Curriculum of Master in Science in Medicine with Industrial Specialisation

The Faculty of Medicine
Aalborg University
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with Industrial Specialisation

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Preface:
Pursuant to Act 695 of June 22, 2011 on Universities (the University Act) with subsequent changes, the following curriculum for the Master’s programme in Medicine with Industrial Specialisation is stipulated. The programme also follows the Framework Provisions and the Examination Policies and Procedures for the Faculty of Engineering and Science and The Faculty of Medicine.
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Chapter 1: Legal Basis of the Curriculum

1.1 Basis in ministerial orders
The Master’s programme in Medicine with Industrial Specialisation is organised in accordance with the Ministry of Science, Technology and Innovation’s Ministerial Order no. 814 of June 29, 2010 on Bachelor’s and Master’s Programmes at Universities (the Ministerial Order of the Study Programmes) and Ministerial Order no. 857 of July 1, 2010 on University Examinations (the Examination Order) with subsequent changes. Further reference is made to Ministerial Order no. 233 of March 24, 2011 (the Admission Order) and Ministerial Order no. 250 of March 15, 2007 (the Grading Scale Order) with subsequent changes.

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

1.3 Board of Studies affiliation
The Master’s programme falls under the Board of Studies for Medicine
Chapter 2: Admission, Degree Designation, Programme Duration and Competence Profile

2.1 Admission
Admission to the Master’s programme in Medicine with Industrial Specialisation requires a Bachelor’s degree in Medicine, Biotechnology, Molecular Medicine or the like.

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

2.2 Degree designation in Danish and English
The Master’s programme entitles the graduate to the designation cand.scient.med. (candidatus/candidata scientiarum medicinae). The English designation is: Master of Science (MSc) in Medicine with Industrial Specialisation.

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

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

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

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

2.5 Competence profile of the programme
The candidate programme in Medicine with Industrial Specialization is composed of three health related profiles:

1. Biomedicine
2. Translational Medicine
3. Medical Market Access
2.5.1 Competence profile for Biomedicine

Knowledge

• Demonstrate knowledge in one or more subject areas that, in selected areas, is based on the highest international research in a subject area
• Understand and, on a scientific basis, reflect over the relevant knowledge and identify scientific problems
• Explain in detail advanced concepts and theories of molecular and cellular biology in pathophysiology as well as potential in diagnostics in normal conditions and disease.
• Identify the current perspectives and challenges in cell and molecular-based assays used in biomedicine
• Summarize how manipulations of the immune system may alleviate, stop or avoid disease processes

Skills

• Evaluate and select among the scientific theories, methods, tools and general skills and, on a scientific basis, advance new analyses and solutions
• Communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists
• Elaborate on how disease processes may originate
• Investigate and critically assess relevant scientific literature
• Design experimental protocols, identifying the appropriate sources of materials and interpreting the corresponding technical specifications
• Qualitatively and quantitatively analyse experimental biomedical data
• Can design rational biotherapies for relevant human diseases using appropriate set of engineering and molecular biological tools
• Can apply different regenerative and tissue engineering approaches to treat human diseases.

Competences

• Manage work and development situations that are complex, unpredictable and require new solutions.
• Independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility.
• Independently take responsibility for own professional development and specialisation
• Synthesize knowledge about how common diseases arise in man and be able to suggest likely targets for therapy based on genetic and phenotypic manifestations
• Combine the theoretical knowledge about genes and genomes with the ability to perform laboratory experiments in order to design a diagnostic or analytical protocol
• Solve and evaluate complex analytical issues e.g. design of new diagnostic tools, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course.
• Analyse molecular data such as DNA sequences, mRNA and proteins using bioinformatic tools
• Compare and suggest suitable forms of protein, immunotherapy, stem cell therapy and regenerative medicine for a series of typical patients and give reasons for the choices
• Analyse disease processes using relevant methods
2.5.2 Competence profile for Translational Medicine

Knowledge

- Demonstrate knowledge of core principles of research pharmacology based on the highest international knowledge in modern pharmacology
- Understand scientific problems and challenges in R&D pharmacology and how to reflect on challenges with possible solutions
- Describe the legal and organisational framework of translational medicine
- Have an in depth understanding of different steps for planning, practical execution and completion of a clinical trial
- Discuss the interests and needs of healthy and ill subjects in research and the concept “conflicts of interests” in terms of researchers and other actors
- Understand and, on a scientific basis, reflect over the relevant knowledge and identify scientific problems

Skills

- Apply methods and tools to analyse current pharmacology research projects, to evaluate obtained data, to predict or interpret findings and to communicate these by scientific presentations
- Explain the role of the end user and identify actors and their driving forces in research
- Suggest how Good Clinical Practice and Good Manufacturing Practice can be implemented
- Analyse, compare and discuss critically and systematically different forms of clinical trials concerning design and statistical models.
- Explain topics essential for translational medicine and drug/medical device development.
- Apply a set of principles and methods at any stage from design to conduction and reporting a clinical trial at any phase from phase I to phase IV.
- Apply rules and guidelines to conduct and monitor a trial, report of post-marketing drug surveillance, adverse reactions, pharmacovigilance, and the role of media and pharmacoconomics.
- Explain topics in pharmacology essential for translational medicine and drug development
- Assess or predict mechanisms of action or potential side-effects of drugs for a certain disorder or condition
- Design protocols for research in translational medicine and choose suitable methodology and apply appropriate statistics and data handling

