AALBORG UNIVERSITET

CIVILINGENIØR, CAND.POLYT. I ELEKTRO-MEKANISK SYSTEMDESIGN 2017

CIVILINGENIØR
AALBORG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

ELECTRICAL AND FLUID POWER SERVOMECHANISMS 2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained in-depth understanding of theoretical and experimental mode of operation of electrical and hydraulic servomechanisms.
- Have attained an understanding for methods of analysis and experimental methods and the characteristics of their applications and limitations.

SKILLS

- Be able to set up the governing equations a servomechanism
- Be able to specify performance criteria for a given application
- Be able to design linear controllers for a servomechanism
- Be able to implement a controller digitally
- Be able to analyse a computer controlled system
- Be able to use information technology tools to analyse and design of computer-controlled systems
- Be able to use correct terminology
- Be able to compare theoretical and experimental results
- Be able to critically evaluate applied methods and their results

COMPETENCES

- Be able to analyse and design a hydraulic or electrical servomechanism on a model based approach. The system being a complex mechatronic system encompassing mechanical, electrical and control engineering elements requiring a creative design method
- Be able to implement a computer-controlled system addressing areas important for development in the field such as process knowledge, measurement technology, computer technology and control theory
- Be able to compare, evaluate and validate theoretical and experimental results carefully, and critically evaluate the methods applied and the results obtained.

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module the expected workload is 450 hours for the student.

EXAM

EXAMS

Name of exam	Electrical and Fluid Power Servomechanisms
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Elektriske og hydrauliske servomekanismer
Module code	M-EMS-K1-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Per Johansen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

CONTROL OF FLUID POWER AND ELECTRICAL SERVOMECHANISMS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained an understanding of analysis, design and control of hydraulic servo mechanisms
- Have gained knowledge about methods for electro-mechanical energy conversion by means DC and square-wave brushless machines
- Have gained knowledge about the construction, the operating principles, the modelling and the performance characteristics for DC and brushless machines
- Have a basic understanding about closed-loop control principles for DC and brushless machines for servo applications
- Have a fundamental understanding of permanent magnet materials and their applications in electric actuators
- Have gained knowledge about methods for electric energy conversion by power electronic converters
- Have gained knowledge about active and passive power electronic components and their use in power converters.
- Have gained an understanding of Lagrange equation and how it is used for modelling of a mechanical system.
- Have a basic understanding of non-linarites in mechanical system including modal interaction.

SKILLS

- Be able to set up the governing equations (physically based) for a hydraulic servo system
- Be able to apply linear control strategies to a hydraulic servo system
- Be able to analyse different kinds of DC machines and to formulate dynamic models hereof
- Be able to calculate performance characteristics for the DC machine and to select a DC motor for a given application
- Be able to analyse and to design servo systems using DC machines with speed, position and current feedback
- Understand the basics of square-wave permanent magnet brushless machines and their applications for servo mechanisms
- Be able to understand the operating principles for basic electric converters, including pulse-width modulated buck, boost, half- and full-bridge converters
- Understand the fundamentals of semiconductor physics and the basic operating principles for power semiconductor devices such as power diodes and MOSFET’s
- Be able to read power semiconductors datasheets, including understanding of switching characteristics and safe operating areas
- Be able to design simple power electronic converters, including gate drivers and thermal aspects such as switching and conduction losses
- Have a basic understanding of good circuit layout techniques for switching converters.
- Be able to set up a dynamic model for mechanical system using Lagrange equation.

COMPETENCES

- Have the ability to model and analyse a hydraulic servo system, thereby being able to set up performance criteria and identify performance limitations
- Be able to design and implement linear controllers for hydraulic servo mechanisms and evaluate and validate the performance obtained
- Have the ability to design, model and simulate a servo system based on either a DC machine or a square-wave brushless machine
- Be able to design a closed-loop servo control system taking component limitations into account and to use a power electronic converter as part of the actuator system
- Be able to design simple power electronic converters, including component selection and proper thermal management.

