Semester Description of Study Programme at Aalborg University

Semester description for 2nd semester, Master of Science in Medicine with Industrial Specialisation, Spring, 2021

Semester details

Study Board of Medicine, The Faculty of Medicine, Aalborg University.
CURRICULUM OF MASTER OF SCIENCE IN MEDICINE WITH INDUSTRIAL SPECIALISATION 2020: https://studieordninger.aau.dk/2020/23/1811

Semester framework theme

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

The programme is structured into three profiles: Biomedicine, BM; Translational Medicine, TM; Medical Market Access, MMA.
Biomedicine focuses on the understanding of causes and treatment of disease at the molecular and cellular level. It builds upon the understanding of whole-body functions. The students will learn how to perform hypothesis-driven experiments in order to understand human pathophysiology and to identify new targets for treatment. Therefore, a substantial part is devoted to experiments on cells or laboratory animals. In this semester the courses Regenerative medicine, Disease Processes and Diagnostics – Personalized Medicine and Immuno- and Molecular Therapy will support this.
Translational medicine is driven by the objective of improving clinical outcomes by efficiently moving results from basic science to clinical application. In this semester this is supported by the courses Immuno- and Molecular Therapy, Translational Research Principles, and Advanced statistics.
Medical Market Access is driven by the objective to improve market access of industry within the biotechnological, pharmaceutical and medical devices markets. The will be done through the courses Decision-Analytic Modelling and Trial-Based Evaluations in Health Economics, Organisation and Financing in Healthcare and Advanced Statistics.
All profiles will make a project in Applied Project Management within Medicine with Industrial Specialisation.

Semester organisation and time schedule

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

Definitions of course activities
The semester applies a combination of academic, problem-oriented and interdisciplinary approaches and organised based on the following work and evaluation methods that combine skills and reflection (depends on the course and topic). See below list. All forms are included in this semester.

Lecture – a 45-90 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 – lectures 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 - scheduled study activity in which students present the task they are doing, in order to feedback from teachers and fellow students.
Mini Project - students prepare in small groups a project - a self-chosen task, which allows them to train

skills in project management.

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

Semester coordinator: Tue Bjerg Bennike tbe@hst.aau.dk, Department of Health, Science and Technology
Semester secretary: Dorthe Skree, dsk@hst.aau.dk, The Faculty of Medicine
Semester representative (student): See Moodle page

Module description (description of each module)

Module title, ECTS credits (and possibly STADS code)
APPLIED PROJECT MANAGEMENT WITHIN MEDICINE WITH INDUSTRIAL SPECIALISATION / Anvendt projektledelse indenfor medicin med industriel specialisering
Profile: BM/TM/MMA
15 ECTS
Code: MEDMS20K2_1

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Tue Bjerg Bennike tbe@hst.aau.dk, Department of Health, Science and Technology

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

Project module
English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:
SKILLS

- Extract relevant information from the scientific literature and interpret that information in relation to the problem
- Apply selected scientific methods to the identified problem and argue for the relevance of these methods
- Evaluate the planning of the project work and reflect on the significance of planning for the accomplishment of the project
- Identify own need for learning and knowledge to conduct the project

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

Overall, the students should identify their own need for learning and knowledge to conduct the project. Furthermore, the project will enable the students to extract and interpret relevant information from the scientific literature, apply selected scientific methods and argue for the relevance of these. Additionally, the planning of the project and the significance of this for the accomplishment should be evaluated.
The subject of the projects will vary since there are different research topics represented in the sections of BM, TM, and MMA.

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

The project is planned to encompass 15 ECTS/450 hours/half of the semester. The students are supposed to do initial theoretical preparations (est. 50 hours) followed by the practical work (est. 300 hours), report writing (est. 75 hours) and reading and preparations to the exam (est. 25 hours) the practical work in the laboratory and meetings with the supervisor

15 ECTS course (450 hours):
Theoretical research: 50 hours
Practical work: 300 hours
Report writing: 75 hours
Preparation including exam: 25 hours

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

2nd semester students of the Master of Science in Medicine with Industrial Specialisation with the BM, TM, and MMA profile.

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

Participation in all exams of the 1st Semester is required

Module activities (course sessions etc.)
Depending on the profile, BM, TM, or MMA, the students are expected to choose a project proposed for their profile. They are expected to be able to implement knowledge from the courses of this and earlier semesters.
The supervisors are mainly affiliated to (but not limited to) The Department of Health Science Technology (HST) and Department of Clinical Medicine. External co-supervisors can be involved when relevant for the project.

Examination
1. Oral group examination
2. During the exam both the supervisor and maybe co-supervisor will be present together with an internal examiner
3. During the project period, the students will write a project and hand it in using "Digigtal Eksamen" – date TBA. The exam is initiated by the students giving a scientific presentation of their project, followed by questioning by the examiners.
4. There is 45 min available in total for each student covering: student presentations, questioning by examiners and grading. As an example, a group of 4 students will be examined for 4 x 45 min = 3 hours covering: student presentations, questioning by examiners, and grading.
5. The project will be evaluated using the 7-point grading scale and the grade will be given individually and based on an overall assessment of:

a) The written project
b) The individual student presentation of the project
c) The individual performance of the students during the oral examination

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)
Profile: BM
Regenerative Medicine / Regenerativ medicin
5 ECTS course module
Module code: MEDMS20K2_2

Location
Master, Science in Medicine with Industrial Specialisation, 2nd semester
Board of Studies for Medicine

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

Vladimir Zachar, vlaz@hst.aau.dk, HST (Inst. 21)

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

Course module in English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:
After attending this course, the student is expected to:

Knowledge
- Has knowledge about engineering, developmental, molecular biological, biological, and medical concepts

Skills
- Can apply an understanding of the processes that determine at the molecular level cellular responses into schemes that aim to replace human tissues or organs, or aim at the restoration of physiological state of thereof
- Can design rational biotherapies for relevant human diseases using appropriate set of engineering and molecular biological tools
- Can assess the prospective value of proposed solutions, including medical significance and feasibility, both at the theoretical and empirical levels
- Can apply different regenerative and tissue engineering approaches to treat intractable human diseases.

Competences
- Must have insight into molecular processes that underlie cell-cell as well as cell-material interactions and must understand how knowledge of these processes can be applied for the benefit of tissue regeneration in vivo and engineering of tissues in vitro.
- Can research, synthesize, and critically appreciate knowledge available across different fields to account for treatment options that are viable from the point of currently established medical criteria
- Can evaluate and identify novel areas of interest, the theoretical and practical knowledge of is necessary, in order to accomplish a successful regenerative therapeutic paradigm.

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

The module addresses in the first part interactions between the cells and biomaterials and the properties of stem cells. In the second part, the previous knowledge is used to obtain a deeper understanding of cell-based and tissue engineering approaches to treat pathological conditions of major organ systems.

