AALBORG UNIVERSITET

STUDIEORDNING FOR BACHELORUDDANNELSEN (BSC) I ELEKTRONIK OG DATATEKNIK 2014

BACHELOR (BSC) I TEKNISK VIDENSKAB
ESBJERG

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

TECHNOLOGICAL PROJECT WORK

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Through this module, the student shall acquire knowledge about problem oriented and problem based learning. Furthermore, he/she shall acquire first-hand knowledge about project-oriented group work as a learning method. Additionally, the student will be introduced to basic problems and concepts within the field of Electronics and IT.

Content
The project group must prepare a report and process analysis, participate in a P0 collection of experience and attend a presentation seminar where the project group documents discussed.

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have insight into elementary concepts related to project-oriented group work.
- Shall be familiar with the processes involved in project work, knowledge acquisition and supervisor collaboration

SKILLS

- Shall be able to define project goals and work in a methodical manner toward achieving such goals
- Shall be able to describe and analyse several approaches to project solutions
- Shall be able to present results achieved within the project in writing, orally, and graphically in a comprehensive manner.

COMPETENCES

- Shall be able to reflect upon the problem oriented and problem based learning approach taken throughout the study
- Shall be able to document the results achieved during the project in a report
- Shall be able to cooperate with other students during the project period and make a joint presentation of the results achieved in the project.
- Shall be able to reflect upon different ways of presenting results achieved with the project in writing, orally, and graphically.

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

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

EXAM

EXAMS

Name of exam	Technological Project Work
Type of exam	Oral exam based on a project
ECTS	5

Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Project (P0) on 1st Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Teknologisk projektarbejde
Module code	N-ED-B1-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain

ORGANISATION

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

MONITORING & PROGRAMMING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Technological project work (P0)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
One of the most fundamental capabilities any electronics and computer Engineer must possess is the ability to construct functionality that allows a computer to interact with its surroundings. Through the 1st semester project, the students shall acquire basic knowledge within electronics and computer engineering through practical and theoretical work. The project takes its starting point in a problem of relevance to society or industry; the problem is then broken down into smaller, more manageable sub-problems and analysed for the purpose of defining a relevant technical problem formulation, which can be solved via theories and methods related to micro-processor- or PC- based systems. The solution shall encompass an electronic system containing (at least) a programmable electronic computing device, which is able to measure signals from its surroundings via selected sensors and process them in some digital form.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have understanding of basic electronic systems and their interaction with their surroundings
- Must have basic insight into concepts such as signals, sensors, actuators and micro-processors
- Shall have sufficient insight into technological and social issues to enable them to pinpoint relevant problems that can be solved by technical means
- Shall have knowledge about common processes in extensive, problem-oriented projects
- Shall be able to explain and clarify theories and methods used in the project

SKILLS

- Given a socially relevant problem, must be able to identify relevant requirements to a technical solution, product or similar
- Must be able to follow a relevant method for structured development in the project, including formulation and analysis of the problem, define a requirement specification and divide the problem into sub-problems that can be resolved separately
- Shall be able to utilize the selected sensors and actuators for data collection and interaction with an electronic system and its surroundings as well
- Shall be able to formulate and solve technical problems via algorithms and be able to implement algorithms in a micro-processor or similar programmable device
- Shall be able to analyse and evaluate their own utilization of taught theories and methods
- Shall be able to document and present the knowledge and skills outlined above, using correct terminology, in writing as well as orally
- Shall be able to analyse and evaluate their own learning processes using relevant methods
- Shall be able to plan and carry out an extensive group project in collaboration with a supervisor

COMPETENCES

- Shall understand the general concept of a system, in particular pertaining to electronic systems interacting with their surroundings
- Shall be able to assume responsibility for their own learning processes during an extensive group project, as well as generalize and interpret the experience acquired
- Shall be able to plan, structure, carry out, and reflect upon a project that starts from a socially or industrially relevant problem, in which electronic systems and information technology is an important element, individually as well as in groups.

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

Since it is a 10 ECTS project module, the work load is expected to be 300 hours for the student

EXAM

EXAMS

Name of exam	Monitoring & Programming
Type of exam	Oral exam based on a project
ECTS	10
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Project (P1) on 1st Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Overvågning og programmering
Module code	N-ED-B1-2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	10
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain

ORGANISATION

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

IMPERATIVE PROGRAMMING

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Students who complete the module enrich their background in working with computers and other digital devices in procedural ways to enable programming for different media platforms and working with analog and digital sensors.

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have understanding of integrated development environments
- Shall have understanding of differences between run-time and compile-time computer programming languages
- Shall be able to explain the concepts of types, declarations, expressions and statements
- Shall be able to make use of libraries and understand the concept of linking
- Shall have insight into data structures, such as arrays
- Shall have insight into input/output in various forms
- Shall have understanding of procedures and functions, including function arguments
- Shall have understanding of pointers and references
- Shall have understanding of the complexity of a program
- Shall have understanding of simple algorithms

SKILLS

- Shall be able to interpret and analyse a basic imperative program and elaborate its functionality
- Shall be able to design and implement algorithms for data structure manipulation using references and addresses where necessary
- Shall be able to estimate the complexity of a program
- Shall be able to explain how to use algorithms, functions and data for solving problems (understanding)

COMPETENCES

- Must be able, individually and in collaboration with others, to design and implement one or more imperative program(s) to solve a previously specified problem

TYPE OF INSTRUCTION

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

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	Imperative Programming
Type of exam	Written and oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Imperativ programmering
Module code	N-ED-B1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Daniel Ortiz Arroyo

ORGANISATION

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

PROBLEMBASERET LÆRING I VIDENSKAB, TEKNOLOGI OG SAMFUND

2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Viden der gør den studerende i stand til at:
  - Redegøre for den grundlæggende læringsteori
  - Redegøre for teknikker til planlægning og styring af projektarbejde
  - Redegøre for forskellige tilgange til problembaseret læring (PBL); herunder Aalborg modellens udgangspunkt i problemer, der indgår i en samfundsmæssig og/eller humanistisk sammenhæng
  - Redegøre for forskellige tilgange til analyse og vurdering af ingeniør, natur og sundhedsvidenskabelige problemstillinger og løsninger i et videnskabsteoretisk, etisk og samfundsmæssigt perspektiv
  - Redegøre for konkrete metoder inden for fagområdet til at udføre denne analyse og vurdering

FÆRDIGHEDER

- Færdigheder der gør de studerende i stand til at:
  - Planlægge og styre et problembaseret studieprojekt
  - Analysere projektgruppens organisering af gruppesamarbejdet med henblik på at identificere stærke og svage sider, og på den baggrund komme med forslag til, hvordan samarbejdet i fremtidige grupper kan forbedres
  - Reflektere over årsager til og anvise mulige løsninger på eventuelle gruppekonflikter
  - Analysere og vurdere egen studieindsats og læring med henblik på at identificere stærke og svage sider, og der ud fra overveje videre studieforløb og studieindsats
  - Reflektere over de anvendte metoder i et videnskabsteoretisk perspektiv
  - Udpege relevante fokusområder, begreber og metoder til at vurdere og udvikle løsninger under hensynstagen til de samfundsmæssige og humanistiske sammenhænge i hvilke løsningen skal indgå

KOMPETENCER

- Kompetencer, som gør den studerende i stand til at:
  - Indgå i et teambaseret projektarbejde
  - Formidle et projektarbejde
  - Reflektere og udvikle egen læring bevidst
  - Indgå i og optimere kollaborative læreprocesser
  - Reflektere over sit professionelle virke i relation til det omgivende samfund

UNDERVISNINGSFORM

Kurset er organiseret som et mix af forelæsninger, seminarer, workshops, gruppekonsultation og selvstudie.

OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

EKSAMEN

PRØVER

Prøvens navn	Problembaseret læring i videnskab, teknologi og samfund

Prøveform	Skriftlig Kurset eksamineres individuelt på baggrund af en skriftlig opgave.
ECTS	5
Bedømmelsesform	Bestået/ikke bestået
Censur	Intern prøve
Vurderingskriterier	Som angivet i Fællesbestemmelser for uddannelser (Vurderingskriterier) http://www.engineering.aau.dk/uddannelse/studieadministration/

FAKTA OM MODULET

Engelsk titel	Problem-based Learning in Science, Technology and Society
Modulkode	N-EN-B1-5
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Dansk og engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg, Campus Esbjerg, Campus København
Modulansvarlig	Annette Grunwald, Søren Rosenlund Frimodt-Møller

ORGANISATION

Studienævn	Studienævnet for Energi
Institut	Institut for Energiteknik
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

CALCULUS

2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

• skal have kendskab til definitioner, resultater og teknikker inden for teorien for differentiation og integration af funktioner af to eller flere variable
• skal have kendskab til de trigonometriske funktioner og deres inverse funktioner

• skal have kendskab til beskrivelsen af simple flader i hhv. retvinklede, polære og cylindriske koordinater

• skal have kendskab til de komplekse tal, deres regneregler og deres repræsentationer

• skal have kendskab til faktorisering af polynomier over de komplekse tal

• skal have kendskab til den komplekse eksponentialfunktion, dens egenskaber, og dens forbindelse med trigonometriske funktioner

• skal have kendskab til kurver i planen (både i rektangulære og polære koordinater) og rummet, parametrisering, tangentvektor og krumning for disse

• skal have kendskab til teorien for anden ordens lineære differentialligninger med konstante koefficienter

FÆRDIGHEDER

• skal kunne visualisere funktioner af to og tre variable ved hjælp af grafer, niveaukurver og niveauflader
• skal kunne foretage bestemmelse af lokale og globale ekstrema for funktioner af to og tre variable

• skal kunne bestemme areal, volumen, inertimoment og lignende ved anvendelse af integrationsteori

• skal kunne approksimere funktioner af en variabel ved hjælp af Taylors formel, og kunne anvende lineær approksimation for funktioner af to eller flere variable

• skal have færdighed i regning med komplekse tal

• skal kunne finde rødder i den komplekse andengradsligning og udføre faktorisering af polynomier i simple tilfælde

• skal kunne løse lineære andenordens differentialligninger med konstante koefficienter, generelt, og med begyndelsesbetingelser

• skal kunne ræsonnere med kursets begreber, resultater og teorier, i simple konkrete og abstrakte problemstillinger

KOMPETENCER

• skal udvikle og styrke sit kendskab til, forståelse af, og anvendelse af matematiske teorier og metoder inden for andre fagområder

• skal ud fra givne forudsætninger kunne ræsonnere og argumentere med matematiske begreber fra calculus

UNDERVISNINGSFORM

Forelæsninger med tilhørende opgaveregning.

OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

EKSAMEN

PRØVER

Prøvens navn	Calculus
Prøveform	Skriftlig eller mundtlig
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Som angivet i Fællesbestemmelser for uddannelser (Vurderingskriterier) http://www.engineering.aau.dk/uddannelse/Studieadministration/

FAKTA OM MODULET

Engelsk titel	Calculus
Modulkode	F-MAT-B1-3
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Dansk og engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg, Campus Esbjerg
Modulansvarlig	Morten Grud Rasmussen

ORGANISATION

Studienævn	Studienævnet for Matematik, Fysik og Nanoteknologi
Institut	Institut for Matematiske Fag
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

ANALOG INSTRUMENTATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Monitoring and programming (P1)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Through theoretical and practical work on a selected problem, the students acquire knowledge in the electronics and computer engineering discipline, as well as use appropriate methods to document that the problem has a relevant social context. The problem is analysed by decomposition into sub problems in order to formulate a technical problem that can be solved by using analog electronic systems that interact with the environment in one way or another. The complete solution is assessed with respect to the relevant social context. Compared to the first semester, this semester focuses more on the continuous-time (analog) aspects of electronic systems as well as interaction with the surroundings in greater detail.

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have gained experience with theories and methods of calculation and simulation of linear electronic circuits, linear electro-mechanical systems, and/or other linear systems
- Shall have acquired knowledge of methods for analysis of linear dynamic systems, including electronic circuits, described by differential equations
- Shall have gained insight into basic feedback theory and its applications in electronic systems
- Must master calculations with complex numbers, as used within the field of electronics
- Shall have knowledge of recognized standards for documentation of electronic circuits, including electrical diagrams, PCB layout, etc.
- Shall be able to demonstrate knowledge of theory and method to the extent of being able to explain and justify the project's theory and methods, including both selection and de-selection.
- Shall master the relevant terminology

SKILLS

- Shall have understanding of basic theories behind simple electronic components such as resistors, capacitors, operational amplifiers, etc., including calculation of these components
- Shall be able to identify, analyse and formulate issues within the discipline through the use of contextual and technical analysis methods
- Shall, based on the above, be able to create requirements and test specifications that enable the completed system to be tested rigorously
- Shall be able to use mathematical theories and methods to analyse problems involving linear dynamic components
- Shall be able to simulate and design simple analog circuits, allowing specific, desired properties to be achieved.
- Shall be able to design and implement basic analog and digital circuits and demonstrate that these work as intended
- Shall be able to document and disseminate knowledge and skills with proper use of terminology, orally and in writing through a project report
- Shall be able to analyse and reflect upon his/her own learning process using appropriate methods of analysis and experience from P0 and P1
- Shall be able to analyse a technical-scientific problem under consideration of technological and societal contexts, and assess the technological and social consequences of proposed solutions.

COMPETENCES

- Must be able to demonstrate, independently and in groups, the ability to plan, organize, implement and reflect upon a project that is based on a problem of relevance to society or industry, in which analog electronic devices play a central role
- Must have acquired, independently and in groups, the ability to obtain the necessary knowledge of a contextual as well as of technical nature, and be able to formulate models of limited parts of reality to such a level of abstraction that the models can be used in the design, implementation and test of a comprehensive system to meet given requirements
- Must be able to evaluate and take responsibility for science and technical solutions in a societal perspective.
- Must be able to generalize and reflect upon the experience with project planning and cooperation for the further study acquired during the project work

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the work load is expected to be 450 hours for the student

EXAM

EXAMS

Name of exam	Analog Instrumentation
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Project on 2nd Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Analog instrumentering
Module code	N-ED-B2-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain
Time allocation for external examiners	B

ORGANISATION

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

LINEÆR ALGEBRA

2018/2019

FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Modulet bygger på viden opnået i modulet Calculus.