Competences

- Formulate a research proposal to identify mechanisms of action or potential side-effects of new drugs for a certain disorder or condition
- Analyse case studies of clinical trials and plan a (small) research project concerning approval, conduct and ethical considerations and Relate relevant aspects of translational medicine with advanced concepts in biomedicine
- Assess safety and efficacy of drugs/medical devices considering global benefits to people and economies utilizing guidelines, standards, tools, and approaches
2.5.3 Competence profile for Medical Market Access

Knowledge

- Demonstrate knowledge of the methods for the identification and reduction of waste in the health care system and linkages between quality and economics.
- Demonstrate knowledge in one or more subject areas that, in selected areas, is based on the highest international research in a subject area.
- Demonstrate basic knowledge of marketing theory and marketing strategy (Introduction to the field and overview of theory) with focus on Marketing in the health sector.
- Understanding of economic evaluation methods/models, i.e. cost-effectiveness, cost-utility.
- Demonstrate knowledge of the health care system’s organisation and financing, including the central differences between different health systems.
- Demonstrate basic knowledge of the use of microeconomic theories/models for analysis of the health sector and models for analysis of the costs and effects of new medical technologies.
- Demonstrate knowledge of the use of patient-specific data from clinical trials as well as register-based data for analysis of costs and effects of new medical technology, including subgroup analyses.

Skills

- Use theoretical models for analysis and interpretation of specific quality and safety problems in the health care system.
- Formulate descriptions of operational indicators for measuring quality and safety, including outlining a plan for data collection, processing and analysis.
- Use the basic tools for statistical quality development, such as series charts and Pareto charts, for presentation and analysis of clinical indicator measurements.
- Analyse a given market issue, identify company needs for information/knowledge on key market conditions.
- Design and conduct interviews as part of a market study and outline the content of a simple marketing initiative based on context and formulation of the problem.
- Can produce a (simple) economic evaluation of a medical technology (e.g. a new medicine/intervention) including sensitivity analysis and calculate the budget expenditures.
- Can structure and present results from advanced health economic models and analyses of cost-effectiveness, budget impact and cost-of-illness analyses.
- Design and develop a market analysis for a topic related to the health care system.

Competences

- Contribute to planning, implementation and reporting of clinical quality development projects.
- Critically assess existing economic analyses and alternative models of financing and organizing in the health sector.
- Develop advanced health economic analyses, including economic evaluations (cost-effectiveness analysis, cost-utility analysis, cost-benefit analysis, etc.), budget analyses, cost-of-illness analyses, MTV reports, etc.
- Assess methods and results from health economic calculations and design market studies.
Chapter 3: Content and Organisation of the Programme

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

The programme is structured into three profiles:

1. Biomedicine, BM
2. Translational Medicine, TM
3. 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.

Translational medicine is driven by the objective of improving clinical outcomes by efficiently moving results from basic science to clinical application.

Medical Market Access is driven by the objective to improve market access of industry within the biotechnological, pharmaceutical and medical devices markets.

Students entering the candidate will have to choose a specific profile and the corresponding courses and projects, as the programme is designed to be coherent this way. Any exemptions must be approved by the study board.

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

- lectures
- classroom instruction
- project work
- workshops
- exercises (individually and in groups)
- teacher feedback
- reflection
- portfolio work
## Overview of the programme:

<table>
<thead>
<tr>
<th>Semester</th>
<th>Profile</th>
<th>Module</th>
<th>ECTS</th>
<th>Assessment</th>
<th>Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BM</td>
<td>Molecular Pathogenesis</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project: Pathophysiology and Diagnostics</td>
<td>15</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>BM/TM</td>
<td>Genomics, Proteomics and Bioinformatics in Disease and Diagnostics</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Molecular and Cellular Methods in Biomedicine</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>TM</td>
<td>Current Research Topics in Modern Pharmacology</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project: Research and Methodology in Pharmacology</td>
<td>15</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>MMA</td>
<td>Quality Development and Patient Safety</td>
<td>5</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Principles of Marketing and Marketing Management</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economics of Health and Health Care</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
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<tr>
<td></td>
<td>MMA</td>
<td>Project: Market Analysis and New Products Business Cases</td>
<td>15</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>BM/TM/MMA</td>
<td>Regulatory and Ethical Aspects of Clinical Research</td>
<td>5</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>BM/TM</td>
<td>Immuno- and Molecular Therapy</td>
<td>5</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td>2</td>
<td>BM</td>
<td>Regenerative Medicine</td>
<td>5</td>
<td>7 scale</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project: Personalised Medicine</td>
<td>15</td>
<td>7 scale</td>
<td>External</td>
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<tr>
<td></td>
<td>TM</td>
<td>Perspectives of Clinical Trials in Drug and Medical Device Development</td>
<td>5</td>
<td>7 scale</td>
<td>Internal</td>
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<tr>
<td></td>
<td></td>
<td>Project: Clinical Trials</td>
<td>15</td>
<td>7 scale</td>
<td>External</td>
</tr>
<tr>
<td></td>
<td>MMA</td>
<td>Economics of Health Technologies and Technology Assessment</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
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<tr>
<td></td>
<td></td>
<td>Non-Experimental Research Design and Analysis</td>
<td>5</td>
<td>Pass/Fail</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project: Economic Evaluations and Technology Assessments</td>
<td>15</td>
<td>7 scale</td>
<td>External</td>
</tr>
<tr>
<td>3</td>
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<td>Professional Development*</td>
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<td>Internal</td>
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<tr>
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<td>Master's Thesis*</td>
<td>30</td>
<td>7 scale</td>
<td>External</td>
</tr>
</tbody>
</table>