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

Total student load is 5 ECTS in the form of study group.
Each topic is introduced by a 45 min lecture followed by 90 min to deliver the assignment. Giving a total of 125 min combined lecture and group work + preparation for lecture. There are in total 7 hrs for individual study.

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

MedIS students

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

Participation in exams on 1st semester

Module activities (course sessions etc.)

Activity - type and title	**Planned instructor***	**Learning goals from curriculum**
Lecture: Intro + Cell fate	V. Zachar RMG	- Introduction to the course - Basic cell responses - Signal transduction, cell survival
Lecture: Extracellular matrix and environment	C.P. Pennisi RMG	- Basic cell responses - Extracellular molecules, cell responses to environment
Lecture: Biomaterials and biocompatibility	C.P. Pennisi RMG	- Cell-material interactions - Chemistry of biomaterials, surface topography and physical properties
Lecture: Tailoring biomaterials	C.P. Pennisi RMG	- Cell-material interactions - Cell responses to 2- and 3- dimensional matrices, manufacturing of scaffolds
Lecture: Pluripotent stem cells	V. Zachar RMG	- Cell and molecular responses - Types and biology of pluripotent stem cells, differentiation strategies, therap. applications
Lecture: Somatic stem cells	H. Alipour RMG	- Cell and molecular responses - Types and biology of somatic stem cells, differentiation strategies, therap. applications
Lecture: Neural regeneration	F. Febbraro AU	- Specific regenerative approach - Structure of nervous system, regeneration of CNS and PNS
Lecture: Cartilage regeneration	V. Zachar RMG	- Specific regenerative approach - Structure of cartilage, approaches to regenerate cartilage
Lecture: Bone regeneration	T. Fink RMG	- Specific regenerative approach - Structure of bone, approaches to regenerate bone
Lecture: Skeletal muscle regeneration	C.P. Pennisi RMG	- Specific regenerative approach - Structure of skeletal muscle, approaches to regenerate skeletal muscle

Lecture: Smooth muscle regeneration	J. Emmersen RMG	- Specific regenerative approach - Structure of smooth muscle, approaches to regenerate smooth muscle
Lecture: Corneal regeneration	H. Alipour RMG	- Specific regenerative approach - Structure and physiology of corneal limbus, approaches to regenerate cornea
Lecture: Cell-based therapies for wound healing	S. E. Riis RMG	- Specific regenerative approach - Pathophysiology of chronic wounds, approaches to treat chronic wounds
Lecture: Regeneration of heart	F. Dardmeh RMG	- Specific regenerative approach - Cell-based therapy of heart from a clinical perspective
Lecture: Special lecture by invited guest	To be announced	- To be announced

* *All rights reserved for changes during the semester due to e.g. illness, cancellations etc.*

Examination

1. The exam is written with grading.
2. The exam is based on assay type questions, each covering a module.
3. Modul co-ordinator participates at the exam.
4. The exam is done through “Digital Eksamen”
5. The duration of the exam is 2 hours.
6. Aids are not permitted.

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)

Immuno- and Molecular Therapy / Immun- og molekylærterapi
Profile: BM+TM
5 ECTS course module
Module code: MEDMS20K2_3

Location

Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

Module coordinator

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

Coordinator Ralf Agger, agger@hst.aau.dk Department of Health Science and Technology

Co-coordinator (molecular therapy part): Torben Moos (tmoos@hst.aau.dk) HST

Type and language

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

English

Objectives

Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

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

The course builds on the qualifications in biochemistry, cell biology, pathology, and immunology acquired in the bachelor program of Medicine with Industrial Specialization or in similar bachelor programs. Furthermore, the course draws on the course on molecular and cellular methods in biomedicine taught on the 1st semester of the master programme in Medicine with Industrial Specialization.

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

The total load of 5 ECTS (150 hours) is distributed between:
The course consists of 9 sessions with the following activities:

- **Lecture**: Two lectures per session 1-9 (90 min (approximately) = total 13.5 hours)
- **Workshop/Exercise:** The remaining time after lectures (session 1-9, 90 min (approximately): 13.5 hours; session 10, 180 min: 3 hours = Total 16.5 hours) will be used for practices in form of exercises, cases (work with literature and study problems), student presentations and discussion in plenum with feedback from the course organiser.
- **Self-Study** – Student are expected to prepare for each session 9hours
- **Preparation for exam** 30 hours

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

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

Passed course in basic immunology (module 2.3 of the AAU medicine/medIS bachelor programme or equivalent). Passed course on proteomic and genomics ("Proteomics and Genomics in Diagnostics and Disease" on the AAU medIS master programme or equivalent).

Module activities (course sessions etc.)

Level 1		
Activity - type and title	**Lecturer including department affiliation***	**Learning goals from curriculum**
Immunotherapy session 1. Lecture: "Transplantation immunology and immunosuppressive drugs - with an introduction to immu-notherapy" Clinical lecture: "Kidney transplantation and how	Ralf Agger, HST, AAU (Torben Moos, HST, AAU: introduction to molecular therapy) Birgitte Bang Pedersen, con- sultant, Dept. of Nephrology, Aalborg University Hospital.	**Knowledge** • Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes • Argue how proteins and products of the immune system (antibodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and

to avoid rejection" (Titles of lectures are preliminary) Work with study problems and discussion in plenum		immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immunotherapy for a series of typical patients and give reasons for the choices.
Immunotherapy session 2. **Lecture:** "Immunostimulatory and immunomodulatory drugs (-imex and -imod)" **Clinical lecture:** "Immune therapy in MS" (Titles of lectures are preliminary)" Work with study problems and discussion in plenum	Emil Kofod-Olsen, HST, AAU Claudia Pfleger, Dept. of Neurology, Aalborg University Hospital.	**Knowledge** • Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes • Argue how proteins and products of the immune system (antibodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Immunotherapy session 3. **Lecture:** "New and experimental forms of immunotherapy in cancer" **Clinical lecture:** "Immune checkpoint blockade as a treatment for cancer" (Titles of lectures are preliminary)" Work with study problems and discussion in plenum	Ralf Agger, HST, AAU Andreas Carus, Dept. of Oncology, Aalborg University Hospital	**Knowledge** • Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes • Argue how proteins and products of the immune system (antibodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Immunotherapy session 4. **Lecture:**	Emil Kofod-Olsen, HST, AAU Line Uhrenholt, Dept. of	**Knowledge** • Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes

"Tissue damage induced by the immune system" **Clinical lecture:** "Biologic treatment in rheumatoid arthritis" (Titles of lectures are preliminary)" Work with study problems and discussion in plenum	Rheumatology, Aalborg University Hospital	• Argue how proteins and products of the immune system (antibodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Immunotherapy session 5. **Lecture:** "Tolerance and autoimmunity" **Clinical lecture:** "Autoimmune diseases with focus on SLE and ANCA-associated vasculitis" (Titles of lectures are preliminary)" Work with study problems and discussion in plenum	Ralf Agger, HST, AAU Jon Waarst Gregersen, Dept. of Nephrology, Aalborg University Hospital.	**Knowledge** • Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes • Argue how proteins and products of the immune system (antibodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Molecular therapy session 1 - Peptide and protein therapeutics Lecture 1: "Introduction to the module: Immuno- and Molecular Therapy" Lecture 2: "Peptide and protein therapeutics" Lecture 3: "TBA"	Torben MoosHST, AAU TBA	**Knowledge** • Argue how proteins and products of the immune system (anti- bodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drugencapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the

		choices.
Molecular therapy session 2 – Gene therapy Lecture 1 and 2: "Viral and Non-viral drug delivery" Work with study problems and discussion in plenum	Eva Hede Olsen, HST, AAU	**Knowledge** • Argue how proteins and products of the immune system (anti- bodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Molecular therapy session 3 – Targeted theapy Lecture 1: "Targeted delivery" Lecture 2: "Macromolecular drug transport into the brain using targeted therapy" Work with study problems and discussion in plenum	Torben Moos, HST, AAU	**Knowledge** • Argue how proteins and products of the immune system (anti- bodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.
Molecular therapy session 4 – Nano carriers and their formulation Lecture 1 and 2: "Multifunctional Nanocarrier systems, their formulations and clinical value" Work with study problems and discussion in plenum	Kasper Bendix Johnsen, DTU Health Tech	**Knowledge** • Argue how proteins and products of the immune system (anti- bodies, cytokines and cells) can be utilized as therapeutic agents either as such or in conjugation with drug-encapsulated carriers **Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the

		choices.
Molecular therapy session 5 – Follow up. Student presentations and discussion in plenum.	Torben Moos, HST, AAU	**Skills** • Summarize the mechanisms of action of different forms of protein and immunotherapy • Design experiments in protein and immunotherapy **Competences** • Compare and suggest suitable forms of protein and immuno therapy for a series of typical patients and give reasons for the choices.

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Examination
Examination

1. Written exam and Digital Exam (www.de.aau.dk) will be used.

2. The students will be tested in their knowledge, skills, and competences obtained through the module by answering multiple choices, short and long assay questions, and cases.
3. The exam:
    a. Duration: 2 hours
    b. Remember to bring your student identification card
    c. Please make sure to install the program ITX-Flex. AAU takes no liability if there arise problems with your electronic equipment Dataset and written materials.
    d. Digital Exam Questions are in English (NB! There will be no dictionaries available).
    e. The answers may be in English or Danish
    f. No form of communication with other examinees is allowed
    g. No aids of any kind are allowed

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)
Advanced statistics
Profile: TM+MMA
5 ECTS
Module code: MEDMS20K2_4

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Kristian Kjær Petersen, KKP@hst.aau.dk, Department for Health Science and Technology

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

English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:
KNOWLEDGE
- Overview of different types of data sources and statistical methods
- Principles of decision-making for evidence-based healthcare
- Understand how clinical trail design affect statistical choices

SKILLS
- Can write a statically analysis plan (SAP) for a clinical trial
- Can perform selected statistical tests including multi-factorial analysis
- Can report statistical results

COMPETENCES
- Can develop appropriate designs for clinical research
- Can select appropriate statistical analysis
- Critical discuss differences in outcomes using different clinical trial designs (case, cohort, parallel, un-controlled, RCT etc).

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

This module is focused on providing students with the needed skills for conducting statistical analysis plans and therefore a large part of the module is dedicated towards this goal. This module adds to the pre-existing module on “Statistics and Study Design (MEDIS bachelor)”.

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

The module comprises lectures and classroom activities on various theoretical subjects, work with study problems, presentations by students, and lectures by experts in clinical trials. Students are required to actively participate in module and to write a statistical analysis plan (SAP), which is to be presented at the end of the course during a workshop.

Workload will correspond to the 5 ECTS credits (i.e. 150 hours) provided by the course and the workload is described as follow:

There are nine lectures followed by assignments are planned. Preparing for the lectures and active participation in the lectures correspond to 90 hours of workload. Students (alone or in groups) are to prepare a SAP, which should be evaluated to pass the module and presented during a workshop. The preparation and workshop participation correspond to 60 hours of work.

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

Students on the MEDIS Master program with a Translational Medicine or Medical Market Access specialization.

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

Participation in all exams of the 1st semester is required.

Module activities (course sessions etc.)

Level 1		
Activity - type and title	**Lecturer including department affiliation***	**Learning goals from curriculum**
Introduction workshop assignment and the industrial perspective on statistics in clinical trials	Kristian Kjær Petersen and industrial partner	- Can write a statically analysis plan (SAP) for a clinical trial - Can select appropriate statistical analysis - Principles of decision-making for evidence-based healthcare
Lecture Reproducibility and sample size estimation	Carsten Dahl Mørch	- Understand how statistical choices affect clinical trial designs
Lecture Multifactorial ANOVA and Repeated measures ANOVA	Carsten Dahl Mørch	- Understand how statistical choices affect clinical trial designs - Can perform selected statistical tests including multi-factorial analysis
Lecture Multiple linear regressions	Carsten Dahl Mørch	- Understand how statistical choices affect clinical trial designs - Can perform selected statistical tests including multi-factorial analysis
Lecture Multiple logistic regressions	Carsten Dahl Mørch	- Understand how statistical choices affect clinical trial designs - Can perform selected statistical tests including multi-factorial analysis
Lecture Survival analysis	Morten Hasselstrøm Jensen	- Understand how statistical choices affect clinical trial designs -
Lecture Generalized linear models	Morten Berg Jensen / Carsten Dahl Mørch	- Can select appropriate statistical analysis
Lecture Metaanalysis and network metaanalysis	Morten Berg Jensen	- Overview of different types of data sources and statistical methods - Principles of decision-making for evidence-based healthcare - Critical discuss differences in outcomes using different clinical trial designs (case, cohort, parallel, un-controlled, RCT etc).
Lecture Statistical analysis of validated questionnaires	Morten Berg Jensen	- Overview of different types of data sources and statistical methods - Can perform selected statistical tests including multi-factorial analysis - Can report statistical results - Can select appropriate statistical analysis
Preparation of workshop	Students	- Can write a statically analysis plan (SAP) for a clinical trial
Workshop Student presentations of assignment work	Kristian Kjær Petersen, Carsten Dahl Mørch, Morten Berg Jensen	- Can develop appropriate designs for clinical trials. - Can report statistical results - Critical discuss differences in outcomes using different clinical trial designs

		(case, cohort, parallel, un-controlled, RCT etc).