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Control of Fluid Power and Electrical Servomechanisms
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Regulering af hydrauliske og elektriske servomekanismer
Module code	M-EMS-K1-2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Sergiu Viorel Spataru, Peter Omand Rasmussen, Anders Hedegaard Hansen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

EMBEDDED MICRO PROCESSORS: APPLICATIONS AND C PROGRAMMING

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained a fundamental knowledge about *C*/*C*++ programming and have a basic understanding of structured object-oriented programming
- Have attained a basic understanding of the architecture and the applications of micro processors, including digital signal processors (DSP) and micro controller units (MCU)
- Have gained experience with programming of DSP's and MCU's for real-time applications, including interfacing to peripheral units

SKILLS

- Be able to understand basic *C* syntax, including *C* data types, statements, loop constructs and functions
- Be able to understand basic object-oriented programming concepts, including classes, objects, scope, constructors, destructors and inheritance
- Be able to use pointers, arrays and function pointers in C
- Be able to use static and dynamic memory allocation
- Be able to understand the interrupt concept and its use for real-time task scheduling and prioritisation
- Be able to understand basic architectures used in micro processor systems
- Be able to understand and to configure a micro processor's built-in peripheral units
- Be able to understand the role and application of peripheral serial interfaces such as e.g. SPI and I2C
- Be familiar with *C*/*C*++ development tool chains and the use of integrated development environments

COMPETENCES

- Have the ability to develop and to test algorithms in *C* and *C*++ for real-time micro processor applications
- Be able to use peripheral units such as e.g. A/D converters, timers, pulse-width modulator units, encoder interface for interfacing an DSP/MCU to external devices such as sensors and actuators
- Be able to implement control and monitoring algorithms taking timing and prioritisation aspects into account
- Be able to apply serial interfaces for communication with external devices such as e.g. D/A converters and intelligent sensors

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Embedded Micro Processors: Applications and C Programming
Type of exam	Written or oral exam

ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Indlejrede mikroprocessorer: anvendelse og C programmering
Module code	M-EMS-K1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Lajos Török, Sergiu Viorel Spataru

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

FINITE ELEMENT METHODS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Be able to use the finite element method in static stress analysis.
- Have knowledge of element technology, such as bar, beam, solid and shell elements.
- Be able to apply methods for error estimation and adaptive mesh generation.
- Be able to solve structural dynamics and vibrations problems using methods such as free vibrations, modal methods and direct time integration methods.
- Be able to apply nonlinear finite element methods including solution of systems of nonlinear equations, geometrically nonlinear problems, contact problems, and nonlinear material models.
- Be able to perform linearised buckling analysis.
- Be able to solve exercises using a commercial finite element program (e.g., ANSYS).

SKILLS

- Demonstrate a basic understanding of concepts, theory and applications of finite element analysis from a mechanical engineering view point.
- Be able to perform linear and nonlinear static and dynamic stress analysis including the use of commercial finite element software.

COMPETENCES

- Be able to apply the concepts, theories and techniques covered in the area of linear and nonlinear finite element analysis on practical problems.
- Be able to apply the concepts and theories to the solution of relevant problems using commercial software programs.

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Finite Element Methods
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Elementmetoder
Module code	M-DMS-K1-5
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Erik Lund

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ELECTRICAL AND FLUID POWER SERVOMECHANISMS

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 1st Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of design of a power transmission system featuring a poly phase AC motor
- Be able to, on a scientific basis, to understand and apply advanced model based analysis tools for evaluating the performance of a power transmission system

SKILLS

- Be able to set up the governing equations for a poly phase AC machine.
- Be able to understand the function of a frequency converter
- Be able to master the conventional control strategies for control of a poly phase AC machine
- Be able to understand the interaction between motor, frequency converter and the actuated plant
- Be able to apply advanced analysis theory and tools for optimising the performance of a power transmission system
- Be able to implement control strategies digitally

COMPETENCES

- Be able to design a power transmission system involving control of a poly phase AC machine taking into account the dynamic properties of the actuated system
- Be able to handle a multidisciplinary problem of high complexity that requires use of both the understanding of the innovative process of mechatronic design methodology and new design methods

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module the expected workload is 450 hours for the student.

