

**Semesterbeskrivelse for 2. semester kandidat Idrætsteknologi – forår 2021****Oplysninger om semesteret**

Institut for Medicin og Sundhedsteknologi
Studienævn for Idræt og Folkesundhedsvidenskab
[Studieordning for Idrætsteknologi](#)

Semesterets temaramme

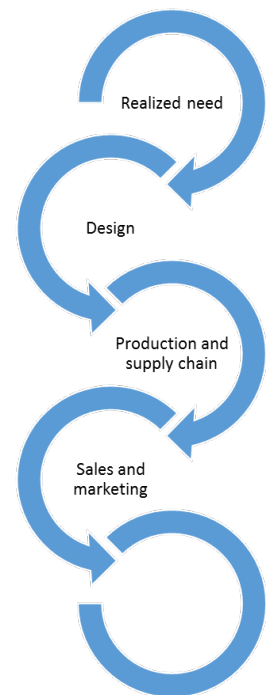
Herunder en mere udfoldet redegørelse i prosaform for semesterets fokus, arbejdet med at indfri lærings- og kompetencemål og den eller de tematikker, der arbejdes med på semesteret. Semesterbeskrivelsen rummer altså den "temaramme", som de studerende arbejder under, og endvidere beskrives semesterets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

I projektmodulet skal hver gruppe udvælge ét af to valgprojekter med tema henholdsvis "Test af idrætsudstyr" og "Design, udvikling og afprøvning af idrætsudstyr". De studerende placerer i samarbejde med vejleder det valgte projektforslag under et af de to temaer. Dette kan typisk, ske efter der er lagt en plan for projektets gennemførelse.

A catalogue of project proposals within these themes 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.

The semester comprises four course modules, all of which are mandatory: "Mechanics of Materials", "Manufacturing Processes", "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: Susanne Kragelund Hansen, skha@hst.aau.dk, Department of Health Science and Technology

Student representative: Please check semester details on Moodle

Modulbeskrivelse (en beskrivelse for hvert modul)

<p>Modultitel, ECTS-angivelse</p> <p>Dette semester tilbyder valg mellem to projektemaer:</p> <ol style="list-style-type: none">1. Test af Idrætsudstyr2. Design, udvikling og afprøvning af idrætsudstyr <p>10 ECTS projektmodul</p>
<p>Placering</p> <p>Master, Sports Technology, 2nd semester Studienævn for Idræt og Folkesundhedsvidenskab</p>
<p>Modulansvarlig</p> <p><i>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.</i></p> <p>John Rasmussen, jr@mp.aau.dk, Institut for Materialer og Produktion.</p>
<p>Type og sprog</p> <p><i>Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign. Angivelse af sprog.</i></p> <p>Project module, Language of instruction is Danish or English depending on the participants. The report can take the form of either a monograph or a scientific paper with additional work sheets.</p>
<p>Mål</p> <p><i>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).</i></p> <p><u>Fra Studieordningen:</u></p> <p>For valgprojekt 1, Test af idrætsudstyr, gælder følgende læringsmål:</p> <p>Viden</p> <ul style="list-style-type: none">• Har viden om industrien for idrætsprodukter, herunder specifikt i relation til test af idrætsudstyr• Har viden om de analysemetoder, der findes, og om deres fordele og begrænsninger i forbindelse med test af idrætsudstyr.• Har viden om kravene til grænsefladen mellem idrætsudøveren og udstyret• Kan forklare fordele og ulemper ved det testede produkt• Forstår idrætsteknologiske produkters tekniske specifikationer <p>Færdigheder</p> <ul style="list-style-type: none">• Kan anvende teori om styrkelære og indlejrede systemer på idrætsudstyr• Kan anvende en hensigtsmæssig eksperimentel og numerisk metode på en case• Kan teste og indsamle data fra et idrætsprodukt, der fungerer i samspil med kroppen <p>Kompetencer</p> <ul style="list-style-type: none">• Kan analysere interaktionen mellem idrætsudøver og idrætsprodukt• Kan diskutere idrætsprodukters design, kvalitet og omkostninger med relevante videnskabelige eller industrielle faggrupper (f.eks. ingeniører, produktanalytikere og udstyrsproducenter)• Kan interagere med de involverede parter om både de videnskabelige og idrætsteknologiske aspekter af et givet produkt

For valgprojekt 2, Design, udvikling og afprøvning af idrætsudstyr, gælder følgende læringsmål:

Viden

- Har viden om udvikling/anvendelse af prototyper i industrien for idrætsprodukter
- Har viden om designløsninger der ofte anvendes til idrætsudstyr
- Har viden om produktionsprocesser, der ofte anvendes i produktionen af idrætsudstyr
- Kan redegøre for produktlivscyklussen fra konceptudvikling over implementering og produktion til genanvendelse
- Forstår de tekniske specifikationer af en prototypes forskellige designelementer.