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Examination

Prerequisite for enrolment for the exam requires active participation and approval of presentation during the course, meaning that each student should participate in the following obligatory activities:

1) *prepare and upload a statistical analysis plan*
2) *Participate in a workshop where the statistical analysis plan is presented and constructive criticism is provided to other statistical analysis plans*
3) *Prepare and upload a portfolio of solutions to exerciese posed during the course module*

The exam will be an oral exam, where the students draw and explains an exercise from the portfolio or the statistical analysis plan. The exam lasts for 20 min including assessment. The course responsible and lectures will be examiner and internal censor. The exercise portfolio and the statistical analysis plan are available during the exam. The course will be graded Passed/Not Passed.

Module title, ECTS credits (and possibly STADS code)
Decision-Analytic Modelling and Trial-Based Evaluations in Health Economics / Beslutningsanalytisk modellering og forsøgsbaserede evalueringer indenfor sundhedsøkonomi
Profile: MMA
5 ECTS
Module code: MEDMS20K2_5

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Mathilde Slot
Department of Clinical Medicine
(Anne Sig Sørensen asv@dcm.aau.dk vikar indtil 1. Februar 2021)

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

English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:

Knowledge

- Understand what decision-analytic modelling implies and its relation to prioritisation in healthcare
- Demonstrate knowledge of different types decision-analytic models and their application in health economic evaluation
- Demonstrate knowledge of the design and methods for economic analysis conducted alongside clinical trials
- Understand the importance of uncertainty and how it may affect decision making
- Understand the potential value of future research in relation to the decision making process
- Demonstrate basic knowledge of cutting-edge methods within economic evaluation

Skills

- Extract, present and analyse relevant data for the construction of decision-analytic models by conducting a systematic search of the existing literature
- Design and apply decision-analytic models for the evaluation of new interventions
- Analyse real-world data in relation to economic evaluation using statistical software
- Produce a probabilistic sensitivity analysis

Competences

- Differentiate between different types of uncertainty and assess the importance for economic evaluation
- Critically assess the methods and results of health economic evaluations based on decision-analytic modelling

Academic content and conjunction with other modules/semesters

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

Evidence of 'value for money' is increasingly requested when healthcare technology is introduced in healthcare systems in many countries, including Denmark. The construction and understanding of sound economic evaluation are pivotal for making informed prioritization in healthcare. Consequently, the knowledge, skills, and competencies needed to both execute and evaluate advanced economic evaluation are increasingly valuable for businesses and the public sector as it may substantiate informed decision making.

The course provides knowledge, skills, and competencies for decision-analytic modelling and economic evaluation alongside clinical trials. It builds on the 1st-semester course "Methods of Economic Evaluation in Healthcare" in the master of Medical Market Access, in which the basic principles of economic evaluation were introduced.

The course provides the students with hands-on experience of how to construct advanced economic evaluations. This experience includes knowledge, skills, and competencies relevant to the construction of evidence-based decision-analytic models using relevant software programs such as TreeAge and Excel. Furthermore, the students will become acquainted with and gain hands-on knowledge of advanced methods used for economic evaluation alongside clinical trials, using relevant statistical software, such as Stata. Also, the students will be introduced to cutting-edge, currently applied research within economic evaluation used in research and business practice.

In short, the students attending the course will learn how to conduct advanced economic evaluation and analyses using decision-analytic models and statistical methods using large data sets. The underlying focus of the course is the use of the methods and analyses in research and business with a particular emphasis on medical market access.

Scope and expected performance

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

'Decision-analytic Modelling and Trial-based Evaluation in Health Economics' is a 5 ECTS course and the students can expect a workload of approximately 150 hours. These may be distributed as follows or as according to the students own volition and judgement:

- **Lectures**: 8 lectures á 4 hours = 32 hours + 1 lecture á 2 hours; in total 34 hours (the lectures contain lecture delivery with the use of intermittent supporting exercises to ensure coherence between and understanding of the introduced theory and its practical application)
- **Workshops**: 3 workshops á 4 hours = 12 hours, providing hands-on experience with decision-analytic models and the execution of trial-based evaluations.
- **Preparation during the semester:** the students should expect to use approximately 80 hours for preparations during the semester. The time should be used for, particularly, reading, but also exercises presented during lectures.
- **Preparation for the exam:** 3 working days x 7,4 hours/working day, including time for reading a text in preparation for the exam = approx. 22 hours.
- **Exam**: 2 hours.

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

The course is a part of the Medical Market Access programme, and participants are primarily students who have enrolled at the Medical Market Access programme. It builds on the 1st-semester course 'Methods of Economic Evaluation in Healthcare', and students from other educations should not participate without a basic understanding of health economic evaluation from that or similar courses.

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

Prerequisites for participation in the course include participation in the courses taught at the 1st semester of the master Medical Market Access, with a particular emphasis on the course 'Methods of Economic Evaluation in Healthcare' OR the attained competencies, skills, and knowledge equivalent to what is taught in the 1st semester of the master Medical Market Access.

Module activities (course sessions etc.)

Level 1		
Activity - type and title	**Lecturer including department affiliation***	**Learning goals from curriculum**
Lecture 1: *Introduction to decision theory and decision-analytic modelling*	Anne Sig Sørensen, Department of Clinical Medicine	• Understand what decision-analytic modelling implies and its relation to prioritisation in healthcare • Demonstrate knowledge of different types decision-analytic models and their application in health economic evaluation • Design and apply decision-analytic models for the evaluation of new interventions
Lecture 2: *Investigating uncertainty: Deterministic sensitivity analysis*	Anne Sig Sørensen, Department of Clinical Medicine	• Understand the importance of uncertainty and how it may affect decision making • Differentiate between different types of uncertainty and assess the importance for economic evaluation
Lecture 3: *Investigating uncertainty: Probabilistic sensitivity analysis*	Anne Sig Sørensen, Department of Clinical Medicine	• Understand the importance of uncertainty and how it may affect decision making • Differentiate between different types of uncertainty and assess the importance for economic evaluation • Produce a probabilistic sensitivity analysis