All modules are assessed through individual grading according to the 7-point scale or Pass/Fail. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the supervisor only).
According to the framework provisions, students can design their own individual semester by choosing a 60 ECTS master project. Students can choose to go abroad or perform the project work in a public or private company. Regardless, students must choose an internal supervisor for their projects.
3.1 Description of modules on 1st Semester Medicine with Industrial Specialization

Molecular Pathogenesis / Molekylær pathogenese

Profiles: BM

Prerequisites:
Passed course in general pathology (module 4.3 of the AAU Medicine/MedIS bachelor programme or equivalent).

Objective:
After attending this course, the student is expected to:

Knowledge
• Demonstrate relevant knowledge of all topics taught in the bachelor education in Medicine with Industrial Specialization

Skills
• Elaborate on how disease processes may originate from common hazards like oxidative stress, inflammation, autoimmunity, pathogens, atherosclerosis, carcinogens, hemorrhagic diathesis, and genetic deficiencies.
• Reflect upon the temporal aspect of disease progression
• Understand how aging affects health and tendency towards disease manifestations
• Evaluate and compare the causative roles of oxidative stress, inflammation, autoimmunity, pathogens, atherosclerosis, carcinogens, hemorrhagic diathesis, and genetic deficiencies in the pathogenetic mechanisms leading to major human diseases

Competences
• Synthesize knowledge about how common diseases arise in man and be able to suggest likely targets for therapy based on genetic and phenotypic manifestations

Organization:
Modules consisting of lectures by university staff, experts from hospitals or other universities in Denmark, presentations by students, and work with scientific papers and study problems.

Examination: Oral presentation during the module
Evaluation criteria:
As stated in the framework provisions
Genomics, Proteomics and Bioinformatics in Disease and Diagnostics/ Genomik, proteomik og bioinformatik i sygdom og diagnostik

Profiles: BM and TM

Objectives:
After attending this course, the student is expected to:

This course should give an in-depth understanding of molecular basis of life. Furthermore the role of genes and genomes in disease development in principally all organs of the body is a big part of this course. The most important methods in molecular diagnostics are discussed. The course encompasses basic bioinformatics tools needed in a modern biomedical laboratory.

The course spans the following topics:

1. Genomics and proteomics in diagnostics and disease:
   a. Regulation of gene expression
   b. Post-translation protein modifications and fibrillation
   c. Epigenetics
   d. Molecular cloning
   e. Mutations and DNA repair
   f. Modern diagnostic methods

2. Bioinformatics:
   a. Biological Databases
   b. Alignments and Phylogeny
   c. Gene expression and Structural Analysis of genes and gene products

Knowledge

- Explain organization of genes and genomes in eukaryotes, particularly in human.
- Explain all levels at which expression of genes is regulated and what consequences it has for the disease pathophysiology as well as potential in diagnostics

Skills

- Apply basic molecular methods in diagnostic laboratory
- Evaluate a choice of diagnostic method
- Choose appropriate databases, algorithms and parameters in a bioinformatics analysis

Competences

- Combine the theoretical knowledge about genes and genomes 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 analytical issues e.g. design of new diagnostic tools, evaluation of scientific articles at the highest international level; integrating knowledge from the previous semesters with the current course.
- Analyse molecular data such as DNA sequences, mRNA, proteins using bioinformatics

**Type of instruction:**
The course is developed as a series of lectures with exercises, mini projects and practical laboratory exercises.

**Exam format:** Written exam based on individual written assignments during the course. Students must have attended at least 80% of all practical skill developing exercise parts.

**Evaluation criteria:** Stated in the Framework Provisions.
Molecular and Cellular Methods in Biomedicine/Molekylære og cellulære metoder i biomedicin

Profiles: BM and TM

Objectives:
The goal of this module is to introduce students to modern methods used in biomedicine to investigate and diagnose disease processes, with a focus on methods used to study the diseases at molecular and cellular levels.