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

• skal have viden om definitioner, resultater og teknikker inden for teorien for lineære ligningssystemer
• skal have kendskab til lineære transformationer og deres sammenhæng med matricer

• skal have viden om computerværktøjet Matlab og dets anvendelse inden for lineær algebra

• skal have kendskab til simple matrixoperationer

• skal have kendskab til invertibel matrix og invertibel lineær afbildning

• skal have kendskab til vektorrummet Rn og underrum deraf

• skal have kendskab til lineær afhængighed og uafhængighed af vektorer, samt dimension og basis for underrum

• skal have kendskab til determinant for matricer

• skal have kendskab til egenværdier og egenvektorer for matricer og deres anvendelse

• skal have kendskab til projektioner og ortonormale baser

• skal have viden om første ordens differentialligninger, samt om systemer af lineære differentialligninger

FÆRDIGHEDER

• skal kunne anvende teori og regneteknik for lineære ligningssystemer til at afgøre løsbarhed, og til at bestemme fuldstændige løsninger og deres struktur
• skal kunne repræsentere lineære ligningssystemer ved hjælp af matrixligninger, og omvendt

• skal kunne bestemme og anvende reduceret echelonform af en matrix

• skal kunne anvende elementære matricer i forbindelse med Gauss-elimination og inversion af matricer

• skal kunne afgøre lineær afhængighed eller lineær uafhængighed af små systemer af vektorer

• skal kunne bestemme dimension af og basis for underrum
• skal kunne bestemme matrix for en givet lineær afbildning, og omvendt

• skal kunne løse simple matrixligninger

• skal kunne beregne invers af små matricer

• skal kunne bestemme dimension af og basis for nulrum og søjlerum

• skal kunne beregne determinanter og kunne anvende resultatet af beregningen

• skal kunne beregne egenværdier og egenvektorer for simple matricer

• skal kunne afgøre, om en matrix er diagonaliserbar, og i bekræftende fald gennemføre en diagonalisering, for simple matricer

• skal kunne beregne den ortogonale projektion på et underrum af Rn

• skal kunne løse separable og lineære første ordens differentialligninger, generelt, og med begyndelsesbetingelser

KOMPETENCER

• skal udvikle og styrke sit kendskab til, forståelse af, og anvendelse af matematiske teorier og metoder inden for andre fagområder
• skal ud fra givne forudsætninger kunne ræsonnere og argumentere med matematiske begreber inden for lineær algebra

UNDERVISNINGSFORM

Forelæsninger med tilhørende opgaveregning.

OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

EKSAMEN

PRØVER

Prøvens navn	Lineær algebra
Prøveform	Skriftlig eller mundtlig
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Som angivet i Fællesbestemmelser for uddannelser (Vurderingskriterier) http://www.engineering.aau.dk/uddannelse/Studieadministration/

FAKTA OM MODULET

Engelsk titel	Linear Algebra

Modulkode	F-MAT-B2-2
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Dansk og engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg, Campus Esbjerg
Modulansvarlig	Morten Grud Rasmussen

ORGANISATION

Studienævn	Studienævnet for Matematik, Fysik og Nanoteknologi
Institut	Institut for Matematiske Fag
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

GRUNDLÆGGENDE ELEKTRONIK

2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Have opnået viden om og forståelse for resistive elektriske kredsløb
- Have opnået viden om og forståelse for operationsforstærkere
- Have opnået viden om og forståelse for induktive og kapacitive elektriske kredsløb
- Have opnået viden om og forståelse for elektrisk måleteknik
- Have opnået viden om forskellige elektriske læresætninger
- Have opnået viden om og forståelse for laboratorieprocedurer i forbindelse med el-tekniske laboratorieforsøg

FÆRDIGHEDER

- Kunne analysere enkle og sammensatte elektriske DC-kredse
- Kunne anvende kredsløbsteknikken til at beregne strømme, spændinger, energier og effekter i DC-kredse
- Kunne anvende kredsløbsreduktionsmetoder til at reducere elektriske kredse
- Kunne anvende analyse metoder til at designe operationsforstærkerkoblinger
- Kunne planlægge og udføre velgennemtænkte, succesfulde el-tekniske laboratorieforsøg på en sikker og hensigtsmæssig vis
- Kunne anvende softwareværktøj til design af elektriske kredse
- Have færdigheder inden for følgende områder:
    - Grundlæggende DC-kredsløbsteori (indeholdende energilagrende komponenter), Ohms lov, enheder, Kirchhoffs love, kredsløbsreduktioner (serie og parallel), stjerne-trekant koblinger, afhængige og uafhængige kilder, knudepunkts- og maskemetoden, grundlæggende operationsforstærkerkoblinger, den ideelle operationsforstærker, Thévenin og Nortons teoremer, superposition og maksimal effektoverføring, første og anden ordens transienter
    - Måling af strøm, spænding, effekt og energi, anvendelse af almindelige elektriske måleinstrumenter som voltmeter, amperemeter, wattmeter i digital teknologi samt oscilloskoper
    - Målenøjagtighed, sammensat målefejl og usikkerhedsberegninger
- Kunne anvende software til beregninger af forskellige elektriske signaler i enkle elektriske kredse

KOMPETENCER

- Skal kunne håndtere enkle udviklingsorienterede situationer i forbindelse med elektriske kredse og laboratorieopstillinger i studie- eller arbejdssammenhænge
- Skal selvstændigt kunne indgå i fagligt og tværfagligt samarbejde med en professionel tilgang inden for grundlæggende DC-kredsløbsteori
- Skal kunne identificere egne læringsbehov og strukturere egen læring inden for grundlæggende kredsløbsteori og el-tekniske laboratorieforsøg.

UNDERVISNINGSFORM

Forelæsninger med tilhørende opgaveregning.

OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

EKSAMEN

FORUDSÆTNING FOR INDSTILLING TIL PRØVEN

- Der er mødepligt til kursusgangene i forbindelse med laboratorieøvelserne.

PRØVER

Prøvens navn	Grundlæggende elektronik
Prøveform	Skriftlig 4 timers prøve.
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Som angivet i Fællesbestemmelser for uddannelser (Vurderingskriterier) http://www.engineering.aau.dk/uddannelse/studieadministration/

FAKTA OM MODULET

Engelsk titel	Basic Electrical Engineering
Modulkode	N-ED-B2-3
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Esbjerg
Modulansvarlig	Seyed Mohsen Nourbakhsh Soltani

ORGANISATION

Studienævn	Studienævnet for Energi
Institut	Institut for Energiteknik
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

DIGITAL DESIGN & SENSORS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Monitoring and programming (P1)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To help the students to acquire knowledge and skills which enable the analysis and designing of basic digital circuits, they acquire knowledge about various sensors and develop skills to use and monitor the signals. To teach the operating principles of various typical sensors and to introduce the concepts & designs for the measurement of electrical and non-electrical quantities.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge and understanding of basic digital circuits
- Must have knowledge of Boolean algebra and minimal methods
- Must be able to explain the difference between CMOS and TTL circuits
- Must have knowledge of Multi-vibrators & Sequential circuits.
- Must have knowledge of Bi-stable Circuits, structure of mono-stable and a-stable circuits.
- Must have knowledge of Mealy and Moore State Machines
- Must have knowledge of Counters and Must have knowledge of Counters and Shift Registers
- Must have knowledge of different sensors
- Must have knowledge of how signal is obtained from different sensors
- Must have knowledge of internal working principal of various sensors.