Workshop session I: *Building decision trees, making them probabilistic and interpreting the results from probabilistic sensitivity analyses*	Sabine Raunbak Michelsen and Matilde Slot, Department of Clinical Medicine	• Design and apply decision-analytic models for the evaluation of new interventions • Produce a probabilistic sensitivity analysis • Understand the importance of uncertainty and how it may affect decision making
Lecture 4: *Markov modelling*	Anne Sig Sørensen, Department of Clinical Medicine	• Demonstrate knowledge of different types decision-analytic models and their application in health economic evaluation • Design and apply decision-analytic models for the evaluation of new interventions
Lecture 5: *Advanced topics within decision-analytic modelling*	Anne Sig Sørensen, Department of Clinical Medicine	• Demonstrate knowledge of different types decision-analytic models and their application in health economic evaluation • Understand the potential value of future research in relation to the decision making process • Demonstrate basic knowledge of cutting-edge methods within economic evaluation
Workshop session II: *Practical introduction to Markov modelling*	Sabine Raunbak Michelsen and Matilde Slot, Department of Clinical Medicine	• Demonstrate knowledge of different types decision-analytic models and their application in health economic evaluation • Design and apply decision-analytic models for the evaluation of new interventions • Produce a probabilistic sensitivity analysis
Lecture 6: *Finding evidence for decision-analytic modelling*	Henrik Vitus Bering Laursen, Sabine Raunbak Michelsen and Matilde Slot, Department of Clinical Medicine	• Extract, present and analyse relevant data for the construction of decision-analytic models by conducting a systematic search of the existing literature •
Lecture 7: *Conducting trial-based evaluations used in health economics I*	Lars Holger Ehlers, Department of Clinical Medicine	• Demonstrate knowledge of the design and methods for economic analysis conducted alongside clinical trials • Analyse real-world data in relation to economic evaluation using statistical software
Lecture 8: Conducting *trial-based evaluations used in health economics II*	Lars Holger Ehlers, Department of Clinical Medicine	• Demonstrate knowledge of the design and methods for economic analysis conducted alongside clinical trials • Analyse real-world data in relation to economic evaluation using statistical software
Lecture 9: *Interpreting published economic evaluations based on decision-analytic modelling*	Sabine Raunbak Michelsen and Matilde Slot, Department of Clinical Medicine	• Critically assess the methods and results of health economic evaluations based on decision-analytic modelling
Workshop session III: *Practical introduction to trial-based economic evaluations*	Sabine Raunbak Michelsen and Matilde Slot or Mads Nørding and Emmelie Ploug, Department of Clinical Medicine	• Demonstrate knowledge of the design and methods for economic analysis conducted alongside clinical trials • Analyse real-world data in relation to economic evaluation using statistical software

Examination

- The exam will be an individual written exam of 2-hour duration.
- Seventy-two hours before the exam starts, a written text, for instance, a report or a scientific paper, will be made available to the students via the Moodle page for the course. A part of the exam questions will take their starting point in this text.
- The written exam questions will be framed so that the students' skills, competencies, and knowledge will be tested with respect to the construction, interpretation and use of decision-analytic models and trial-based evaluations in health economics as covered in the learning objectives. Approximately half of the questions will relate to the students' knowledge with respect to the curriculum, and the other half will relate to their acquired skills and competencies, respectively. Some questions may necessitate the employment of more learning objectives simultaneously. There will be short answer questions and essay questions. The questions will be based on the stated curriculum covered in lectures, in exercises in the workshops, and the stated literature.
- The exam will be assessed using the 7-point grading scale. The exam will be evaluated by the module coordinator or a teacher in the course and an internal examiner. The internal examiner will have the appropriate competencies and knowledge of the academic content related to the course and knowledge of the master Medical Market Access to enable fair assessment of the exam.
- "Digital Eksamen" be used for distribution and handing in the written exam.
- All aids are allowed during the exam, except for the use of the Internet and communication. The Internet may be used for download and upload of the assignment only. It is the students' responsibility to ensure that no communication takes place during the exam.
- If the exam format for the re-examination is changed before the re-examination, this will be announced no later than 14 days before the re-examination takes place.

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)
Organization and Financing in Healthcare

5 ECTS

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Emmelie Jørgensen
Department of Clinical Medicine
(Astrid Langergaard asla@dcm.aau.dk vikar indtil 1. Februar 2021)

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

English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:

Knowledge

- Understand the financing and organization of healthcare systems including differences between the Danish and international healthcare systems
- Understand how different types of financing and organization creates different incentives in healthcare
- Understand theory of health system governance
- Understand how organization and management of healthcare influence patient outcomes.
- Demonstrate knowledge of the primary instruments used in governance of the Danish healthcare system both financial and quality related
- Understand the linkages between quality, economics and governance

Skills

- Use theoretical models and methods for analysis and interpretation of specific quality, economical and governance problems in the healthcare system
- Apply methods for stakeholder analysis within healthcare

Competences

- Analyze and assess the consequences of different forms of governance and financing

Academic content and conjunction with other modules/semesters

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

Healthcare is organised and financed in different ways across the world. The organisation and financing of healthcare is often taken for granted within a country, with little reflection on the alternative governance models, or the implications of different forms of organisation, management and financing on provider performance and patient outcomes.

This modules gives an introduction to the organisation and financing of health care from a health economic perspective. It introduces the analytical tools necessary to understand the choices countries make and are faced with when designing the organisation and financing of healthcare, the incentives created by different design choices, and the consequences of different forms of governance.

The module is designed with a high degree of student interaction, ensuring that students develop their analytical competences throughout the module.

Scope and expected performance

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

'Organization and Finanzing in Healthcare' is a 5 ECTS course and the students can expect a workload of approximately 150 hours. These may be distributed as follows or as according to the students own volition and judgement:

- **Lectures**: 8 topic sets comprising of 1-3 pre-recorded short lectures for asynchronous learning = 10 hours (this does not necessarily equate to the length of recorded lectures, but includes students engagement with the online material)
- **Workshops**: 8 workshops of 2 hours = 16 hours, giving students an opportunity to give and receive formative feedback from their peers and the lecturer on their analytical skills
- **Preparation during the semester:** the students should expect to use on average 7 hours on reading and 4 hours for preparation of presentations for the workshops per topic, in total 88 hours
- **Preparation of final report:** 5 working days x 7,4 hours/working day, = approx. 37 hours

Participants

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

The course is a part of the Medical Market Access programme, and participants are primarily students who have enrolled at the Medical Market Access programme, although other students that fulfil the prerequisites can also participate.

Prerequisites for participation

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

Prerequisites for participation in the course include microeconomic principles introduced in the 1st semester course "Marketing and Market Access for Healthcare". Students from other educations should not participate without a basic understanding of microeconomics from that or similar courses.

Module activities (course sessions etc.)