Students who complete this module will be able to:

Knowledge
- Recall the terminology, concepts, and theories in molecular and cellular biology associated to the methods discussed in the module, both under normal conditions and in disease.
- Identify and classify the different approaches for the study and diagnosis of disease processes, recognizing the advantages and limitations of each of these approaches.
- Demonstrate understanding of the theory and principles behind the different molecular and cellular methods.
- Identify the current perspectives and challenges in cell and molecular-based assays used in biomedicine.

Skills
- Investigate and critically assess the relevant scientific literature.
- Apply the theory to design experimental protocols, identifying the appropriate sources of materials and interpreting the corresponding technical specifications.
- Select the appropriate methods in the context of a cell or molecular biological research problem.
- Use basic routines to collect data from measurement instruments.
- Use bioinformatic tools and databases to obtain and analyse relevant molecular biology data.
- Qualitatively and quantitatively analyse experimental data and apply cell and molecular biology knowledge to interpret the results.

Competences
- Critically assess, organize and present scientific information, both orally and in writing.
- Integrate the obtained knowledge and skills within new areas to design, plan and conduct advanced tasks and projects.
- Select the appropriate methods and approaches to aid the screening, diagnosis, and monitoring of diseases in their professional practice.

Type of instruction:
Lectures and exercises. The last session of the module will consist of oral group presentations of a final assignment by the students.

**Exam format:**

Written: continuous evaluation of exercises and delivery of the final assignment

**Evaluation criteria:**

Are stated in the Framework Provisions.
Current Research Topics in Modern Pharmacology/Aktuelle forskningsområder i moderne farmakologi

Profile: TM

Objectives:
Pharmacology is a research discipline applying a set of principles and methods to study mode of action of drugs in biological systems.

The goal of this course is to expose students to a variety of cutting-edge research topics in basic and applied pharmacological research. Through this course students will be trained and prepared for careers in research and development (R&D) in pharmaceutical industry, academic and research institutions, governmental and other healthcare agencies.

Topics encompass a number of different areas in modern pharmacology such as molecular pharmacology, cardiovascular pharmacology, gastrointestinal pharmacology, respiratory tract pharmacology, urogenital tract pharmacology, pharmacology of tissue repair, neuropharmacology, psychopharmacology, Immunopharmacology, pharmacology of aging, paediatric pharmacology, and latest developments in drug delivery.

Students who complete the module are expected to:

Knowledge
• Have solid knowledge of core principles of research pharmacology based on the highest international research in modern pharmacology
• Understand scientific problems and challenges in R&D pharmacology and how to reflect on challenges with possible solutions

Skills
• Apply methods and tools to analyse current pharmacology research projects, to evaluate obtained data, to predict or interpret findings and to communicate these by scientific presentations
• Apply knowledge gained in this course to solve problems in pharmacology research in a real-world manner. Must be able to initiate discussion, define a problem and implement pharmacology discipline-specific tools to arrive at a consensus on how the problem is best solved

Competences
• Formulate a research proposal to identify mechanisms of action or potential side-effects of new drugs for a certain disorder or condition
Instruction:
This course consists of formal lectures given by faculty members and visiting lecturers from academia and industry; research seminars or workshops; interactive in-class discussions; literature-based projects; and student seminars on various properties and effects of newer drugs in form of oral presentations or written reports.

Research projects on current pharmacological research, new drug and delivery developments and re-evaluation of currently employed drugs, their mechanism of action, etc. will be introduced, followed by group discussions on PBL exercises.
Small lab visits can be arranged to provide students a direct research experience in a chosen area.

Examination:
Evaluation of students will be based on multiple assessment tools including: class participation and interactive discussion, homework assignments, written reports and oral presentations.

Quality Development and Patient Safety/Kvalitetsudvikling og patientsikkerhed

Profile: MMA

Content:
Concepts and definitions of quality in the health care system
Laws and regulations on quality and safety in the health care system
Methods for monitoring and improving quality
Methods and principles for the prevention of adverse events
Clinical quality databases
Involvement of patients and relatives in quality and safety
Quality and economics, including the concept of waste

Knowledge
• Demonstrate understanding of basic concepts and terminology in quality and patient safety including:
  • the different dimensions of quality in health care, such as clinical quality, patient experienced quality and staff experienced quality
  • different views on safety, such as the absence of injuries and the presence of robust systems that ensure against injuries
• Demonstrate knowledge and overview of the methods used for quality development in health care, such as accreditation, indicator monitoring, auditing, event analysis and analysis of error sources, as well as knowledge of the efficacy of these methods according to the latest research in the field.
• Demonstrate knowledge of healthcare law regulations on quality and safety, such as reporting adverse events.
• Demonstrate knowledge of the possibilities and methods for involving patients and families in the development of quality and safety.
• Demonstrate understanding of selected models and theories on innovation and implementation, with particular focus on the difficulties in implementing new initiatives in the health care system.
• Demonstrate understanding of the different purposes of measuring quality, for example research, improvement and control, and the related prerequisites and methods.
• Demonstrate understanding of the concept of variation as it is used in statistical quality development.
• Demonstrate knowledge of the methods for the identification and reduction of waste in the health care system and linkages between quality and economics.