EXAM

EXAMS

Name of exam	Electrical and Fluid Power Servomechanisms
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale

Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Design and Control of Power Transmission Systems
Module code	M-EMS-K2-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Omand Rasmussen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ENGINEERING OPTIMIZATION – CONCEPTS, METHODS AND APPLICATIONS

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in 1st Semester.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained an in-depth understanding of important concepts and methods of optimization for efficient solution of optimization problems within different areas of engineering, including design optimization of mechanical systems.

SKILLS

- Be able to use optimization concepts and topics.
- Be able to use numerical methods of unconstrained optimization.
- Be able to use numerical (mathematical programming) methods for optimization of multi-dimensional functions with constraints.
- Be able to solve multicriterion optimization problems.
- Be able to apply other methods of optimization, such as integer problems, response surface methods, genetic algorithms, etc.
- Be able to perform general applications of optimization methods: parameter identification, optimization as an analysis tool for problems governed by an extremum principle, surrogate and metamodelling problems.

COMPETENCES

- Be able to apply the concepts, theories and methods for solution of engineering optimization problems.
- Be able to account for the considerations involved in the process of formulating and modeling an engineering optimization problem, choosing an advantageous method of solution, and implementing it in practice.

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Engineering Optimization – Concepts, Methods and Applications
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale

Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Ingeniørmæssig optimering – begreber, metoder og anvendelser
Module code	M-DMS-K2-2
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Erik Lund

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

MULTI VARIABLE CONTROL

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module is based on knowledge achieved in classical control theory and state space control.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained an in-depth understanding of basic aspects of multivariable control design, the approaches, the key quantities to consider and the fundamental limitations inherent in the design
- Be able to, on a scientific basis, to understand and apply advanced model based control design tools
- Be able to document understanding of multivariable systems (multiple inputs and multiple outputs MIMO)

SKILLS

- Be able to understand the fundamental performance limitations of single input and single output (SISO) systems
- Be able to represent linear systems in different ways: Transfer functions matrices, input-output equations, state space form, etc.
- Be able to understand what disturbances are, and to describe their character in a suitable way
- Be able to set up design specifications for MIMO systems
- Be able to understand basic limitations in control design
- Be able to set up the configuration of multivariable controllers
- Be able to design linear multivariable controllers

COMPETENCES

- Be able to undertake analysis, design and implementation of advanced multivariable control systems where experience and intuition play a very important role

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	Engineering Optimisation – Concepts, Methods and Applications
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Multivariabel regulering
Module code	M-EMS-K2-3
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Lasse Schmidt

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

AC MOTOR DRIVES: CONVERTERS AND CONTROL

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 1st Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge of methods for electro-mechanical energy conversion by means of three-phase AC machines
- Have gained knowledge of the construction and the operating principles for induction machines and for three-phase sine-wave brushless machines
- Understand the stationary performance characteristics for such machines
- Have a solid understanding of stationary and dynamic models of AC machines
- Have gained a solid understanding of basic methods for speed control of AC machines using power electronic converters
- Have gained a basic understanding of high-performance torque control methods based on vector-control principles
- Have gained knowledge of power electronic converters for AC drives
- Have knowledge of dynamic models of power converters
- Understand the principle of three-phase pulse-width modulation (PWM) for three-phase systems and being able to apply PWM as part of an AC motor control loop

SKILLS

- Be able to explain the operating principles for induction and brushless machines
- Be able to apply equivalent circuit diagrams for stationary performance analysis
- Be able to measure motor parameters using standard tests
- Be able to make dynamic models of AC machines using space-vector models in stationary and rotating coordinates
- Be able to design and to simulate simple scalar control techniques for AC machines based on stationary performance characteristics
- Be able to understand field-oriented control techniques and to apply these for high-performance AC drives
- Be able to design a pulse-width modulator using both carrier-based and space-vector based approaches
- Being able to analyse and to model single- and three-phase power converters taking component voltage drops and blanking effects into account

COMPETENCES

- Have the ability to analyse, model and simulate the stationary and dynamic characteristics for an AC motor drive based on both induction and permanent-magnet machines
- Be able to design a complete AC motor control system using either classical V/Hz techniques or high-performance vector-control techniques based on field-orientation and instantaneous current control

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module the expected workload is 150 hours for the student.

