modeling using the Finite Element Method (FEM), which is a widely used computer-based engineering tool for design of mechanical components. The FEM is useful in analysis and design of sports equipment but may also be applied to simulate many of the physical phenomena within the living human body. This course provides a brief theoretical introduction to displacement-based FEM but focuses on design rules, practical application and documentation of the method. The course theory will exclusively address solid geometries of isotropic materials with linear behavior. However, examples of nonlinear modeling with the FEM are given since many of the problems involved in sports science fall in this category. If possible, the objects of investigation in the student projects will be integrated in the last lecture and subjected to FE analysis and subsequent result interpretation and documentation. For exercises the commercial software SolidWorks will be used with the integrated FEM solver SolidWorks Simulation. Thus the students need to bring a computer with Solidworks for the exercise sessions. Solidworks will be made available before the first lecture by the course responsible.

The course uses topics from the course on mechanics of materials. The course on numerical modelling is therefore delayed compared to the course on mechanics of materials in order to make sure the students have been presented to the relevant topics within mechanics of materials before they are needed in the course on numerical modelling.

Omfang og forventet arbejdsindsats
Forventninger om den konkrete udmøntning af modulets ECTS-belastning, hvilket omfatter antallet af konfrontationstimer, øvelsesarbejde, tid til forberedelse, eventuel rejseaktivitet med videre.

A 5 ECTS course represents an *average* student workload of 150 hours. A *rough* estimate of the workload distribution is as follows:

- Active participation in 9 lectures (incl. exercises) and 2 seminars = 41 hours.
- Preparation for the 9 lectures = 14 hours
- Subsequent processing of the 9 lectures and completion of the exercises = 17 hours.
- Prepare presentations of exercise solutions to exercises from the exercise sessions = 5 hours.
- Work on the course mini-project including seminar = 38 hours.
- Exam preparations = 35 hours.

Deltagere

Her angives deltagerne i modulet, det vil sige først og fremmest en angivelse af deltagere, hvis der er flere årgange/retninger/samlæsning. Hvis der er tale om valgfag, angives den/de pågældende studieretning(er).

Students enrolled at the 2nd semester of the Master's programme in Sports Technology.

Deltagerforudsætninger

Herunder beskrives den studerendes forudsætninger for at deltage i kurset, det vil sige eksempelvis tidligere moduler/kurser på andre semestre etc. Beskrivelsen er overvejende beregnet på at fremhæve sammenhængen på uddannelsen. Dette kan eventuelt være i form af en gengivelse af studieordningsteksten.

Completion of the 1st semester of the Master's programme in Sports Technology or the like. A background in basic mechanics and mathematics corresponding to the Bachelor programme's courses in biomechanics.

Modulaktiviteter

Definition of activities :

- Lecture – a 90-150 minutes presentation by teacher followed byproblem solving, which are 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
- Mini project– a more comprehensive task or topic to prepare a presentation and short report on a predefined topic

The order of the course modules and schedules are subject to change due to organisational constraints. For the most detailed and updated information about the content, please refer to the Moodle page.

Aktivitet - type og titel	**Planlagt undervi-ser***	**Læringsmål fra studieordning**
L1: Introduction to geo-metrical modelling. (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how to establish a geometrical specification of a product via computer based models using Computer Aided Design and Technical Drawings Can establish a three dimensional parametric model of a struc-ture or component using a commercial com-puter software pro-gram Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineering
L2: Technical documen-tation (Lectures + exer-cises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Can produce and interpret a technical drawing of a product (i.e. a structure or component)
L3: Introduction to FEM (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be ap-plied to obtain approximate solutions to physi-cal problems gov-erned by partial differential equations Have knowledge about the applications, assumptions, and limi-tations of the Finite Element Method Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite ele-ment analysis in order to obtain results of deformation (strains) and stresses. Can perform a linear static stress analysis using a commercial fi-nite element program Can interpret and report results of simple finite element analyses

		Can demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science view point.
L4: Interpolation and approximations (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physi-cal problems governed by partial differential equations Have knowledge about the applications, assumptions, and limitations of the Finite Element Method Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses. Can perform a linear static stress analysis using a commercial finite element program Can interpret and report results of simple finite element analyses
L5: Equilibrium equations and the stiffness matrix (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physi-cal problems governed by partial differential equations Have knowledge about the applications, assumptions, and limitations of the Finite Element Method Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses. Can perform a linear static stress analysis using a commercial finite element program Can interpret and report results of simple finite element analyses
L6: Element technologies (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physi-cal problems governed by partial differential equations Have knowledge about the applications, assumptions, and limitations of the Finite Element Method Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses. Can perform a linear static stress analysis using a commercial finite element program Can interpret and report results of simple finite element analyses
L7: Advanced modelling: natural frequencies and buckling (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physical problems governed by partial differential equations Have knowledge about the applications, assumptions, and limitations of the Finite Element Method Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses. Can interpret and report results of simple finite element analyses.
L8: Nonlinear problems (Lectures + exercises)	Brian L. V. Bak/Simon Mosbjerg Jensen	Have knowledge on how the Finite Element Method can be applied to obtain approximate solutions to physical problems governed by partial differential equations Have knowledge about the applications, assumptions, and limitations of the Finite Element Method