SKILLS

- Must be able to analyse simple digital circuits
- Must be able to design digital circuits which is a central feature of data or electrical engineering
- Must be able to understand the analysis, design and the realization of digital circuits
- Must be able to demonstrate an understanding of relevant concepts, theories and methods of analysis and synthesis of combinational and sequential networks.
- Must be able to apply concepts, theories and methods to describe and analyse a specific problem and explain the theoretical and practical implementation considerations.
- Must be able to outline the main electrical characteristics of logic building blocks.
- Must be able to demonstrate knowledge of different logical networks, including both combinational and sequential
- Must be able to model and synthesize digital circuits.
- Must be able to use Karnaugh Map to simplify circuit design
- Must be able to use measurements terminologies including resolution, sensitivity, accuracy, and uncertainty
- Must be able to use sensors for example for the measurement of temperature, displacement and position, digital encoders, shaft encoders, absolute and relative encoders, linear encoders.

COMPETENCES

- Must be able to handle simple development-oriented situations related to digital circuits design, sensors and laboratory setups in study- or work-related contexts
- Must be able to independently engage in professional and interdisciplinary collaboration with a professional approach within the context of digital electronics and sensor measurements
- Must be able to identify his/her own learning needs within digital electronics and sensor technology theory and the electro technical laboratory experiments, and structure such learning accordingly.

TYPE OF INSTRUCTION

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

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	Digital Design & Sensors
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Digital design og sensorer
Module code	N-ED-B2-4
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain

ORGANISATION

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

MICRO PROCESSOR BASED SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Knowledge of electronics corresponding to analog Instrumentation (2nd semester)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Students shall understand the fundamental principles of microprocessor based systems and be able to construct and program a specific microprocessor based system so as to handle a small sized practical problem.

LEARNING OBJECTIVES

KNOWLEDGE

- Be able to build and program a microprocessor based system
- Must have knowledge of the methodology used for constructing connected digital systems, including an introduction to fundamental digital circuits, their use and limitations
- Must have insight of basic terminology for the architecture of microprocessors

SKILLS

- Be able to synthesize a microprocessor based system based on a specific technical problem, with the possibility of simple interaction between a user and surroundings
- Be able to modularize the total system into hardware and software with well-defined interfaces
- Be able to determine the architecture with regard to hardware and software and communication between subsystems
- Must be able to design a microprocessor program which can runs on its own for controlling the digital/analog hardware
- Must be able to elaborate a number of possibilities for analysis, program development, programming and testing for the entire microprocessor based system
- Be able to synthesize, document and bring the entire system (hardware and software) to working condition

COMPETENCES

- Be able to analyse and specify the design requirement through problem domain analysis
- Be able to design a microprocessor based system based on the design specifications
- Be able to implement and test the developed system with the purpose of verifying the hypothesis, as well as draw conclusions based on the achieved result.

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the work load is expected to be 450 hours for the student

EXAM

EXAMS

Name of exam	Micro Processor Based Systems
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Project on 3rd Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Microprocessor-baserede systemer
Module code	N-ED-B3-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain
Time allocation for external examiners	B

ORGANISATION

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

AC-CIRCUITS & ELECTRO PHYSICS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Knowledge of electronics corresponding to analog instrumentation (2nd semester)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To teach students with fundamental knowledge of AC circuits and electro physics. To enable them to do analysis about static, quasistatic and dynamic electrical circuits connecting with combined electrical and magnetic fields.

LEARNING OBJECTIVES

KNOWLEDGE

- Have knowledge of static and quasistatic electrical and magnetic fields, capacity and inductance
- Must be able to understand and analyse circuits containing resistive, capacitive and inductive elements
- Must be able to understand and analyse stationary AC-circuits using complex symbolic methodology
- Must be able to understand and use Laplace transformation to analyse of dynamic electrical circuits

SKILLS

- Must be able to analyse static and quasistatic electrical and magnetic fields and their usage
- Must be able to apply electro physics to determine electrical resistance, capacitance and inductance
- Must be able to apply electro physics to calculation of mechanical forces produced by electrical and magnetic fields
- Must be able to analyse stationary conditions in circuits containing resistive, capacitive and inductive elements
- Must be able to analyse electrical circuits dynamic conditions
- Must be able to apply methods for analyse of frequency conditions (amplitude and phase characteristic)
- Must be able to apply complex symbolic methodology for calculating stationary AC-circuits
- Must be able to analyse current, voltage, energy and power conditions in AC-circuits
- Must have skills within Electro physics including
    - Electrical fields, Displacement, electrical field strength, permittivity, Coulombs law, dielectric polarisation, Electrical potential.
    - Energy in electrical fields, Gauss' law, capacitance for simple geometries, electric flux, capacitors and capacitance
    - Magnetic fields, flux intensity and magnetic field strength, permeability, Biot-Savarts magnetic polarisation, Ampère's law and magnetic flux
    - Inductance, magnetic forces on conducting conductors, torque on current loops in homogeny magnetic fields and magnetic forces between two parallel conductors, and coils
    - The generalized form of Ampére's law
    - Faraday's law, induced electromotive force, the electric generator
    - Lenz' law
    - Maxwell's equations
    - Ferromagnetic materials, hysteresis, B-H curves, energy in magnetic fields, vortex losses
- Must have skills in elementary circuit theory including
    - Energy storing components (L and C), initial values (L(0) and C(0))
    - First order systems, solving circuit equations of first order, Universal method
    - Second order systems, damping and natural frequency (θ and ω), solving circuit equations of second order (over damped, under damped and critically damped)
    - Transfer functions and usage of Laplace transformation on electrical circuits
    - Frequency analysis and Bodepots (amplitude and phase characteristics)
    - Resonance circuits
    - Poles and zeroes analysis
    - Frequency analysis
    - Filter networks

    - Fourier analysis
- Must have skills in elementary AC-circuits theory including
    - The complex symbolic methodology for calculating AC-circuits (single phased)
    - Impedance and admittance principle for stationary circuits
    - Power in AC-circuits, immediate power, average power, RMS, active and reactive power, power factor
    - Phasordiagrams for calculating stationary AC-circuits
    - Mutual inductance, coupling factor, single phase transformer

COMPETENCES

- Shall be able to handle simple development oriented situations regarding electro physics and circuit technical problems in study- or work situations
- Shall independently be able to engage in disciplinary and interdisciplinary corporations with a professional approach within elementary electrical and physics theory and methods.
- Must be able to identify own learning needs and structure own learning within electro physics and dynamical electrical circuits

TYPE OF INSTRUCTION

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

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	AC-Circuits & Electro Physics
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	AC kredsløbsteori og elektrofysik
Module code	N-ED-B3-2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5

Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Amin Hajizadeh

ORGANISATION

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

AVANCERET CALCULUS

2018/2019

FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Modulet bygger på viden opnået i modulerne Calculus og Lineær algebra eller tilsvarende.