Skills
• Use theoretical models for analysis and interpretation of specific quality and safety problems in the health care system, such as Reason’s Swiss cheese model, the ETTO principle, Donabedian’s quality-of-care dimensions, Deming’s system of profound knowledge, Juran’s Trilogy, etc.
• Use the Model for Improvement for a specific issue in the health care system.
• Formulate descriptions of operational indicators for measuring quality and safety, including outlining a plan for data collection, processing and analysis.
• Use the basic tools for statistical quality development, such as series charts and Pareto charts, for presentation and analysis of clinical indicator measurements.

Competences
• Contribute to planning, implementation and reporting of clinical quality development projects.
• Identify and report adverse events

Instruction:
Teaching varies between lectures, workshops, (group) exercises and individual study.

Exam format: Written

Evaluation criteria: As stated in the Framework Provisions
Principles of Marketing and Marketing Management/Principper inden for markedsføring og markedsføringsledelse

Profile: MMA

Objective:
After attending this course, the student is expected to:

Knowledge
- Demonstrate basic knowledge of marketing theory and marketing strategy (Introduction to the field and overview of theory)
- Demonstrate basic knowledge of marketing considerations regarding product properties, branding, packaging, price, costs of innovation, distribution, promotion, key stakeholders, corporate branding, segmentation, product development (user-driven).
- Demonstrate basic understanding of a customer focus (i.e. learning to focus on the customer; the need to know something about the customer in order to make strategic decisions)
- Demonstrate knowledge of Applied Methods in Market Analysis
- Demonstrate basic knowledge of marketing in the health sector, including an introduction to business planning and implementing marketing activities in Denmark.
- Demonstrate knowledge of market access tasks in a company, including knowledge of companies’ work relative to doctors and patients (and patient associations, researchers, etc.) with an eye toward the use of medicine (both the introduction of new medicines, as well as sustaining the market over time) and collaboration/negotiation with authorities
- Demonstrate knowledge of pricing in selected countries such as the United States, the United Kingdom, Germany, Denmark and Sweden

Skills
- Use the methods of the field to analyse a given market issue
- Identify company needs for information/knowledge on key market conditions
- Design and conduct interviews as part of a market study
- Outline the content of a simple marketing initiative based on context and formulation of the problem

Competences
- Understand the need of pharmaceutical companies for information on markets
- Understand companies’ organisation of market analyses and marketing activities

Instruction:
Teaching varies between lectures, workshops, (group) exercises and individual study.

Exam format: Written or oral
Evaluation criteria: As stated in the Framework Provisions
Profile: MMA

Objective:
After attending this course, the student is expected to:

Knowledge
- Demonstrate basic understanding of costs, including the difference between expenses and disbursements, as well as fixed, variable, indirect and direct costs
- Understand economic evaluation methods/models, i.e. cost-effectiveness, cost-utility (and QALY), cost-benefit
- Demonstrate knowledge of the health care system’s organisation and financing, including the central differences between the Danish health care system and corresponding systems in selected countries such as the United States; the United Kingdom, Germany and Sweden.
- Demonstrate basic knowledge of the use of microeconomic theories/models for analysis of the health sector, including supply-demand model, Principal-agent, human capital and investment in health, corporate production function and cost components, large scale operations and productivity.

Skills
- Produce a (simple) economic evaluation of a medical technology (e.g. a new medicine/intervention) including sensitivity analysis (one-way, two-way, threshold value analysis, scenario analysis).
- Calculate the budget expenditures for the introduction of new medical technology (for a given organisation such as a hospital or region) and assess whether a new intervention represents “good value for money.”
- Use the models and methods of the field to analyse selected issues

Competences
- Critically assess existing economic analyses
- Critically assess alternative models of financing and organizing in the health sector
- Read and understand the key messages and assumptions in published economic evaluations and reports on economic conditions in the health care system

Teaching method:
Teaching varies between lectures, workshops, (group) exercises and individual study.

Exam format: Written

Evaluation criteria: As stated in the Framework Provisions
3.2 Description of projects on 1st semester Medicine with Industrial Specialization

Pathophysiology and Diagnostics / Patofysiologi og diagnostik

Profile: BM

Objective:
After completing this module, the student is expected to:

Skills
• Choose relevant methodology for analysing disease states of the human biological system
• Formulate a working hypothesis based on biomedical knowledge and data

Competences
• Analyse disease processes using relevant methods
• Select and critically demonstrate an understanding at the theoretical and practical level on relevant methodology used for testing their hypotheses
• Analyze data from experimental or theoretical experiments relevant to the chosen biological systems

Instruction: Project as described in chapter 3. Literature review. Hypothesis formulation. Practical work in laboratory. The project period is experimentally based and will attempt to allow the students to work in depth in the laboratory.