Søren Rud Kristensen (srkristensen@health.sdu.dk), DaCHE, SDU is the lecturer of all activities

Topic	Description	Activity	Learning goals from curriculum
1	Introduction to the module and key analytical tools	Lectures	• Understand theory of health system governance
		Workshop	• Apply methods for stakeholder analysis within healthcare • Demonstrate knowledge of the primary instruments used in governance of the Danish healthcare system both financial and quality related
2	The demand for healthcare and implications for the organisation and financing of care	Lectures	• Understand how different types of financing and organization creates different incentives in healthcare •
		Workshop	• Use theoretical models and methods for analysis and interpretation of specific quality, economical and governance problems in the healthcare system •
3	Economic arguments for government intervention in healthcare markets and implications for health policy	Lectures	• Understand the financing and organization of healthcare systems including differences between the Danish and international healthcare systems • Understand how different types of financing and organization creates different incentives in healthcare
		Workshop	• Apply methods for stakeholder analysis within healthcare
4	Supply and organisation of healthcare	Lectures	• Understand the financing and organization of healthcare systems including differences between the Danish and international healthcare systems • Understand how organization and management of healthcare influence patient outcomes. • Understand the linkages between quality, economics and governance

		Workshop	• Analyze and assess the consequences of different forms of governance and financing • Use theoretical models and methods for analysis and interpretation of specific quality, economical and governance problems in the healthcare system
5	Financing healthcare: Insurance, taxation and out-of-pocket payments	Lectures	• Understand the financing and organization of healthcare systems including differences between the Danish and international healthcare systems • Understand how different types of financing and organization creates different incentives in healthcare
		Workshop	• Analyze and assess the consequences of different forms of governance and financing
6	Provider reimbursement	Lectures	• Understand how different types of financing and organization creates different incentives in healthcare • Understand the linkages between quality, economics and governance •
		Workshop	• Demonstrate knowledge of the primary instruments used in governance of the Danish healthcare system both financial and quality related • Apply methods for stakeholder analysis within healthcare
7	Equity in health and healthcare	Lectures	• Understand the linkages between quality, economics and governance
		Workshop	• Analyze and assess the consequences of different forms of governance and financing
8	Assessing variation in healthcare use and outcomes	Lectures	• Understand the financing and organization of healthcare systems including differences between the Danish and international healthcare systems • Understand how organization and management of healthcare influence patient outcomes
		Workshop	• Analyze and assess the consequences of different forms of governance and financing • Demonstrate knowledge of the primary instruments used in governance of the Danish healthcare system both financial and quality related

The core reading is

Olsen, J.A., 2017. Principles in Health Economics and Policy, 2nd ed. Oxford University Press.

Supplemented with academic papers as listed in the module reading list

** All rights reserved for changes during the semester due to e.g. illness, cancellations etc.*

Examination

The assessment will consist of a written report comparing the mode of organisation and financing used in Denmark to a county of the student's own choice. The analysis will focus on the dimensions covered in the curriculum and will consist of a classification/description of the country of choice in comparison to Denmark using the concepts presented in course, followed by an analytical assessment of each dimension. Students are strongly encouraged to participate in the workshops which will provide students with opportunities to develop the analytical skills needed for the assignment by giving and receiving feedback on presentations of their ongoing work throughout the module.

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)
Disease Processes and Diagnostics - Personalized Medicine
Sygdomsprocesser og diagnostik - personlig medicin
Profile: BM
5 ECTS
Module code: MEDMS20K2_7

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Coordinator: Jacek Lichota jlichota@hst.aau.dk Department of Health Science and Technology
Co-coordinator: Allan Stensballe as@hst.aau.dk Department of Health Science and Technology

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

English

Objectives
Description of the content and objectives of the course as regards learning objectives of the students in the module. This comprises a transcript of the knowledge, skills and competences described in the study regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

From Curriculum:
Purpose of the course:
The course provides students to cutting-edge personalized medicine (PM) research principles and Omics methods that are related to obtain knowledge in clinical diagnostics, understand disease processes and mode-of-action of drugs in higher eukaryotes, particularly in humans.

LEARNING OBJECTIVES

KNOWLEDGE

- Explain organization of genomes, proteomes and metabolomes in higher eukaryotes, particularly in human

- Explain how epigenetic, transcriptional, proteomic, posttranslational modifications, metabolic and environmental factors influence disease and patients' response to treatment
- Explain the effects of drugs, biologics and small molecules, on their targets
- Explain how drugs regulate and affect disease progresses and what consequences it has for the disease pathophysiology
- Describe genetic, epigenetic and proteomic biomarkers use in diagnostics, biomarker discovery and validation in a personalized medicine context

SKILLS

- Apply advanced molecular methods in diagnostics
- Evaluate a choice of diagnostic method or technology
- Choose appropriate databases, algorithms, statistics and parameters in a bioinformatics analysis
- Analyze systems biology data such as DNA sequences, mRNA, proteins as well as integrated Omics type data using bioinformatics
- Use bioinformatical and analytical strategies to solve problems in personalized medicine

COMPETENCES

- Combine the theoretical knowledge about genomes and proteomes with the ability to perform laboratory experiments in order to design a diagnostic or analytical protocol
- Evaluate the obtained results based on the theoretical knowledge within pathophysiology and molecular medicine
- Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalized genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course

Academic content and conjunction with other modules/semesters

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

The course prepares the students in understanding the concept of personalized medicine in the study of human diseases from laboratory knowledge into new diagnostics, preventing and treating disease. The course equips the students with relevant knowledge to pursue a career as “state-of-the-art” into molecular medicine, diagnostics and related clinical science. The course requires an active participation of the students where the students engage discovery process by tackling on-going research using state-of-the-art.

Scope and expected performance

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

The expected workload of 150 hours for this 5 ECTS module:

Lectures (incl. preparation): 20 x 45 min=40h
Exercises (incl. preparation): 4x2=12h
Laboratory work (incl. preparation): 10h
Workshop (incl. preparation): 4x4=20 h
Exam: 40 h
Q&A session: 2 h
Self-study: 26 h

Participants

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

Mandatory course for MedIS students who have chosen BM track.

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

Participation in all exams of the 1st semester MedIS master education is required.

Module activities (course sessions etc.)
The course consists of different modules:
(i) general lectures covering core theories and principles related to advanced human pathophysiology and pharmacology related to personalized medicine research and clinical applications
(ii) presentations from main research areas
(iii) hands-on laboratory and computer\web-based exercises, where the students are presented to a variety of methodological approaches and techniques related to translational research
(iv) workshops where students can critically discuss and actively present different thematic topics

Lectures: 90 min (2x45 min; break) presentation by lecturer with theory and case presentations.
Exercises: 90 min (2x45 min; break) where the students work in small groups on different thematic assignments provided by the individual lecturers.
Laboratory work: mix of theory and practical laboratory assignment.
Workshop: Students' critical discussion and presentation of their laboratory or informatics work (4 h).