		Have knowledge about the compromise between accuracy and simulation time Have knowledge about the numerical steps taken in a finite element analysis in order to obtain results of deformation (strains) and stresses. Can interpret and report results of simple finite element analyses
L9: Designing with FEM and reporting the results (Lectures + Work on Mini-project)	Brian L. V. Bak/Simon Mosbjerg Jensen	Knowledge about good practice within the field of FEA. Reporting FE results. Knowledge about FEA and the design process. Can interpret and report results of simple finite element analyses Can demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science view point Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineering Can conduct a qualified dialogue with analysis specialists on numerical analysis of sports products
L10: Mini-project seminar	Brian L. V. Bak/Simon Mosbjerg Jensen	Can interpret and report results of simple finite element analyses Can demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science view point Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineer-ing Can conduct a qualified dialogue with analysis specialists on numerical analysis of sports products
L11: Mini-project seminar	Brian L. V. Bak/Simon Mosbjerg Jensen	Can interpret and report results of simple finite element analyses Can demonstrate a basic understanding of concepts and applications of finite element analysis from a sports science view point Know when and where to use finite element analysis as a part of an analysis or design process in sports science and engineer-ing Can conduct a qualified dialogue with analysis specialists on numerical analysis of sports products

**Forbehold for ændringer under semestrets forløb ved f.eks. sygdom, aflysninger m.v*.

Eksamen

The exam is oral and consists of two parts. In part 1 you have to present/answer one question, which is provided by the teacher during the last lecture of the course. All the questions are within the course curriculum. In order to determine which question you have to present/answer you will draw a number which corresponds to the number of the question. You have to begin presenting/answering the question immediately after you have drawn the number. There is no time for preparation. The evaluation is without aids of any kind. That means, you are not allowed to bring books, notes, etc. for the evaluation. Part 2 is based on questions for your mini project and you must therefore bring your own copy of the submitted mini-project.

During the evaluation of both part 1 and 2, it is expected that you present the subject or answer the questions with the use of the paper and pencil, which the examiner will make sure is available. It is expected that you can use the time available to account for the questions you are asked in an autonomous manner. You are encouraged to start with a general description of the topic, followed by a detailed description of the subject of the exam question, i.e. characteristics, governing equations and how they can be used. You must show that you have an understanding of the topic and how the topic can be used for practical solving of sports related engineering problems. The examiner may ask clarifying questions during the evaluation. The exam lasts approximately 15 minutes in total. Hereafter the examiner and internal assessor will spend approximately 3 min. determining and presenting the grade.

Before the exam, the secretariat will send out a schedule where you can see when you are scheduled for exam.

There will be no immediate preparation time on the day of the exam. No books, notes, etc. may be brought along except for the handed-in course mini-project.

Further information including exam dates is available at the exam web page: https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse
Elective Course D: Embedded/mobile Systems and their Applications in Sports / Indlejrede/mobile systemer og deres anvendelse indenfor idræt)
5 ECTS course module

Placering
Master, Sports Technology, 2nd semester
Study board for Health, Technology and Sports Science

Modulansvarlig
Angivelse af den ansvarlige fagperson for modulets tilrettelæggelse og afvikling. Den modulansvarlige kan være identisk med semesterkoordinatoren. Såfremt der udpeges en eksamensansvarlig nævnes vedkommende her.

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

Type og sprog
Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.
Angivelse af sprog.

This is a course module.

The course will be conducted in English, but instructions may be offered in Danish in case the instructor and every single student attending the course sessions agree on it.

The course is organized in form of 4 lecture blocks and 4 workshops. In each block, the teacher(s) will present the basis of embedded systems and how to implement hardware and software solutions with relevance to sports-related applications. At the end of each block, a workshop will be organized where some exercises will be assigned to the students such that they get to practice the instructed knowledge, skills and work on gaining competences in each block. The workshop will be organized right after the block to have an interactive structure and students receive feedback to their assignments during the workshop.