EXAM

EXAMS

Name of exam	AC Motor Drives: Converters and Control
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	AC motor drev: konvertere og regulering
Module code	M-EMS-K2-4
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Peter Omand Rasmussen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

INDUSTRIAL DEVELOPMENT

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module the expected workload is 450 hours for the student.

EXAM

EXAMS

Name of exam	Industrial Development
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS. The project may be finalized with a project report or in the form of a scientific paper with supporting appendices.

The extent of the project must reflect the allotted time in ECTS

FACTS ABOUT THE MODULE

Danish title	Industrielt udviklingsarbejde
Module code	M-EMS-K3-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

INDUSTRIAL DEVELOPMENT

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 20 ECTS project module the expected workload is 600 hours for the student.

EXAM

EXAMS

Name of exam	Industrial Development
Type of exam	Oral exam based on a project
ECTS	20
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS. The project may be finalized with a project report or in the form of a scientific paper with supporting appendices.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Industrielt udviklingsarbejde
Module code	M-EMS-K3-6
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

INDUSTRIAL DEVELOPMENT

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 25 ECTS project module the expected workload is 750 hours for the student.

EXAM

EXAMS

Name of exam	Industrial Development
Type of exam	Oral exam based on a project
ECTS	25
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS. The project may be finalized with a project report or in the form of a scientific paper with supporting appendices.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Industrielt udviklingsarbejde
Module code	M-EMS-K3-7
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	25
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

INDUSTRIAL DEVELOPMENT

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 30 ECTS project module the expected workload is 900 hours for the student.

EXAM

EXAMS

Name of exam	Industrial Development
Type of exam	Oral exam based on a project
ECTS	30
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS. The project may be finalized with a project report or in the form of a scientific paper with supporting appendices.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Industrielt udviklingsarbejde
Module code	M-EMS-K3-8
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module the expected workload is 450 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS.

The extent of the project must reflect the allotted time in ECTS

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	M-EMS-K3-2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 20 ECTS project module the expected workload is 600 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project
ECTS	20
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	M-EMS-K3-9
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 25 ECTS project module the expected workload is 750 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project
ECTS	25
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	M-EMS-K3-10
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	25
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

ACADEMIC INTERNSHIP

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module is based on knowledge gained on 2nd Semester of the MSc programme in Electro-Mechanical System Design.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

SKILLS

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

COMPETENCES

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 30 ECTS project module the expected workload is 900 hours for the student.

EXAM

EXAMS

Name of exam	Academic Internship
Type of exam	Oral exam based on a project
ECTS	30
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The project can be combined with up to 15 ECTS of courses, which reduces the ECTS of the project accordingly (e.g., a 20 ECTS project combined with 10 ECTS of course-work). The semester must add up to a total workload of 30 ECTS.

The extent of the project must reflect the allotted time in ECTS.

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	M-EMS-K3-11
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

45 ECTS MASTER'S THESIS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

- Have attained thorough knowledge of a broad range of theoretical, numerical and experimental methods and techniques within the area of Electro Mechanical System Design, i.e. mechanical engineering, electrical engineering, control engineering and information technology

SKILLS

- Be able to apply scientific methodology to the solving of a wide variety of problems within the field of specialisation
- Be able to perform scientific work in relevant topics of the field of the specialisation
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialisation
- Be able to participate or lead projects in electro-mechanical development and/or research projects

COMPETENCES

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation
- Be able to take part in technical development and research
- Be able to direct the technical management of development projects within the industry
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge

TYPE OF INSTRUCTION

Project work

EXTENT AND EXPECTED WORKLOAD

Since it is a 45 ECTS project module the expected workload is 1350 hours for the student.