Level 1		
Activity - type and title	**Lecturer including department affiliation***	**Learning goals from curriculum**
Lecture (2h): Genome anatomy and variation. Impact on personalized medicine.	Jacek Lichota, M.Sc., PhD, lector HST	• Explain organization of genomes, proteomes and metabolomes in higher eukaryotes, particularly in human • Explain how epigenetic, transcriptional, proteomic, posttranslational modifications, metabolic and environmental factors influence disease and patients' response to treatment
Lecture-Exercise (2h+2h): Proteomics – Concepts and applications in personalized medicine	Allan Stensballe, Ph.D (ATV), HST	• Describe genetic, epigenetic and proteomic biomarkers use in diagnostics, biomarker discovery and validation in a personalized medicine context • Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalized genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course
Workshop (4h): Clinical repositories for PM – From sequence to clinical insight	Allan Stensballe, Ph.D (ATV), HST	• Explain organisation of genomes, proteomes and metabolomes in higher eukaryotes, particularly in human • Describe genetic, epigenetic and proteomic biomarkers use in diagnostics, biomarker discovery and validation in a personalised medicine context • Choose appropriate databases, algorithms, statistics and parameters in a bioinformatics analysis

Lecture (2h): Next Generation Sequencing- Principle and Application in Clinical Diagnostic	Ihab Bishara Lolas, M.Sc., PhD, KI	• Apply advanced molecular methods in diagnostics • Evaluate a choice of diagnostic method or technology • Evaluate the obtained results based on the theoretical knowledge within pathophysiology and molecular medicine • Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalised genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course
Lecture: Personalized cancer medicine (2h)	Mads Sønderkær, M.Sc., PhD, KI	• Choose appropriate databases, algorithms, statistics and parameters in a bioinformatics analysis • Analyse systems biology data such as DNA sequences, mRNA, proteins as well as integrated Omics type data using bioinformatics • Use bioinformatical and analytical strategies to solve problems in personalised medicine • Evaluate the obtained results based on the theoretical knowledge within pathophysiology and molecular medicine • Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalised genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course
Lecture (2h): Tools for Big Data Analysis	Jeppe Emmersen, PhD, HST	• Choose appropriate databases, algorithms, statistics and parameters in a bioinformatics analysis.
Lecture (2h): Pharmacogenomics and personalized treatment	TBA	• Explain the effects of drugs, biologics and small molecules, on their targets • Explain how drugs regulate and affect disease progresses and what consequences it has for the disease pathophysiology
Lecture (2h): Clinical biomarkers and drugs in personalized pain management	Parisa Gazerani, M. Pharm., PhD, HST	• Describe genetic, epigenetic and proteomic biomarkers use in diagnostics, biomarker discovery and validation in a personalised medicine context
Laboratory Work (4h): Quantitative proteomics workflow for liquid biomarker discovery	Allan Stensballe, Ph.D (ATV), HST, Christopher Aboo; Ph.D student; Jacob Skallerup, Ph.D student; HST	• Combine the theoretical knowledge about genomes and proteomes with the ability to perform laboratory experiments in order to design a diagnostic or analytical protocol.

Lecture-Exercise (2h+2h): Proteomics – From raw data to drug target's and disease pathophysiology	Allan Stensballe, Ph.D (ATV), HST	• Explain the effects of drugs, biologics and small molecules, on their targets • Explain how drugs regulate and affect disease progresses and what consequences it has for the disease pathophysiology • Analyze systems biology data such as DNA sequences, mRNA, proteins as well as integrated Omics type data using bioinformatics • Use bioinformatical and analytical strategies to solve problems in personalized medicine
Lecture-Exercise (2h+2h): Biological sequence analysis in a PM context	Jeppe Emmersen, PhD, HST	• Analyze systems biology data such as DNA sequences, mRNA, proteins as well as integrated Omics type data using bioinformatics • Use bioinformatical and analytical strategies to solve problems in personalized medicine
Workshop (4h): Network and genome wide analysis	Jeppe Emmersen, PhD, HST	• Analyze systems biology data such as DNA sequences, mRNA, proteins as well as integrated Omics type data using bioinformatic • complex medical applications: design of new diagnostic tools, genetic counselling based on personalized genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level
Workshop (4h): Companion diagnostics for precision medicine	Thomas Poulsen; Ph.D student; Allan Stensballe, Ph.D (ATV), HST	• Explain how drugs regulate and affect disease progresses and what consequences it has for the disease pathophysiology • Choose appropriate databases, algorithms, statistics and parameters in a bioinformatics analysis • Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalised genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course.
Lecture-Exercise (2h+2h): Translational biomarker approaches: From lab-bench to bedside	Allan Stensballe, Ph.D (ATV), HST	• Evaluate a choice of diagnostic method or technology
Workshop (4h): Home-tests and diagnostics for precision medicine	Allan Stensballe, Ph.D (ATV), HST Christopher Aboo; Ph.D student;	• Apply advanced molecular methods in diagnostics • Evaluate a choice of diagnostic method or technology

		• Combine the theoretical knowledge about genomes and proteomes with the ability to perform laboratory experiments in order to design a diagnostic or analytical protocol • Evaluate the obtained results based on the theoretical knowledge within pathophysiology and molecular medicine • Solve and evaluate complex medical issues e.g. design of new diagnostic tools, genetic counselling based on personalized genome sequence data, disease related proteome data, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course

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Examination
Written exam with aids, incl. PC, so you can do assignments in bioinformatics.
It will create coherence between the theory and the exercises covered in the course.
Assignments are covering the entire module.
Duration 3 hours.
Exam paper is distributed and should be handed through Digital Exam.

For further information about examination, we refer to Digital Eksamen (DE).

Module title, ECTS credits (and possibly STADS code)
Translationelle forskningsprincipper/Translational Research Principles
Profile: TM
5 ECTS
Module code: MEDMS20K2_8

Location
Master of Science in Medicine with Industrial Specialisation, 2nd semester
Study board for medicine

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

Coordinator: Laura Petrini lap@hst.aau.dk Department of Health Science and Technology;
Co-coordinator: Lars Arendt-Nielsen lan@hst.aau.dk Department of Health Science and Technology
Co-coordinator: Kristian Kjær Petersen kkp@hst.aau.dk Department of Health Science and Technology

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

English

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

regulations and curriculum. Reference can be made to elaborations on semester Moodle site and/or to curriculum on Study Board website (applicable for MedIS and Medicine).

Purpose of the course:
The course provides students to cutting-edge translational research principles and methods that are related to practice-led research.

From Curriculum:

KNOWLEDGE

- Demonstrate knowledge of core theories and principles of translational research.
- Demonstrate an in depth understanding of different translational models and approaches from a multi-and interdisciplinary perspective.
- Understand scientific problems and challenges in translational research.
- Understand on how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans.

SKILLS

- Select suitable principles and methods in the context of translational research.
- Identify relevant translational biomarkers to be applied in translational research.
- Investigate and critically assess relevant scientific literature.
- Apply translational research knowledge in a multi- and interdisciplinary environment.
- Explain topics essential translational biomedicine and drug/medical device development.
- Apply research questions to translational biomedical research.
- Assessing relevant markers related to translational research.
- Apply basic science methodology.