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Skal have viden om grundlæggende regneregler inden for vektoranalyse i det 2 og 3 dimensionale rum, og hvordan de anvendes på ingeniørområdet
- Skal kunne forstå Laplace-transformation og anvende den til løsning af differentialligninger bla. eksemplificeret ved problemstillinger fra fx mekanik, elektronik eller varmeledning
- Skal have viden om komplekse analytiske funktioner
- Skal have forståelse for potensrækker og Taylor-rækker
- Skal have forståelse for hvordan komplekse analytiske funktioner og rækkeudviklinger kan anvendes i forhold til fysiske systemer

FÆRDIGHEDER

- Skal kunne anvende vektoranalyse, herunder:
  - Indre produkt (prik-produkt)
  - Vektor-produkt (kryds-produkt)
  - Vektor- og skalarfunktioner og felter
  - Vektor kurver, tangent og længde
  - Vektordifferentialregning: Gradient, divergens, rotation
  - Vektorintegralregning: Linje-integraler, kurveuafhængighed af linje-integraler, dobbelt-integraler, Greens sætning i planet, overflade-integraler
- Skal kunne anvende Fourier-rækker, herunder:
  - Fourier-rækker og trigonometriske rækker
  - Periodiske funktioner
  - Lige og ulige funktioner
  - Komplekse Fourier-rækker

- Skal kunne anvende LaPlace-transformation, herunder:
  - Definition af LaPlace-transformation. Invers transformation. Linearitet og s-skifte
  - Transformation af almindelige funktioner, herunder periodiske, impuls og trin funktioner
  - Transformation af afledede og integraler
  - Løsning af differentialligninger
  - Foldning og integralligninger
  - Differentiation og integration af transformerede systemer med ordinære differentialligninger

- Skal kunne anvende komplekse analytiske funktioner inden for konform afbildning og komplekse integraler, herunder:
  - Komplekse tal og kompleks plan
  - Polær form for komplekse tal
  - Eksponentielle funktioner
  - Trigonometriske og hyperbolske funktioner
  - Logaritmiske funktioner og generelle potensfunktioner
  - Kompleks integration: Linje-integraler i det komplekse plan
  - Cauchys integral sætning

KOMPETENCER

- Skal kunne håndtere vektoranalyse, rækker, LaPlace-transformation og komplekse analytiske funktioner på grundlæggende ingeniørmæssige eksempler

UNDERVISNINGSFORM

Uddannelsen bygger på en kombination af faglige, problemorienterede og tværfaglige tilgange og tilrettelægges ud fra følgende arbejds- og evalueringsformer, der kombinerer færdigheder og faglig refleksion: - forelæsninger - klasseundervisning - projektarbejde - workshops - opgaveløsning (individuelt og i grupper) - lærerfeedback - faglig refleksion - porteføljearbejde - laboratoriearbejde

OMFANG OG FORVENTET ARBEJDSINDSATS

Kursusmodulets omfang er 5 ECTS svarende til 150 timers studieindsats.

EKSAMEN

PRØVER

Prøvens navn	Avanceret calculus
Prøveform	Skriftlig 4 timers prøve
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Som angivet i Fællesbestemmelser for uddannelser (Vurderingskriterier) http://www.engineering.aau.dk/uddannelse/studieadministration/

FAKTA OM MODULET

Engelsk titel	Advanced Calculus
Modulkode	N-ED-B3-3
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Engelsk
Tomplads	Ja
Undervisningssted	Campus Esbjerg
Modulansvarlig	Morten Nielsen, Henrik Garde

ORGANISATION

Studienævn	Studienævnet for Energi
Institut	Institut for Energiteknik
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

MICRO PROCESSORS & PROGRAMMING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Imperative programming; digital design and sensors

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Most mechatronic systems include dedicated computers that handles the ”intelligent” tasks of guidance, monitoring and control. Typically, such a dedicated computer is connected to/equipped with sensors that allow it to measure important information about current system status and (in some cases) its surroundings. Using these measurements, the dedicated computer executes various algorithms that enable it to determine how to operate the mechatronic system's actuators in response to the immediate situation. Building on the knowledge gained in the 2nd semester, this course aims to provide the students with theories and methods that enable them to design and implement programs for such dedicated computers and use them in a practical system context.

LEARNING OBJECTIVES

KNOWLEDGE

- Shall have understanding of basic real-time aspects of single-processor system operation, including clock frequency, sampling rate, algorithm processing time etc., as well as how these aspects affect each other
- Must have insight into common micro-processor architecture elements, such as RAM, ALU, registers, buses, etc., as well as how these components interact
- Shall have insight into number representation on digital computers
- Must have basic insight into simple digital filtering functionality
- Must be able to use relevant tools to find a digital implementation of a continuous-time differential equation

SKILLS

- Must be able to design algorithms for a chosen micro-processor that satisfy specified timing constraints
- Must be able to use a relevant programming language, along with relevant compilers and linkers, to implement and test said algorithms on said micro-processor
- Must be able to design and implement relevant circuitry to enable a micro-processor to become an integrated part of a mechatronic system

COMPETENCES

- Are able to design and implement simple, micro-processor-based systems that can be integrated in mechatronic systems and handle fundamental monitoring and control tasks.

TYPE OF INSTRUCTION

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

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	Micro Processors & Programming
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Mikroprocessorer og programmering
Module code	N-ED-B3-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain

ORGANISATION

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

CONTROL ENGINEERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Qualifications corresponding to 3rd semester on the Bachelor's programme in Electronics and Computer Engineering.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Students shall understand fundamental principles of regulation systems as well as real time issues within this kind of systems. Students shall be able to develop a physical regulation system using the classical control techniques and implement the developed digital controller using the programming skills. In order to provide effective control solutions, the students are required to make *models* of the systems as well as consider the effects of *feedback* (the control) and *noise* (the disturbances) in a more rigorous manner than before.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have insight of transfer functions described via the Laplace formulation, including feature analysis, such as poles, zeros, and analog/digital implementation
- Must have an understanding of state space description of modern control systems, including the feature analysis, such as controllability, observability and eigen-structures etc.
- Shall have the insight of different modelling techniques, including the first-principle and experimental approaches
- Must be able to linearize non-linear system models in order to approximate them by linear models
- Must have insight into real-time aspects in relation to digital systems communicating with other analog and/or digital systems
- Must have an understanding of basic power electronics and typical electrical machines, such as different types of motors and generators

SKILLS

- Must be able to analyse and select methods for modelling of physical systems, including electric, electro-mechanical, thermal and fluid dynamical systems, at a level where the resulting models can be utilized in a control system design
- Must be able to apply selected theoretical and/or experimental modeling techniques for modeling dynamic systems and simulating them
- Must be able to analyse the open-loop and closed-loop system features and specify system performances, both in transfer function and state space descriptions
- Must be able to apply both classical (frequency-domain) and modern (state space) control techniques for analysis and design of a control system based on a given specification
- Must be able to convert the developed controller into a digital version in order to implement it in a digital programmable device, for example, in a specific micro-processor or PC based manner

COMPETENCES

- Must be able to apply different modelling techniques to illustrate dynamic system’s features and performance, with an orientation for control design purpose
- Must be able to simulate the obtained mathematical model by employing some simulation tools, such as Matlab/Simulink.
- Must be able to analyse, design and implement a control solution for a given specific regulation problem, by using both classical and modern control theories
- Must have insight of basic principles and analysis of power electronics and electrical machines, potentially some control issues of these devices and systems

TYPE OF INSTRUCTION

Project work with supervision.