EXAM

EXAMS

Name of exam	45 ECTS Master's Thesis
Type of exam	Master's thesis/final project
ECTS	45
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	45 ECTS Kandidatspeciale
Module code	M-EMS-K3-3
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	45
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

50 ECTS MASTER'S THESIS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

- Have attained thorough knowledge of a broad range of theoretical, numerical and experimental methods and techniques within the area of Electro Mechanical System Design, i.e. mechanical engineering, electrical engineering, control engineering and information technology

SKILLS

- Be able to apply scientific methodology to the solving of a wide variety of problems within the field of specialisation
- Be able to perform scientific work in relevant topics of the field of the specialisation
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialisation
- Be able to participate or lead projects in electro-mechanical development and/or research projects

COMPETENCES

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation
- Be able to take part in technical development and research
- Be able to direct the technical management of development projects within the industry
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge

TYPE OF INSTRUCTION

Project work

EXTENT AND EXPECTED WORKLOAD

Since it is a 50 ECTS project module the expected workload is 1500 hours for the student.

EXAM

EXAMS

Name of exam	50 ECTS Master's Thesis
Type of exam	Master's thesis/final project
ECTS	50
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	50 ECTS Kandidatspeciale
Module code	M-EMS-K3-4
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	50
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

LONG MASTER'S THESIS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.

LEARNING OBJECTIVES

KNOWLEDGE

- Have attained thorough knowledge of a broad range of theoretical, numerical and experimental methods and techniques within the area of Electro Mechanical System Design, i.e. mechanical engineering, electrical engineering, control engineering and information technology

SKILLS

- Be able to apply scientific methodology to the solving of a wide variety of problems within the field of specialisation
- Be able to perform scientific work in relevant topics of the field of the specialisation
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialisation
- Be able to participate or lead projects in electro-mechanical development and/or research projects

COMPETENCES

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation
- Be able to take part in technical development and research
- Be able to direct the technical management of development projects within the industry
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge

TYPE OF INSTRUCTION

Project work

EXTENT AND EXPECTED WORKLOAD

Since it is a 60 ECTS project module the expected workload is 1800 hours for the student.

EXAM

EXAMS

Name of exam	60 ECTS Master's Thesis
Type of exam	Master's thesis/final project
ECTS	60
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Langt Kandidatspeciale
Module code	M-EMS-K3-5
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	60
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

MASTER'S THESIS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have attained thorough knowledge of a broad range of theoretical, numerical and experimental methods and techniques within the area of Electro Mechanical System Design, i.e. mechanical engineering, electrical engineering, control engineering and information technology

SKILLS

- Be able to apply scientific methodology to the solving of a wide variety of problems within the field of specialisation
- Be able to perform scientific work in relevant topics of the field of the specialisation
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialisation
- Be able to participate or lead projects in electro-mechanical development and/or research projects

COMPETENCES

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation
- Be able to take part in technical development and research
- Be able to direct the technical management of development projects within the industry
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge

TYPE OF INSTRUCTION

The teaching is organized in accordance with the general form of teaching. Please see the programme cirruculum §17.

EXTENT AND EXPECTED WORKLOAD

Since it is a 30 ECTS project module the expected workload is 900 hours for the student.

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	30
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

The master thesis can be conducted as a long master thesis using both the 3rd and 4th semester. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	M-EMS-K4-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Torben Ole Andersen

ORGANISATION

Study Board	Study Board of Mechanical Engineering and Physics
Department	Department of Materials and Production
Faculty	Faculty of Engineering and Science

SYSTEM IDENTIFICATION AND DIAGNOSIS

2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have comprehension of the fundamental principles of typical methods of system identification
- Have comprehension of the fundamental concepts, terms and methodologies of abnormal diagnosis
- Have comprehension of some typical model-based and signal-based diagnosis

SKILLS

- Be able to apply the learned knowledge to handle some simple system identification problems under assistance of a commercial software
- Be able to apply and analyse different diagnosis methods

COMPETENCES

- Independently be able to define and analyse scientific problems within the area of system identification and diagnosis
- Independently be able to be a part of professional and interdisciplinary development work within the area of system identification and diagnosis

TYPE OF INSTRUCTION

The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	System Identification and Diagnosis
Type of exam	Oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

This course is taught to the 1st semester MSc students at the Offshore Energy Systems specialisation and is offered as an elective course at the 3rd semester of the Energy Engineering specialisations as well as the Process Engineering and Combustion Technology specialisation. Students of the Offshore Energy Systems specialisation cannot elect the module again.