Exam: Oral examination based on the project

Evaluation criteria: Stated in the framework Provisions
Research and Methodology in Pharmacology/ Farmakologisk forskning og metode

**Profile:** TM

**Objectives:** After completing this module, the student is expected to:

**Knowledge**
- Explain topics in pharmacology essential for translational medicine and drug development

**Skills**
- Apply a set of principles and methods to study mode of action of drugs in biological systems either in terms of basic or applied pharmacological research.
- Design protocols for research in translational medicine
- Choose suitable methodology and apply appropriate statistics and data handling

**Competences**
- Assess or predict mechanisms of action or potential side-effects of drugs for a certain disorder or condition
- Students must be able to complete a clear and concise literature review;
- Formulate a fundamental aims of their research project;
- Discuss the theoretical and practical aspects of the chosen research field and corresponding methodologies, such as molecular pharmacology, cardiovascular pharmacology, gastrointestinal pharmacology, respiratory tract pharmacology, urogenital tract pharmacology, pharmacology of tissue repair, neuropharmacology, psychopharmacology, Immunopharmacology, pharmacology of aging, paediatric pharmacology, or drug delivery.
- Collect, critically analyse and interpret data

**Examination:** Oral examination based on project

**Evaluation criteria:** As stated in the framework provisions
Market Analysis and New Products Business Cases / Markedsanalyse og marketing cases

Profile: MMA

Objective:
After completing this module, the student is expected to:

Knowledge
• Understand the various components of the health care system including the financing and how demand and supply is influenced by market orientation within the public sector and the medical industry.

Skills
• Develop, design, and implement marketing programs, processes, and activities.
• Apply the analytical procedure to be followed when designing questionnaires for survey or experimental research
• Apply analytical techniques and implement marketing activities in the medical sectors is fundamental competences for the fulfilment of job requirements in the market oriented parts of the medical industry.

Competences
• Recognize and compare the breadth and interdependencies of today’s marketing environment
• Evaluate marketing decisions and the development of goal-oriented marketing strategies and market research including presentation of the stages in the marketing research process from the definition of a research problem to the presentation of research results.

Instruction:
Project based as defined in chapter 3.

Examination: Oral examination based on project

3.3 Description of modules on 2nd Semester Medicine with Industrial Specialization

Regulatory and Ethical Aspects of Clinical Research/Regulatoriske og etiske aspekter i klinisk forskning

Profile: TM, BM and MMA

Prerequisites: Participation in all exams of the 1. semester

Objective: After attending this course, the student is expected to:

Knowledge
- Describe the legal framework of translational medicine
- Describe the regulatory process, including Good Clinical Practice, Good Laboratory Practice and Good Distribution Practice (GCP, GLP, GDP).
- Discuss the institutions and factors governing the conduct of research (legislation, boards, and guidelines)
- Explain the Danish requirements for and process of obtaining approval of experiments with animals and with humans, in particular relating to drug testing
- Discuss the interests and needs of healthy and ill subjects in research
- Reflect on the concept “conflicts of interests” in terms of researchers and other actors (e.g. manufacturing companies, contract research companies, and patient organisations)
- Discuss the issue of access to research results and research data
- Discuss the concept “scientific fraud” and the related institutions in public and private research

Skills
- Explain the role of the end user
- Identify actors and their driving forces in research
- Suggest how Good Clinical Practice, Good Laboratory Practice, Good Distribution Practice can be implemented in a specific experiment/research project or manufacturing process
- Relate Good Manufacturing Practice to the work with research
- Discuss the importance of following

Competences
- Provisionally plan a (small) research project concerning approval, conduct and ethical considerations
- Analyze case studies of clinical trials

Instruction: As described in chapter 3.
Exam format: Written

Evaluation criteria: As stated in the Framework Provisions
Immuno- and Molecular Therapy / Immun- og molekylærterapi

Profiles:
TM and BM

Prerequisites:
Passed course in basic immunology (module 2.2 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).

Objective:
After attending this course, the student is expected to:

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 immunotherapy for a series of typical patients and give reasons for the choices.

Instruction:
Teacher directed lectures and student directed presentations based on scientific papers and study problems.

Examination: Written

Evaluation Criteria: As stated in the framework provisions
Regenerative Medicine/Regenerativ medicin

Profile: BM

Prerequisites:
Participation in exams on 1st semester

Objectives:
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.

Instruction: As described in chapter 3.

Exam format: Written

Evaluation criteria: As stated in the Framework Provisions
Perspectives of Clinical Trials in Drug and Medical Device Development/ Kliniske undersøgelser ved udvikling af medicin og medicinsk udstyr

Profile: TM

Prerequisites:
1st semester Master of Science in Medicine with Industrial Specialization, Profile: Translational Medicine TM

Objectives:
Clinical trials are essential in development of new drugs and medical devices that should undergo rigorous and systematic testing in patient volunteers to ensure well documented safety and effectiveness profiles. Clinical trials are prerequisite for approval and will offer meaningful value for patients' use in a broader popgemulation. There are four phases of clinical trials (I, II, III and IV) and the goal of this course is to expose students to essential elements of these phases.