This course includes a wide set of practical examples which need to be implemented and tested in the course blocks and workshops, therefore, it is necessary for the student to buy a Launchpad development kit to implement the exercises. An affordable kit is considered for this purpose and it can be ordered online from the link below.

http://www.ti.com/tool/msp-exp430fr6989

We recommend that all the students order the kit altogether so that they pay only a single freight fee. Please note that the students may be charged for the custom tax as well. The students will be provided with the application notes and other freely available sources so no particular text book would be required for the course, but for more detailed information, interested students can refer to the following books which are freely available online:

MSP430 Microcontroller Basics by John H. Davies
http://www.hutech.edu.vn/khoacntt/attachments/article/2809/MSP430%20Microcontroller%20Basics.pdf

The C programming language by Brian W. Kernighan and Dennis M. Ritchie
http://www.ime.usp.br/~pf/Kernighan-Ritchie/C-Programming-Ebook.pdf

The course will be taught by two teachers, Afshin Samani (AS), who will present the general and basic concepts of embedded systems and programming for example a typical microcontroller. Later on, John Hansen (JH) will present a broader overview of embedded systems to be used in the implementation of hardware with a potential application in the field of sports technology.

Mål
Kursets indhold og målsætninger beskrives i forhold til, hvad den studerende skal lære i forbindelse med modulet. Dette indbefatter gengivelse af studieordningens beskrivelse af viden, færdigheder og kompetencer.

Der kan suppleres med kortfattet beskrivelse/uddybning af den metodiske, praktiske viden og kunnen, som den studerende opnår. Der kan evt. henvises til uddybninger på Moodle og/eller pensumbeskrivelser på studienævnets hjemmeside (gældende for MedIS og Medicin).

Fra Studieordningen:

Students who complete the module:

Knowledge
- Have knowledge about building-blocks and the underlying scientific principles of embedded systems
- Have knowledge on how to build solutions to real-world problems using embedded systems
- Have knowledge on basic principles of computer programming

Skills
- Can apply microcontroller-based systems solutions for sport relevant projects
- Can implement ad-hoc solutions for hardware and software design
- Can critically read original technical reports relevant to sports technologies

Competences
- Can identify hardware and software solutions and partially implement them

Fagindhold og sammenhæng med øvrige moduler/semestre
Herunder beskrives det kort og generelt, hvad modulets faglige indhold består i, samt hvad baggrunden og motivationen for modulet er, hvilket vil sige en kort redegørelse for modulets indhold og berettigelse. Hensigten er at skabe indsigt i det enkelte modul for den studerende og at skabe mulighed for at forstå modulet i forhold til det øvrige semester og uddannelsen som helhed.

The course covers the basis of design and implementation of embedded systems. The students have the opportunity to learn the principles of embedded system architecture and how to program them. This makes a logical flow to translate the theoretical knowledge that they obtained in the previous semester and see how technological solutions with their processing components are implemented in practice. They will be shown how to make an interface between the hardware and personal computers and increase the visualization capabilities of the designed hardware.

Omfang og forventet arbejdsindsats
Forventninger om den konkrete udmøntning af modulets ECTS-belastning, hvilket omfatter antallet af konfrontationstimer, øvelsesarbejde, tid til forberedelse, eventuel rejseaktivitet med videre.

A 5 ECTS course represents an *average* student workload of 150 hours. A *rough* estimate of the workload distribution is as follows:

- Active participation in Blocks and 4 Workshops = 30 hours.
- Preparation for the Blocks = 10 hours
- Preparation for the hardware used in the course 4 Blocks and workshops= 10 hours
- Work on the course workshops = 30 hours.
- Subsequent processing of the 8 Blocks and workshops and completion of the exercises = 20 hours.
- Prepare presentations of exercise solutions = 15 hours.
- Exam preparations = 35 hours.

Deltagere
Her angives deltagerne i modulet, det vil sige først og fremmest en angivelse af deltagere, hvis der er flere årgange/retninger/samlæsning. Hvis der er tale om valgfag, angives den/de pågældende studieretning(er).

Students enrolled at the 2nd semester of the Master's programme in Sports Technology.
In addition, any student in different disciplines interested in learning basic principles of working with embedded system may enroll to this course.

Deltagerforudsætninger
Herunder beskrives den studerendes forudsætninger for at deltage i kurset, det vil sige eksempelvis tidligere moduler/kurser på andre semestre etc. Beskrivelsen er overvejende beregnet på at fremhæve sammenhængen på uddannelsen. Dette kan eventuelt være i form af en gengivelse af studieordningsteksten.