Færdigheder

- Kan anvende teorier relateret til den mekaniske grænseflade og de elektriske kredsløb i/på sportsudstyr
- Kan anvende en indlejret teknologi i relation til idræt
- Kan designe et idrætsprodukts funktion i relation til kroppen
- Kan gennemføre tests af brugbarheden af idrætsprodukter

Kompetencer

- Kan evaluere idrætsudøverens behov i forhold til træning/funktionsevne og opsummere relevante designkrav til et idrætsprodukt, som kan forbedre udøverens træningen/præstationsevne
- Kan bidrage til at designe idrætsudstyr i samarbejde med andre relevante videnskabelige faggrupper eller kommercielle aktører (f.eks. ingeniører, produktanalytikere og udstyrsproducenter)
- Kan interagere med de involverede parter om både de videnskabelige og idrætsteknologiske aspekter af det produkt, der skal udvikles.

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.

Sammenlignet med tidligere projektmoduler på bacheloruddannelsen i idræt samt det forrige idrætsteknologisemester, har dette semester en mere analytisk og ingeniør-orienteret tilgang. Projektmodulet kan indeholde indsamling af empiriske data og eksperimenter med mennesker, men det vil være mere almindeligt, at arbejdet fokuserer på udvikling af modeller af – samt eksperimenter med materialer, produkter, software og andre artefakter.

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.

Den forventede arbejdsindsats på projektmodulet er 10 ECTS svarende til ca. 300 timers arbejde per studerende. Dette inkluderer alle dele af projektarbejdet, herunder vejledermøder, læsning af baggrundsmateriale, eksperimenter, dataanalyse, rapportskrivning og forberedelse til eksamen. Fordelingen af tidsforbrug mellem aktiviteterne kan variere mellem forskellige typer projekter.

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).

Deltagere er studerende på 2. semester af uddannelsen i Idrætsteknologi. Studentergrupperne har mulighed for at etablere samarbejde med studerende på andre uddannelser, f.eks. via det tværvideenskabelige projekt AAU racing (<http://auracing.dk/>) eller som led i AAUs megaprojekter (<https://www.megaprojekter.aau.dk/>).

Gruppestørrelserne skal være 4-6 personer i overensstemmelse med [retningslinjerne fra studienævnet](#).

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.

Studerende på dette modul skal have kendskab til de videnskabelige tilgange med relevans for menneskekroppen, som blev lært på 1. semester af uddannelsen. Tilgangen på dette semester bygger i øvrigt på kurserne i biomekanik fra bacheloruddannelsen i idræt.

Modulaktiviteter

Dette modul er planlagt som gruppearbejde, der gennemføres på grundlag af Aalborgmodellen for problem-baseret læring (http://www.aau.dk/digitalAssets/62/62747_pbl_aalborg_modellen.pdf).

Vejledere rekrutteres primært fra Institut for Materialer og Produktion (MP) samt Institut for Medicin og Sundhedsteknologi (HST).

De studerende forventes at koordinere arbejdet sammen med deres projektvejleder og at samarbejde med denne om at skitsere og eksekvere en projektplan. Dette indebærer aktiviteter såsom valg af undersøgelsesmetoder, udledning og implementering af metoder til dataanalyse, indsamling af data og præsentation af resultater samt diskussion af resultaterne i et videregående perspektiv. Studerende, som samarbejder med eksterne, kommercielle partnere, har en speciel forpligtelse til at analysere og vurdere problemstillingerne med hensyntagen til de forretningsmæssige aspekter.

Eksamen

Projekteksamen afholdes ifølge [Vejledning for projekteksamen på SUND](#) for så vidt angår formen. Indholdet baseres på læringsmålene for det valgte valgprojekt og deres fortolkning i denne semesterbeskrivelse.