Topics encompass a number of areas from design to conduction and reporting a clinical trial such as different types of clinical trial design, objectives and outcomes, prevention and treatment of missing data in clinical trials through changes in study design and use of appropriate statistical methods, biomarkers, rules and guidelines to safeguard the reliability of trials, policy decisions, roles of stakeholders including pharmaceutical firms, commercial influence on clinical trials, patenting, post-marketing drug surveillance, reporting and monitoring adverse reactions, pharmacovigilance, drug use in community, role of media and pharmacoeconomics.

Students who complete this course are expected to:

Knowledge
- Have an in depth understanding of different steps for planning, practical execution and completion of a clinical trial.

Skills
- Analyze, compare and discuss critically and systematically different forms of clinical trials concerning design and statistical models.
- Identify, formulate, discuss and evaluate issues, rules and responsibilities in clinical trial activities.
- Choose relevant problem-solving techniques in the design and analysis of clinical trials.
- Apply gained knowledge and skills to design a clinical trial following regulations and requirements and analyze it.

Competences
- Assess product safety and efficacy utilizing monitoring tools, standards, and approaches while considering global benefits to people and economies.
• Instruction: This course consists of formal lectures given by mentors and experts, with extensive background in clinical trials, who will guide students through the learning process.

Examination: Written

Evaluation criteria: As stated in the framework Provisions
Economics of Health Technologies and Technology Assessment/Økonomi i sundhedsteknologi og teknologivurdering

Profile: MMA

Prerequisites: Participation in MMA course and project exams in the 1th semester

Objectives: After attending this course, the student is expected to:

Knowledge
- Knowledge of the construction and use of models for analysis of the costs and effects of new medical technologies (including new medicines and medical devices)
- Knowledge of the use of patient-specific data from clinical trials as well as register-based data for analysis of costs and effects of new medical technology, including subgroup analyses.

Skills
- Can use the methods of the field to analyse economic and clinical effects for current issues in the health sector
- Can structure and present results from advanced health economic models and analyses of cost-effectiveness, budget impact and cost-of-illness analyses

Competences
- Can develop advanced health economic analyses, including economic evaluations (cost-effectiveness analysis, cost-utility analysis, cost-benefit analysis, etc.), budget analyses, cost-of-illness analyses, MTV reports, etc.
- Can critically assess methods and results from health economic calculations
- Can be part of a health economic team in a company/organisation that performs and/or uses health economic analyses of new medical technology

Instruction: As described in Chapter 3.

Examination: Written

Non-Experimental Research Design and Analysis/Teoretisk forskningsdesign og -analyse

Profile: MMA

Objective:
After attending this course, the student is expected to:

Skills
• Can design and implement a market analysis
• Can plan, collect, analyze, and present data from e.g. a quantitative study (such as a survey or register-based study), as well as a qualitative study
• Can understand and explain the steps in a “good” regression analysis, including the relationship between purpose and methodology, inclusion of theory/evidence and put forth hypotheses, examination of data, use statistical tools in model specification, risk of bias and a loss of efficiency, etc.
• Can use the guidelines on a “good method of analysis” for a given issue, including assessing the possibilities for conducting a ceteris paribus cause-effect analysis based on a data set with non-randomized data.
• Can critically assess articles/reports that use regression analysis/statistical analysis of register-based data or questionnaire data
• Can use and combine methods in the prerequisite subjects overall to design and develop a market analysis for a topic related to the health care system
• Can work with qualitative data and quantitative surveys simultaneously. Can specifically handle/evaluate how the company can obtain knowledge on a topic by means of a non-experimental study.

Competences
• Can design market studies
• Can be part of a medical market access/marketing team in a company, including constructively assessing and participating in marketing activities (including critiquing the activities of competitors)

Instruction:
As described in Chapter 3.

Examination: Written

3.4 Description of projects on 2nd semester Medicine with Industrial Specialization

Personalised Medicine / Individualiseret medicin

Profile: BM

Prerequisites:
First semester of the profile Biomedicine

Objectives:
After completing this module, the student is expected to:

Knowledge
• Explain the concepts and problems related to personalized medicine

Skills
• Apply theoretical knowledge relevant to the biological system of interest
• Design a proper experimental study
• Compare and choose relevant experimental methods

Competences
• Formulate a working hypothesis and teach the students how to test these hypotheses using relevant methods in order to obtain control of a disease process
• Integrate core knowledge and skills related to personalized medicine
• Critically demonstrate an understanding at the theoretical and practical level on relevant methodology used for testing biomedical hypotheses.

Instruction:
The project period is experimentally based and will attempt to allow the students to work in depth in the laboratory.