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Control Engineering
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Project on 4th Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Regulering
Module code	N-ED-B4-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Simon Pedersen

ORGANISATION

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

MODELLING AND SIMULATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Basic electrical engineering

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To enable students to apply some of theoretical and experimental modelling methods into their project and simulate the system by means of simulation tools, such as Matlab/Simulink.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge of the modelling of some typical physical systems, such as mechatronic systems, flow dynamic systems, energy production/transportation/distribution systems, process systems etc., provision of operating conditions
- Must have insight into the theoretical modelling for dynamic systems, including the principles of mass balance, energy balance and momentum balance
- Must have the knowledge of experimental modelling of linear and non-linear dynamic systems, including the experiment design, data collection and pre-filtering, model structure selection, parameter estimation and model validation
- Must have insight of linearization techniques of nonlinear systems
- Must be able to simulate the obtained mathematical model in some typical simulation environment, such as Matlab/Simulink

SKILLS

- Shall be able to apply basic theoretical and experimental modelling techniques for modelling dynamic systems and simulating them
- Shall be able to model and analyse some typical dynamical systems, including electrical, mechanical, power and thermo dynamical systems etc.
- Must be able to develop models of dynamic systems in the form of block diagrams and be able to reformulate the equivalent diagrams
- Must be able to linearize a obtained nonlinear system and analyse the difference between the linearized and original systems
- Must be able to simulate the obtained mathematical model of concerned system and analyse the system features within a proper simulation environment

COMPETENCES

- Be able to apply the theoretical modelling approach to model some typical physical systems, with an orientation for control design purpose
- Be able to correctly apply the experimental modelling approach for complicated systems, including the proper experiment design, data collation and analysis, selection of model structure and estimation of system parameters, as well as model validation
- Be able to apply Linearization techniques for nonlinear system analysis and simplification

TYPE OF INSTRUCTION

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

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	Modelling and simulation
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Modellering og simulering
Module code	N-ED-B4-2
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang

ORGANISATION

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

CONTROL THEORY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Linear algebra, Calculus, Mathematics, Basic electrical engineering

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To offer students with systematic and fundamental knowledge of feedback control theory, including the classical (transfer function based) and modern (state space based) control methods. After this course, students are able to formulate the control design problem; analyse the open & closed loop systems' features and performances; commit a proper control design by following either classical or modern or both control design methods; implement the designed solution in a digital manner and verify the design through experiment.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have insight of the transfer function description and state space description from a control development point of view
- Must have insight of the system's characteristics with the correlation of system's dynamic and stationary behaviours, including the impact of system type and order, as well as poles and zeros and their influence on the system response
- Must have insight of typical classical control design methods, including the PID tuning, root locus method, and frequency design methods
- Must have an understanding of a system's frequency response characteristics, including open-loop and closed-loop perspectives
- Must be able to commit system's stability analysis and determine the stability margins
- Must have an understanding of fundamental system property analysis based on state space description, i.e., controllability, observability, stability and robustness
- Must have insight into typical modern control design techniques, including full state feedback control, observer design, and observer-based feedback control
- Must have an understanding of basic optimal control methods, such as LQR control.
- Must have insight into implementation of developed controllers

SKILLS

- Shall be able to analyse the concerned system static and dynamic features based on both transfer function description and state space description
- Shall be able to commit a control problem formulation, analysis, design, implementation and validation based on a concerned regulation problem and system, by using both classical and modern control design methods
- Shall be able to develop and tune a PID type of controller and analyse the consequence to the controlled system
- Shall be able to design a type of feedback controller based on the state space model, and analyse the influence to the open-loop and closed loop systems characteristics
- Shall be able to discuss and implement the developed controller in a correct and reliable digital manner

COMPETENCES

- Must have gained the ability to translate academic knowledge and skills within the fields of basic modelling and control engineering to a practical problem, which can be formulated and solved
- Are able to design a control system, such that the system can be used to solve the problem formulated above
- Possesses the ability to design and implement algorithms for the concerned control problem.

TYPE OF INSTRUCTION

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

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	Control Theory
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Kontrolteori
Module code	N-ED-B4-3
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang

ORGANISATION

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

POWER ELECTRONICS AND NETWORKS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Linear algebra, Calculus, Mathematics, Basic electric circuits, AC-circuits and electro physics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To offer students with basic knowledge about power electronics, such as transformers, inverters and converters etc., and fundamental knowledge about electrical machines. Network and data communication is essential part of most systems today so student learns the basics about networks & data communication.

LEARNING OBJECTIVES

KNOWLEDGE

- Have knowledge of components in the area of Power Electronics including diodes, rectifiers, thyristor rectifiers, coils, transformers, capacitors, MOSFETs, bipolar transistors
- Have knowledge of fundamental converter theory including Buck, Boost, Buck-Boost and Forward converter in both Continuous Conduction Mode and Discontinuous Conduction Mode.
- Have knowledge of the principles of Pulse-Width Modulation
- Have knowledge of the transformer idle and load curve including determining parameters through experiments
- Have understanding of the principles and handling of systems characterized by numerous cooperating and communicating processes
- Have knowledge about the comprehension of principles and techniques of modern data network systems and their communications
- Have knowledge of basic embedded sensor networks

SKILLS

- Must be able to apply stationary analysis for transformers and converters
- Must be able to choose the right components and converter topology for a given task
- Must be able to perform calculations of conduction losses, design criteria for choice of components
- Must be able to design and build a coil for a given task
- Must be able to understand OSI models and protocol concepts
- Must be able to understand Layer 1 and 2 including basic data-transmission, MAC, LLC, HDLC
- Must be able to understand network protocols and their programming, including IP, UDP, TCP, Sockets, and RPC.
- Must be able to use concepts from the OSI model, including the MAC, network, transport and application layers.
- Must be able to use TCP / IP protocol stack and be able to assess functions in the network, transport and application layers, including Quality of Service mechanisms.
- Must be able to understand and use network topologies for embedded sensor networks including SPI and I2C

COMPETENCES

- Must be able handle development orientated situations in relation to stationary conditions for converters
- Shall independently be able to engage in disciplinary and interdisciplinary corporations with a professional approach within converter design
- Shall be able to analyse describe/design a communication network for a given system.
- Shall be able to choose the right communication network topology for accessing various types of sensors for a given task

TYPE OF INSTRUCTION

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

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	Power Electronics and Networks
Type of exam	Written and oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Effektelektronik og netværk
Module code	N-ED-B4-4
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Daniel Ortiz Arroyo

ORGANISATION

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

AUTOMATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Qualifications corresponding to the 4th semester on the Bachelor's programme in Electronics and Computer Engineering.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
This semester offers two themes: automation and real-time signal processing, students has the option to select any one of them.