Yderligere eksamensinformation inklusive datoer for eksamen kan findes på: <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, 2 nd semester Studienævn for Idræt og Folkesundhedsvidenskab
Modulansvarlig <i>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.</i> Jørgen Asbøll Kepler, jk@mp.aau.dk , Department of Materials and Production.
Type og sprog <i>Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.</i> <i>Angivelse af sprog.</i> 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 2 x 45 minutes' theoretical lecture sessions with examples followed by 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 <i>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).</i>
<u>Fra Studieordningen:</u>
Viden <ul style="list-style-type: none">• Har viden om forholdet mellem forskellige materials belastning (spænding) og deformation (tøjning), f.eks. metaller, tekstiler, biologiske væv)• Har viden om spændings og tøjnings tensoriske egenskaber og den gensidige afhængighed mellem dem• Har overordnet viden om processen fra den makroskopiske tilstand (geometri, materialer, belastninger) over deformationstilstanden til den lokale tilstand (spænding og tøjning i et punkt, brudforudsigelse)• Har viden om det forhold, at der eksisterer forskellige styrkemodeller afhængig af materialevalg og multi-aksiale belastninger• Har viden om forskellen mellem statisk belastning, udmattelsesbelastning og slagbelastning
Færdigheder <ul style="list-style-type: none">• Kan anvende fagets metoder på simple tilfælde (f.eks. bjælker og stænger) og dermed vurdere deformationer og brudrisici• Kan vurdere primære kriterier i forbindelse med struktur- og materialevalg (f.eks. maksimalbelastning, acceptabel deformation, energiabsorption)• Kan vurdere antallet af belastningscyklusser før brud til sammenligning med belastningskurver
Kompetencer <ul style="list-style-type: none">• Kan vurdere komplekse strukturer gennem diskretisering af deres strukturelle elementer (bjælker, stænger, søjler etc.)

- Kan indgå i en kvalificeret dialog med ingeniører om idrætsprodukters materialer

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.

Modulaktiviteter

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 underviser*	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 loaded members. (Lectures + Problem solving)	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.
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 ap-	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

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

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

Exam

Skriftlig stedprøve (4 timer) - ingen internet (udover til ud- og aflevering af eksamensopgave) og ikke adgang til Moodle.

Tilladte hjælpemidler er skriveredskaber, lommeregner, lærebog og egne notater.

Re-eksamen er mundtlig med udgangspunkt i det ordinære eksamenssæt. Ingen hjælpemidler er tilladt, men egne noter må dog gennemses kortvarigt efter trækning af spørgsmål.

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 Master, Sports Technology, 2 nd semester Studienævn for Idræt og Folkesundhedsvidenskab
Modulansvarlig <i>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.</i> Daniel GH Sørensen, Department of Materials and Production, daniel@mp.aau.dk
Type og sprog <i>Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.</i> <i>Angivelse af sprog.</i> 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 <i>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).</i> Fra Studieordningen: Students who complete the module: Viden <ul style="list-style-type: none">• Har viden om produktkarakteristika i forhold til afklaring af brugers behov• Har viden om produktspecifikationer samt overordnet forståelse for produktudviklingsprocessen• Har viden om de grundlæggende produktionsprincipper, herunder almindelige produktionsprocesser, planlægning, forsyningskæder og udlicitering• Har viden om, hvordan man kommer fra idéen om konceptet/produktet til udvikling af prototypen samt specifikation af produktionsopsætningen• Har viden om samspillet mellem design, materialer og produktion samt hvordan disse faktorer påvirker omkostninger og kvalitet• Har viden om økonomi i forbindelse med produktion og produktudvikling Færdigheder <ul style="list-style-type: none">• Kan vælge egnede analyseredskaber og metoder til den pågældende applikation i forbindelse med produktudvikling og produktion

- Kan kommunikere analyseresultaterne fra produktudviklingsfasen til produktionsafdelingen
- Kan vælge materialer samt fastlægge processen og produktionsopsætningen
- Kan anvende økonomiske analyseværktøjer på problemstillinger vedr. produktudvikling.