Examination: Oral examination based on project

Clinical Trials/Kliniske forsøg

Profile: TM

Prerequisite: 1st semester, Master of Science in Medicine with Industrial Specialization, Profile: Translational Medicine

Objectives: After completing this module, the student is expected to:

Knowledge
• Understand theoretical and practical issues relating to clinical trials essential for translational medicine and drug/medical device development

Skills
• Apply a set of principles and methods at any stage from design to conduction and reporting a clinical trial at any phase from phase I to phase IV.
• Obtain experience in any relevant area within the concept of clinical trials such as design, setting outcomes, use of appropriate statistical methods, application of rules and guidelines to conduct and monitor a trial, report of post-marketing drug surveillance, adverse reactions, pharmacovigilance, and the role of media and pharmacoeconomics.

Competences
• Select methodology appropriate to the chosen field and problem within translational medicine
• Collect, critically analyze and interpret data.
• Utilize guidelines, standards, tools, and approaches for assessing safety and efficacy of drugs/medical devices considering global benefits to people and economies.

Examination: Oral examination based on project

Economic Evaluations and Technology Assessments / Sundhedsøkonomi og teknologivurdering

Profile: MMA

Prerequisites:
First semester of the profile MMA

Objective:
After completing this module, the student is expected to:

Knowledge
• A basic understanding of the methods of health economics and health technology assessment provides a framework for subsequent courses.
• The understanding of economics of health and medical care in theory and practice is the foundation for the track
• To describe topics in market oriented medical care.
• To understand and apply the methods for the health economic evaluation
• To understand and apply the methods for the health technology assessment of alternative health technologies.
• To understand and apply theories of evidence based marketing.

Skills
• Apply the techniques of health economic assessment and health technology are fundamental competences for the fulfilment of job requirements in the market oriented parts of the medical industry.
• Provide a general overview of the economics of health and medical care, and cover the medical and nonmedical determinants of health; markets for health care services and health insurance,
• Analyse key players in the health care sector, and different health care systems.
• Use methods for the economic evaluation of health technologies (i.e. cost-effectiveness analyses, cost-utility analyses, cost-benefit analyses) that are increasingly used for reimbursement and pricing decisions in health care markets.

Competences
• Assess medical products using advanced interdisciplinary tools for. It provide the students with an understanding of the basic tools for health technology assessment as a means for political, administrative and clinical decision-making in national and international health care systems.

Examination: Oral examination based on project

3.5 Project Themes for 3rd and 4th Semester Medicine with Industrial Specialization

The student can decide to use the 3rd and 4th semesters to carry out a long master’s thesis of 60 ECTS, or he/she can use the 3rd semester as an alternative semester and the 4th semester to carry out a master’s thesis. The 3rd semester project can be done abroad or within in a public or private company. An internal supervisor is mandatory in both cases and the project exam takes place at Aalborg University.

Professional Development / Faglig udvikling

Profile: MMA/TM/BM

Placement:
3rd semester in the master program in Medicine with Industrial Specialization

Prerequisites:
Successful conclusion of the first two semesters. Exemptions can be given only by decision of the Study Board.

Objective:
After completing this module, the student is expected to:

Knowledge
- Demonstrate an overview and understanding of scientific literature related to the project

Skills
- Select and apply relevant methods in relation to the project
- Further develop scientific skills within the track and to display the ability to perform scientific work.
- Integrate and to deepen previously acquired knowledge and skills.

Competences
- Experience in identification and analysis of realistic and complex problems.
- To apply and critically evaluate general scientific methods to solve specific problems.
- To synthesize the results of a scientific project to new levels of scientific understanding.
- Design a study with subsequent acquisition of data, processing of results, and discussion.

Examination: Oral examination based on project

Master’s Thesis/ Kandidatspeciale

Placement:
4th semester in the master program in Medicine with Industrial Specialization

Prerequisites:
Successful conclusion of the first three semesters. Exemptions can be given only by decision of the Study Board.

Objective:
After completing this module, the student is expected to:

Knowledge
- Demonstrate an overview and understanding of scientific literature related to the project

Skills
- Select and apply relevant methods in relation to the project
- Further develop scientific skills within the track and to display the ability to perform scientific work.
- Integrate and to deepen previously acquired knowledge and skills.

Competences
- Experience in identification and analysis of realistic and complex problems.
- To apply and critically evaluate general scientific methods to solve specific problems.
- To synthesize the results of a scientific project to new levels of scientific understanding.
- Design a study with subsequent acquisition of data, processing of results, and discussion.

Examination: Oral examination based on project

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of The Faculty of Medicine and enters into force as of September 2013.

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

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

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

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

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

5.3 Rules for examinations
The rules for examinations are stated in the Examination Policies and Procedures published by the Faculty of Engineering and Science on their website.

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

5.5 Completion of the Master’s programme
The Master’s programme must be completed no later than four years after it was begun.
5.6 Rules and requirements for the reading of texts
It is assumed that the student can read academic texts in his or her native language as well as in English and use reference works etc. in other European languages.

5.7 Additional information
The current version of the curriculum is published on the website of the Board of Study for Medicine including more detailed information about the programme, including exams.