Through the automation theme student shall acquire fundamental knowledge of digital regulation systems as well as the real time issues within these kinds of systems. Students shall be able to develop a physical regulation system using the control techniques leaned from previous semester. They should be able to implement the developed digital controller using the real-time and embedded programming skills.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have insight of sampling mechanism and sampling theorem for an ADC implementation
- Must have insight of typical numerical computation methods, including the principles, features and limitations
- Must be able to simulate the concerned digital control solution in an efficient and reliable manner
- Must be able to convert a controller initially formulated in an analog form to its equivalent digital version and analyse the influence because of this discretization
- Must have insight of typical digital filter design techniques, including FIR and IIR filters
- Must have insight of discrete Fourier transform and its efficient digital computation algorithms, FFT
- Must be able to deal with real-time issues in a systematic manner when a digital controller is implemented

SKILLS

- Must be able to determine a correct sampling frequency based on the system frequency feature analysis
- Must be able to commit a proper discretization of a controller which initially is in analog form
- Must be able to perform spectrum analysis of the signals
- Must be able to handle the real-time issues of digital implementation in a professional manner

COMPETENCES

- Must be able to analyse and design a digital system controller in a professional way
- Must be able to design typical frequency selective filters both as direct digital as well as in an indirect manner
- Must be able to perform the real-time analysis and programming of the designed digital controller

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Automation
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Elective project module on 5th Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Automation
Module code	N-ED-B5-1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang
Time allocation for external examiners	B

ORGANISATION

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

DIGITAL FILTERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Qualifications corresponding to 4th semester on the Bachelor's programme in Electronics and Computer Engineering.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
This semester offers two themes: automation and real-time signal processing, students has the option to select any one of them.

The purpose of real-time signal processing is to offer students with fundamental knowledge of digital signal processing systems as well as the real time issues within this kind of systems. Students shall be able to develop a signal processing system using the knowledge leaned from this semester, and implement the developed solution using the real-time ad embedded programming skills.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have insight of sampling mechanism and sampling theorem with proper ADC implementation
- Must have insight of typical numerical computation methods, including the principles, features and limitations
- Must be able to simulated the concerned digital signal processing solution in an efficient and reliable manner
- Must be able to convert an analog filter into its equivalent digital version, and analyse the influence due to this discretization
- Must have insight of typical digital filter design techniques, including FIR and IIR filter designs
- Must have insight of discrete Fourier transform and its efficient digital computation algorithms, named FFT
- Must have an understanding of different digital filter, e.g., DSP implementation
- Must be able to take care of the real-time issue in a systematic manner when a digital filter is implemented

SKILLS

- Must be able to determine a correct sampling frequency based on system frequency feature analysis
- Must be able to commit a proper discretization of an analog filter
- Must be able to design frequency selective filters and analyse the system frequency features
- Must be able to commit digital signal spectrum analysis and analyse its results and limitations
- Must be able to cope with the real-time issue of digital implementation in an professional manner

COMPETENCES

- Must be able to analyse and design a digital implementation of a filter in an professional way
- Must be able to design typical frequency selective filters either in a direct digital way or indirect way, i.e., converting from analog one to its digital formulation
- Must be able to produce a signal’s digital spectrum and retrieve signal’s corresponding features
- Must be able to commit the real-time analysis and programming of the concerned digital filter

TYPE OF INSTRUCTION

Project work with supervision

EXTENT AND EXPECTED WORKLOAD

Since it is a 15 ECTS project module, the work load is expected to be 450 hours for the student.

EXAM

EXAMS

Name of exam	Digital Filtering
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Elective project module on 5th Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	Digital filtrering
Module code	N-ED-B5-2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang
Time allocation for external examiners	B

ORGANISATION

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

NUMERISKE METODER

2018/2019

FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Modulet bygger videre på viden opnået i ”Anvendt ingeniørmatematik”.

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Skal have forståelse for løsning af partielle differentialligninger med analytiske metoder.
- Skal have forståelse for forskellige numeriske metoder.
- Skal have forståelse for finite difference, finite volume og finite element metoden.

FÆRDIGHEDER

- Skal kunne anvende analytiske metoder til løsning af partielle differentialligninger, herunder
  - Separationsmetoden og D’Alemberts princip.
- Skal kunne anvende numeriske metoder til løsning af matematiske problemer, herunder:
  - Lineære ligningssystemer, Gauss elimination, faktoriseringsmetoder, iterativ løsning af lineære ligningssystemer (bl.a. Gauss-Seidel), dårligt konditionerede lineære ligningssystemer, Matrix egenværdiproblemer, løsning af ikke-lineære ligninger, interpolation, splines, numerisk løsning af bestemt integrale, numerisk løsning af første ordens differentialligninger og numerisk løsning af anden ordens differentialligninger.
- Skal kunne anvende finite difference metoden til løsning af partielle differentialligninger, herunder
  - Differenstilnærmelser, elliptiske ligninger, Dirichlet og Neumann randværdier, parabolske ligninger, eksplicitte og implicitte metoder, Theta-metoden og hyperbolske ligninger.
  - Relationen til finite volume metoden.
- Skal have forståelse for finite element metoden til løsning af partielle differentialligninger.

KOMPETENCER

- Skal kunne håndtere udviklingsorienterede situationer i forbindelse med numeriske metoder i studie- eller arbejdssammenhænge.
- Skal selvstændigt kunne indgå i fagligt og tværfagligt samarbejde med en professionel tilgang inden for matematiske numeriske metoder.
- Skal kunne identificere egne læringsbehov og strukturere egen læring inden for numeriske metoder.

UNDERVISNINGSFORM

Undervisningen tilrettelægges i henhold til de generelle undervisningsformer for uddannelsen, jf. studieordningens §17.

OMFANG OG FORVENTET ARBEJDSINDSATS

Da det er et 5 ECTS kursus forventes der en arbejdsbyrde på 150 timer.

EKSAMEN

PRØVER

Prøvens navn	Numeriske metoder

Prøveform	Mundtlig
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve

FAKTA OM MODULET

Engelsk titel	Numerical Methods
Modulkode	M-MP-B5-3
Modultype	Kursus
Varighed	1 semester
Semester	Efterår
ECTS	5
Undervisningssprog	Dansk og engelsk
Tomplads	Ja
Undervisningssted	Campus Aalborg, Campus Esbjerg
Modulansvarlig	Erik Lund, Thomas Joseph Condra

ORGANISATION

Studienævn	Studienævnet for Industri og Global Forretningsudvikling
Institut	Institut for Materialer og Produktion
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

SIGNAL PROCESSING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Mathematics, Micro processors and programming, fundamental control theory and modelling

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To offer students with fundamental knowledge about analysis, design and implementation of digital systems, including digital controllers or filters.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have the knowledge of Z-transform and its application in analysis and design of digital signals and systems
- Must have knowledge about sampling theories and methods for processing of physical signals on a computer
- Must have knowledge about theories and methods for spectral estimation
- Must have knowledge about theories and methods for design of digital filters (IIR/FIR)
- Must be able to implement IIR filters using bilinear transforms and impulse invariant methods
- Must have an understanding of the limitations of taught theories and methods
- Must have knowledge about the interplay between analysis of signals in the time and frequency domains
- Must have knowledge about basic implementation structures and specific DSP implementation

SKILLS

- Shall be able to utilize some software tools for analysis, design and simulation of digital signal processing systems
- Must be able to apply theories and methods for spectral estimation including DFT / FFT
- Must be able to demonstrate the correlation between frequency resolution, window functions and zero-padding
- Must be able to apply theories and methods for design of digital filters
- Must be able to design FIR filters using windowing methods
- Must be able to explain the relationship between the pole/zero plots and frequency responses of digital filters
- Must be able to implement filters in practice, making use of appropriate filter structures, quantization, and scaling.