FACTS ABOUT THE MODULE

Danish title	Systemidentifikation og diagnosticering
Module code	N-SEE-K1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg, Campus Aalborg
Responsible for the module	Jesper Liniger, Per Johansen

ORGANISATION

Study Board	Study Board of Energy
Department	Department of Energy Technology
Faculty	Faculty of Engineering and Science

NON-LINEAR CONTROL AND MULTI-BODY SYSTEMS 2019/2020

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Be able to carry out kinematic analysis of multi-body systems
- Be able to model multi-body dynamical systems using selected methods
- Be able to develop complete system models that include actuators and possible hard non-linearities
- Be able to analyse systems using linearization-, Lyapunov- and phase plane methods
- Be able to design non-linear controllers for considered systems in the presence on uncertain and possibly varying system parameters

SKILLS

- Be able to establish various types models for non-linear system, including multi-body and actuator models
- Be able to judge the usefulness of the different analyses and design methods
- Be able to apply the learned knowledge to analyse and study non-linear dynamical systems
- Be able to design selected types of non-linear controllers
- Be able to implement selected types of non-linear controllers

COMPETENCES

- Independently be able to describe and analyse non-linear systems
- Independently be able to design considered non-linear controllers
- Independently be able to continue own development within the field of non-linear systems analysis and control

TYPE OF INSTRUCTION

The programme is based on a combination of academic, problem oriented and interdisciplinary approaches and organised based on the following types of instruction that combine skills and reflection: - lectures - class teaching - project work - workshops - exercises (individually and in groups) - teacher feedback - professional reflection - portfolio work - laboratory Work The form(s) of teaching will be determined and described in connection with the planning of the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the roles of the participants.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Non-linear Control and Multi-body Systems
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

ADDITIONAL INFORMATION

This course is taught to the 1st semester MSc students at the Mechatronic Control Engineering specialisation and is offered as an elective course at the 3rd semester of all other specialisations. Students of the Mechatronic Control Engineering specialisation cannot elect the module again.

FACTS ABOUT THE MODULE

Danish title	Ikke-lineær regulering og flerlegeme systemer
Module code	N-EE-K1-11
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg
Responsible for the module	Lasse Schmidt

ORGANISATION

Study Board	Study Board of Energy
Department	Department of Energy Technology
Faculty	Faculty of Engineering and Science

TEST AND VALIDATION

2019/2020

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon knowledge obtained in the modules Applied Statistics and Probability Theory.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Understand methodology for design of experiments and test series and for reduction of ambiguity of experimental results, and for comparability with model predictions
- Explain elementary and advanced quantification tools, and their application to validation between model and experiment data
- Account for common contemporary methods and relevant specific industry standards
- Understand processing methods for analog and digital data (continuous vs. discrete)

SKILLS

- Scrutinize a non-trivial physical systems for appropriate experimental study
- Isolate principal measurable parameters
- Design an experiment matrix for systematic variation of parameters
- Perform a probabilistic study of the experimental data in order to quantify the influence of individual parameters
- Scrutinize a model (analytical or numerical) for comparison with an appropriate experimental study
- Isolate principal input parameters and their known or assumed statistical variations
- Perform a probabilistic study of the model in order to quantify the level of confidence
- Account for the level of coherence between test results and model predictions
- Identify invalid data (outliers)
- Account for common errors and limitations in the processing of model data or experimentally obtained data

COMPETENCES

- Undertake experiment planning and execution for refinement and validation (or rejection) of model-based predictions of phenomena within their principal line of study

TYPE OF INSTRUCTION

The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course module, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Test and Validation
Type of exam	Written and oral exam Oral examination based on a submitted written assignment.

ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Test og validering
Module code	N-EE-K3-21
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg
Responsible for the module	Erik Appel Jensen, Henrik Sørensen

ORGANISATION

Study Board	Study Board of Energy
Department	Department of Energy Technology
Faculty	Faculty of Engineering and Science