Kompetencer

- Kan diskutere den idrætsvidenskabelige ingeniørmæssige designproces
- Kan vurdere værdiforøgelsen i et projekt med fokus på industrielt design og produktion
- Kan på kvalificeret vis forhandle med offshore-producenter af idrætsprodukter

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 off-shoring. 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 frame the remaining lectures.
Lecture + exercise Product Development	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 Requirements & product concepts	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	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 Polymers - composition, structure and thermo-mechanical properties	Jens Henrik Andraesen	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	Jens Henrik Andraesen	Have knowledge about the interplay between design, material, processing and cost and quality

Polymer composites and their mechanical properties		Can communicate analysis results from the product development towards the manufacturing department Can choose material, process and manufacturing set-up
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.

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

Eksamen

Skriftlig stedprøve med hjælpemidler (inkl. internetadgang og adgang til moodle)

The exam will be written since the learning outcomes of this course are broad, and multiple lecturers will participate. Furthermore, several activities are part of the course, including creation of models and calculations.

The exam will be in English and last 3 hours. Exam questions will be handed out through Digital Eksamen, and answers should be returned in the same place.

Students should be using their computer, along with the permitted materials: course material (consisting of literature and slides), calculator, and notes. No communication is allowed, except with the exam guard.

Students will be asked one or more questions related to each lecture in the course. These may involve calculation, elaboration, and definition tasks covering the course curriculum.

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

Korrekturlæser: Daniel G.H. Sørensen

Modulbeskrivelse (en beskrivelse for hvert modul)

Modultitel, ECTS-angivelse Numerical Modelling / Numerisk modellering 5 ECTS course module
Placering Master, Sports Technology, 2 nd semester Studienævn for Idræt og Folkesundhedsvidenskab
Modulansvarlig <i>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.</i> Brian L.V. Bak, Department of Materials and Production, brianbak@mp.aau.dk .
Type og sprog <i>Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.</i> <i>Angivelse af sprog.</i> 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 lecture before the following lecture is given. To support the competencies of the learning goals, the 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 <i>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).</i>

Fra Studieordningen:

Students who complete the module:

Viden

- Har viden om, hvordan man opstiller en geometrisk specifikation af et produkt ved hjælp af computerbaserede modeller og brug af computerstøttet design (Computer-Aided Design) og tekniske tegninger
- Har viden om, hvordan finite element-metoden kan bruges til at opnå approksimerede løsninger på fysiske problemer, der kan formuleres med partielle differentiaalligninger.
- Har viden om finite element-metodens anvendelser, antagelser og begrænsninger
- Har viden om simuleringstidens betydning for nøjagtigheden af modellen/analysen
- Har viden om de numeriske trin, man gennemløber i en finite element-analyse for at opnå resultater for deformation (tøjning) og belastning (spænding).

Færdigheder

- Kan opstille en tredimensionel parametrisk model for en struktur eller en komponent med kommercielt computersoftware
- Kan udarbejde og fortolke en teknisk tegning af et produkt (dvs. en struktur eller en komponent)
- Kan producere en lineær belastningsanalyse ved hjælp af et kommercielt finite element-program.
- Kan fortolke og rapportere resultaterne af enkle finite element-analyser
- Kan demonstrere en grundlæggende forståelse for begreber og anvendelser af finite element-analyser i et idrætsvidenskabeligt perspektiv

Kompetencer

- Ved hvornår og hvor det giver mening at anvende finite element-analyse som en del af en analyse- eller designproces i idrætsvidenskab og ingeniørprocesser
- Kan gennemføre en kvalificeret dialog med specialister i numerisk analyse af idrætsprodukter

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 deltagerne, 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 by problem 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 underviser*	Læringsmål fra studieordning
L1: Introduction to geometrical 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 structure or component using a commercial computer software program 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 documentation (Lectures + exercises)	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 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.

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

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

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

Eksamen

The exam is an individual oral exam without preparation.

At the exam you have to present/answer questions, which is provided by the teacher no later than at the last lecture of the course. This means that you know all possible questions in advance, but you will not know in advance which specific ones you have to answer at the exam. All the questions are within the course curriculum. In order to determine which questions, 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.

It is expected that you present the subject or answer the questions with the use of the paper and pencil (or corresponding), 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 demonstrate that you understand 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.