COMPETENCES

- Formulate, plan and execute translational research.
- Scientifically reflect over the relevant knowledge and identify scientific problems in translational research.
- Being able to critically evaluate the importance of basic research into a translational context.
- Being able to participate into translational science discussions, which explore a variety of approaches in order to solve big-real world problems.

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

The course prepares the students in understanding how to transfer laboratory knowledge from basic research into new methods for diagnosis, preventing and treating disease in humans. The course equips the students with relevant knowledge to pursuing a career as “state-of-the-art” into translational science. The course requires an active participation of the students where the students engage discovery process by tackling on-going research.

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

The expected workload of 150 hours for this 5 ECTS module:
Lectures: 7x2=14 h
Exercises:7x2=14 h
Laboratory work and group-based assignment (oral/written): 4x18=72 h
Workshop: 3x4=12 h
Lectures preparation: 7x1.5=10.5 h
Exam: 26 h
Q&A session: 1.5 h

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

Mandatory course for MedIS students who have chosen TM track.

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

It is required that the students have previously participated in all exams of the 1st semester.

Recommended literature
Literature material will be provided by each individual lecturer prior the beginning of the course. It will primarily consist of journal articles.

Module activities (course sessions etc.)

The course consists of different modules: (i) general lectures covering core theories and principles related to translational research; (ii) presentations from main translational areas and related models: pain, neurophysiology and neuropsychology, and ad hoc presentations covering translational models of neurorehabilitation, motor control, and brain imaging; (iii) hands-on laboratory exercises, where the students are presented to a variety of methodological approaches and techniques related to translational research; and (iv) workshops where students can critically discuss and actively present different thematic assignment.

Lectures: 90 min (2x45 min) presentation by lecturer with theory and case presentations.
Exercises: 90 min (2x45) where the students work in small groups on different thematic assignments provided by the individual lecturers.
Laboratory work: mix of theory and practical laboratory introduction (2 h) and work group assignment (16 h) provided by each individual lecturer.
Workshop: Students' critical discussion and presentation of their laboratory work (4 h).

Level 1		
Activity - type and title	**Lecturer including department affiliation***	**Learning goals from curriculum**
Lecture 1: Translational medicine approaches in proteomics and genetics: From bench to bed-side	Allan Stensballe, HST	Understand how to transfer Omics laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans Demonstrate an in depth understanding of different translational models and approaches from a multi-and interdisciplinary perspective
Lecture 2: Translational models in drug developoment	Christina Brock, Clinical Medicine	Demonstrate knowledge of core theories and principles of translational research Demonstrate an in depth understanding of different translational models and approaches from a multiand interdisciplinary perspective Explain topics essential to translational biomedicine and drug/medical device development
Lecture 3: Translating mechanistic profiling in animals to volunteers and patients: Pain	Lars Arendt-Nielsen, HST	Understand scientific problems and challenges in translational research Understand how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans
Lecture 4: Translating mechanistic profiling in animals to volunteers	Susan Maijs, HST	Demonstrate knowledge of core theories and principles of translational research

and patients: Rehabilitation		Understand how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans
Lecture 5: Neuropsychological biomarkers in humans and possible correlates to pre-clinical models	Laura Petrini, HST	Understand scientific problems and challenges in translational research Understand how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans
Laboratory Work 1: Practical hands-on on assessing neuropsychological biomarkers I	Laura Petrini, HST	Investigate and critically assess relevant scientific literature Assessing relevant markers related to translational research Apply basic science methodology
Workshop 1: Presenting laboratory work and relevant literature in a plenary session	Laura Petrini, HST	Scientifically reflect over the relevant knowledge and identify scientific problems in translational research Apply translational research knowledge in a multi- and interdisciplinary environment Being able to participate into translational science discussions, which explore a variety of approaches in order to solve big real-world problems
Lecture 6: Cortical neuroplasticity and neurorehabilitation	Dennis Boye Larsen, HST & Andrew James Thomas Stevenson, HST	Understand how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans Scientifically reflect over the relevant knowledge and identify scientific problems in translational research. Demonstrate an in depth understanding of different translational models and approaches from a multi-and interdisciplinary perspective. Understand scientific problems and challenges in translational research
Laboratory Work 2: Assessing cortical neuroplasticity in humans I	Dennis Boye Larsen, HST & Andrew James Thomas Stevenson, HST	Investigate and critically assess relevant scientific literature Formulate, plan and execute translational research Assessing relevant markers related to translational research
Laboratory Work 3: Assessing cortical neuroplasticity in humans II	Dennis Boye Larsen, HST & Andrew James Thomas Stevenson, HST	Apply basic science methodology Scientifically reflect over the relevant knowledge and identify scientific problems in translational research. Understand on how to transfer laboratory discoveries into new methods for diagnosis, preventing and treating diseases and testing these methods in humans. Apply translational research knowledge in a multi- and interdisciplinary environment
Workshop 2: Student presentations of lab assignments and	Dennis Boye Larsen, HST & Andrew James	Scientifically reflect over the relevant knowledge and identify scientific problems in translational research

clinical literature related to neurorehabilitation	Thomas Stevenson, HST	Being able to critically evaluate the importance of basic research into a translational context. Apply research questions to translational biomedical research. Being able to participate into translational science discussions, which explore a variety of approaches in order to solve big real-world problems
Lecture 7: Assessing central pain mechanisms in humans: Can they predict outcome?	Kristian Kjær Petersen, HST	Understand scientific problems and challenges in translational research Demonstrate knowledge of core theories and principles of translational research
Laboratory Work 4: Assessing pain and pain sensitivity	Kristian Kjær Petersen, HST	Select suitable principles and methods in the context of translational research Identify relevant translational biomarkers to be applied in translational research
Assignment: Assess and modulate a mechanism of choice	Kristian Kjær Petersen, HST	Apply research questions to translational biomedical research Assessing relevant markers related to translational research Formulate, plan and execute translational research
Workshop 3: Results from pain mechanism assignment	Kristian Kjær Petersen, HST	Being able to critically evaluate the importance of basic research into a translational context Being able to participate into translational science discussions, which explore a variety of approaches in order to solve big real-world problems

Examination

1. Written individual exam.
2. The exam is graded based on the 7-point scale and it is with an internal examiner. Course coordinator(s) will be responsible for the exam
3. The examination is a mix form of essay type, open and multiple choice questions. The exam questions are based on course learning objectives.
4. The exam takes place in Digital Exam.
5. The duration of the exam is 2 hours.
6. Permitted aids are personal notes (available during the exam as a physical copy and / or as digital material downloaded on PC and / or via access to Moodle).
7. Re-examination can be written or oral.

For further information about examination, we refer to Digital Eksamen (DE).