Completion of the 1st semester of the Master's programme in Sports Technology or the like. A background in basic electronics and computer programming with C is appreciated but not required

Modulaktiviteter
A Block is a presentation of the basis of embedded systems and how to implement hardware and software solutions with relevance to sports-related applications.
The blocks consist of lectures on the principal concepts of the embedded systems, introduction to a typical micro-controller based launch-pad kit and implementation of the essential building blocks of the hardware (accessories), introduction to the building blocks of the codes and how to navigate through the code and retrieve relevant information from the micro-controller datasheet. Throughout the lectures, specific examples on coding the launch-pad kit will be presented and the students will reproduce the presented examples on their own launch-pad kit.

A Workshop contains of the assigned exercises to the students, helping them out to perform them and provide feedback on their activities.
In the workshops, the students are asked to modify the presented codes during the blocks to achieve new functionalities. Direct feedback will be provided to the students for troubleshooting and the students shortly present their solutions to other students in the classroom. This procedure is repeated with several examples so that students feel comfortable handling the given code and the hardware

A workshop will be organized right after the block to have an interactive structure and students take the most use of it.

Activity - type and title	**Planned instructor***	**Learning goals from Curriculum**
Block 1: Embedded system overview and programming	Afshin Samani and John Hansen	Have knowledge of about building-blocks and the underlying scientific principles of embedded systems Have knowledge on basic principles of computer programming
Workshop 1	Afshin Samani	Can implement ad-hoc solutions for hardware and software design
Block 2: General and basic concepts in programming of microcontrollers I	Afshin Samani	Have knowledge about building-blocks and the underlying scientific principles of embedded systems Have knowledge on how to build solutions to real-world problems using embedded systems
Workshop 2	Afshin Samani	Can apply microcontroller-based systems solutions for sport relevant projects Can critically read original technical reports relevant to sports technologies Can identify hardware and software solutions and partially implement them

Block 3: General and basic concepts in programming of microcontrollers II	Afshin Samani	Have knowledge of about building-blocks and the underlying scientific principles of embedded systems Have knowledge on how to build solutions to real-world problems using embedded systems
Workshop 3	Afshin Samani	Can apply microcontroller-based systems solutions for sport relevant projects Can critically read original technical reports relevant to sports technologies Can identify hardware and software solutions and partially implement them
Block 4: Ad-hoc solutions for sport technology relevant projects	John Hansen	Have knowledge on how to build solutions to real-world problems using embedded systems Can apply microcontroller-based systems solutions for sport relevant projects Can implement ad-hoc solutions for hardware and software design Can critically read original technical reports relevant to sports technologies
Workshop 4	John Hansen	Can implement ad-hoc solutions for hardware and software design Can critically read original technical reports relevant to sports technologies Can identify hardware and software solutions and partially implement them.

**Forbehold for ændringer under semestrets forløb ved f.eks. sygdom, aflysninger m.v*.

Eksamen

Since it is an optional course, the number of enrolled students for the exam will not be predefined. Therefore, depending on the number of enrolled students for the course, the exam session can be carried out in form of either an oral or a written exam. In any case, the students will be required to have a computer with installed required software packages with them in the exam session. The students will be given some sample codes of a microcontroller Launchpad kit (a typical example of an embedded system) to be debugged or modified to fulfill a particular design aim. The sample codes will be similar (but not identical) to what they were already given during the course.

To examine whether the students gained the required knowledge, the students will be asked questions to confirm their understanding of the code blocks and the function of different segments of the code.

They will be asked about how they would put building blocks of the required system in question and how they work together (in case of a written exam, drawing of a sketch of what they have in mind would suffice). To examine their acquired skills, intentional bugs and flaws will be made to the sample codes delivered to the students, and they will be asked to fix the bugs and make the code functioning as expected (in case of a written exam, they should make a report of bugs that they found and how they fix it). To do that, they need to have good skills of working with required software packages and understanding of the code and its building blocks. They would need to read application notes and data sheet documents and understand them in order for them to be able to proceed in this part.

To examine their competences, they will be asked to modify the code such that the code can fulfill other aims other than what it has been initially designed for. This often requires adding new code segments to the delivered code and require competencies to find out where and how new adjustments should be implemented in the code.

In case of an oral exam, to implement what is mentioned above, each student will randomly select an assignment out of a collection of prepared questions and he/she will be given 15 min for preparation time followed by maximum 15 min questioning time. The question will be prepared by the course instructors beforehand such that the questions can examine the knowledge, skills and competences of the students as outlined above. An internal assessor will be present in the exam session.

In case of a written exam, to implement what is mentioned above, a set of questions covering the outlined aspects above will be prepared and the responses of the students to the questions will be evaluated by the course instructor and an internal assessor (censor), eventually the list of the marks will be compared and in case of any disagreement between them, the assessor and the instructor convene and the mark list will be finalized.

Further information including exam dates is available at the exam web page: https://www.hst.aau.dk/uddannelser/Undervisning+og+eksamen/.