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 Embedded/mobile Systems and their Applications in Sports / Indlejrede/mobile systemer og deres anvendelse indenfor idræt) 5 ECTS course module
Placering Master, Sports Technology, 2 nd semester Studienævn for Idræt og Folkesundhedsvidenskab
Modulansvarlig <i>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.</i> Afshin Samani, Department of Health Science and Technology, afsamani@hst.aau.dk
Type og sprog <i>Angivelse af modulets type: fx projektmodul, kursusmodul, casemodul eller lign.</i> <i>Angivelse af sprog.</i> 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 5 lecture blocks and 5 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 and some accessories to implement the exercises. An affordable kit is considered for this purpose and it can be ordered online from the link below. https://jentrionic.dk/iot-mainboards/45-doit-esp32-iot-mainboard.html https://jentrionic.dk/iot-displays/41-oled-13-spi.html https://jentrionic.dk/diverse-moduler/64-accelerometer-3-aksler.html https://jentrionic.dk/starter-saet/19-breadboard-starter-saet.html We recommend that all the students order the kit altogether so that they pay only a single freight fee. 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: Kolban's book on ESP32 https://leanpub.com/kolban-ESP32 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:

Viden

- Har viden om elementerne i og de underliggende videnskabelige principper for indlejrede (embedded) systemer
- Har viden om hvordan man skaber løsninger til virkelige (real-world) problemer ved hjælp af indlejrede systemer
- Har viden om de grundlæggende principper for computerprogrammering

Færdigheder

- Kan anvende mikro-controller-baserede systemløsninger i idrætsrelaterede projekter
- Kan implementere hardware- og softwareløsninger ad hoc
- Kan forholde sig kritisk til originale tekniske rapporter, der er relevante for idræsteteknologi

Kompetencer

- Kan identificere hardware- og software-løsninger og medvirke til deres implementering

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: Principles of electric circuits	Afshin Samani	Have knowledge of about building-blocks and the underlying scientific principles of embedded systems
Workshop 2	Afshin Samani	Can implement ad-hoc solutions for hardware and software design
Block 3: 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 3	Afshin Samani	<p>Can apply microcontroller-based systems solutions for sport relevant projects</p> <p>Can critically read original technical reports relevant to sports technologies</p> <p>Can identify hardware and software solutions and partially implement them</p>
Block 4: General and basic concepts in programming of microcontrollers II	Afshin Samani	<p>Have knowledge of about building-blocks and the underlying scientific principles of embedded systems</p> <p>Have knowledge on how to build solutions to real-world problems using embedded systems</p>
Workshop 4	Afshin Samani	<p>Can apply microcontroller-based systems solutions for sport relevant projects</p> <p>Can critically read original technical reports relevant to sports technologies</p> <p>Can identify hardware and software solutions and partially implement them</p>
Block 5: Ad-hoc solutions for sport technology relevant projects	John Hansen	<p>Have knowledge on how to build solutions to real-world problems using embedded systems</p> <p>Can apply microcontroller-based systems solutions for sport relevant projects</p> <p>Can implement ad-hoc solutions for hardware and software design</p> <p>Can critically read original technical reports relevant to sports technologies</p>
Workshop 5	John Hansen	<p>Can implement ad-hoc solutions for hardware and software design</p> <p>Can critically read original technical reports relevant to sports technologies</p> <p>Can identify hardware and software solutions and partially implement them.</p>

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

Eksamen

Individuel mundtlig prøve med forberedelse

- Hvordan eksamensform og eksamensindhold hænger sammen med læringsmål og undervisningsaktiviteter, samt hvordan læringsmål udprøves.

Learning outcomes will be examined by assigning the students to a practical task involving understanding, bug fixing, extending typical embedded hardware and solution similar to those which has been discussed and practiced in the course.

- Eksamenssprog

Primarily Danish, the students can choose to do it in English if they prefer that. The questions may be given in English

- Varighed af eksaminationen + varighed af evt. forberedelse

15 min exam period +15 min preparation

- Tilladte hjælpemidler:

The students must have their computer with all the required software installed. The launchpad kit and the required accessories must be available. The student can have provided datasheet, book and references provided in the course but no internet connection is allowed.

- Udlevering af materiale til brug ved eksamen

The students may be provided with extra-accessories in case they are deemed not at their disposal.

- Praktisk afvikling

The students would be provided with the code of embedded software and the required embedded hardware with a given function. The students must be able to understand its components, fix bugs, extend or modify the functionality of the software and hardware. All the software and hardware pieces are very much similar to what they have already practiced in their course.

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