COMPETENCES

- Shall be able to discuss fundamental theories and methods for analysis and processing of digital signals, using correct terminology
- Shall be able to assess opportunities and limitations in connection with practical application of taught theories and methods

TYPE OF INSTRUCTION

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

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	Signal Processing
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Signalbehandling
Module code	N-ED-B5-4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Dil Muhammad Akbar Hussain

ORGANISATION

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

REAL-TIME EMBEDDED SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Micro-processor and programing

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
To give the students at an application level to construct a real time embedded system.

LEARNING OBJECTIVES

KNOWLEDGE

To enable students at an application level to gain knowledge to make analysis, design and implementation of real time embedded systems.

- Must have knowledge and understanding real time embedded systems
- Must have knowledge of programming concepts and embedded programming
- Must have knowledge the software engineering practices in the embedded software development
- Must have knowledge of real time operating systems
- Must have knowledge of hardware and software co design for a real time embedded system
- Must have knowledge of processors for embedded systems
- Must have knowledge of scheduling and guaranties on deadlines

SKILLS

- Must be able to make analysis of real time including embedded systems
- Must be able to design and develop an embedded systems
- Must be able program and test a real time embedded system
- Must be able to understand and analyse various embedded systems
- Must be able to understand and analyse scheduling and guaranties on deadlines for embedded systems

COMPETENCES

- Must be able to handle real time embedded systems and laboratory setups in study- or work-related contexts
- Must be able to independently engage in professional and interdisciplinary collaboration with a professional approach within the context of real time embedded systems
- Must be able to identify his/her own learning needs within the real time systems including the embedded systems and structure such learning accordingly.

TYPE OF INSTRUCTION

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

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	Real-time Embedded Systems
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Indlejrede realtidssystemer
Module code	N-ED-B5-5
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Daniel Ortiz Arroyo

ORGANISATION

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

BSC PROJECT (AUTOMATION AND CONTROL)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Knowledge, skills and competencies equivalent to having passed the 5th semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
The project must be based on a physical process. The process can be mechanical, thermal, electrical, biologic or chemical. A dynamic model of the process has to be developed. The model has to be adjusted and verified through measurements. Demands as well in the time as in the frequency domain has to be listed. Using the dynamic model a classic and/or a state space controller are designed and implemented on the process. The controllers have to be evaluated and compared to the demands.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge of how to design and analyse control systems
- Must be able to understand and implement dynamic modelling,
- The control design should follow up with the model-base approaches, i.e., either classic or modern controller design.
- Must be able to implement the designed controller in its equivalent digital format, and be able to analyse this discretization influence

SKILLS

- Must be able to analyse dynamic systems in time and frequency domain
- Must be able to analyse and apply model based controller design methods, including classical and modern methods
- Must be able to apply theoretical and experimental modelling principles for mechanical, thermodynamic, biological or chemical systems to develop their corresponding dynamic model with the orientation for control design purpose
- Must be able to analyse and apply numerical methods for simulating dynamic systems
- Must be able to evaluate industrial control and supervision methods.
- Must be able to communicate the above knowledge and skills (using proper terminology of the field), both orally and in a written report

COMPETENCES

- Shall be equipped with all necessary knowledge to be qualified as a control engineer
- Must be able to select and extract relevant features and apply these in a new context
- Must be able to plan, structure and execute a project, within the subject-field of this project module

TYPE OF INSTRUCTION

Project work with supervision.

EXTENT AND EXPECTED WORKLOAD

Since it is a 20 ECTS project module, the work load is expected to be 600 hours for the student

EXAM

EXAMS

Name of exam	BSc Project (Automation and Control)
Type of exam	Oral exam based on a project
ECTS	20
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Elective project module on 6th Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	BSc projekt (Automation og regulering)
Module code	N-ED-B6-1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	20
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang
Time allocation for external examiners	C

ORGANISATION

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

BSC PROJECT (EMBEDDED REAL-TIME SIGNAL PROCESSING)

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Real time embedded system

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
An embedded system is defined as an electronic system which is based on a computer, but the system is not in itself a computer, e.g., like a PC. The purpose of this project module is to specify, design, simulate, implement, test and document (part of) an embedded real-time signal processing system. In this context, the algorithm(s) which are to perform the signal processing have to be developed, simulated/evaluated (preferably using C or Matlab) and optimized. The overall design parameters may include, but are not limited to execution time, code size, numerical robustness, and eventually energy consumption. Primarily, the project will focus on the signal processing theories and algorithms, as well as the development of optimal source- and object codes using commercially available development boards/tools, thus excluding the design and implementation of user-specific hardware.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the building blocks used in a generic embedded real-time digital signal processing system, their mutual interaction and interfaces, as well as relevant performance parameters.
- Must have knowledge about theories and methods used to design numerically robust and resource optimal signal processing algorithms suitable for being executed in real-time on a given hardware.

SKILLS

- Must be able to analyse a technical problem which naturally finds its solution in terms of real-time digital signal processing. Secondly, to formulate a set of specifications for the algorithms to be developed, and possibly also for the hardware/software platform to be used.
- Must be able to apply various methods to design, simulate, and evaluate digital signal processing algorithms according to the specifications.
- Must be able to analyse digital signal processing algorithms from a computational complexity, structural, and data flow oriented point of view in order to specify architectural requirements for a software programmable target platform.
- Must be able to apply design tools, such as C compilers (possibly using in-line assembly language), in order to develop and optimize real-time executable code for digital signal processing algorithms.
- Must be able to evaluate 1) an overall system solution, and 2) the design methods applied to derive the solution. This must be done in terms of relevant metrics such as execution time, memory usage and energy consumption. Secondly, from a micro-computer architectural point of view, the students must be able to evaluate the match between algorithms and architectures.
- Must be able to communicate the above mentioned knowledge and skills (using the terminology of the domain), both orally and in a written report.

COMPETENCES

- Must be able to identify, design, implement, and evaluate a viable solution for an embedded real-time signal processing system.
- Must be able to plan, structure, and conduct a project within the scientific subject of this project module.

TYPE OF INSTRUCTION

Project work with supervision.

EXTENT AND EXPECTED WORKLOAD

Since it is a 20 ECTS project module, the work load is expected to be 600 hours for the student

EXAM

EXAMS

Name of exam	BSc Project (Embedded Real-Time Signal Processing)
Type of exam	Oral exam based on a project
ECTS	20
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

ADDITIONAL INFORMATION

Elective project module on 6th Semester Electronics and Computer Engineering (BSc).

FACTS ABOUT THE MODULE

Danish title	BSc projekt (Indlejret realtidssignalbehandling)
Module code	N-ED-B6-2
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	20
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Zhenyu Yang
Time allocation for external examiners	C

ORGANISATION

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

INTRODUCTION TO PROBABILITY THEORY AND STATISTICS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Fundamentals in linear algebra, calculus, and Fourier theory

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
After attending the course the students have developed the engineering intuition of the fundamental concepts and results of probability, and statistics. They are able to apply the taught material to model and solve simple engineering problems involving randomness.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the concept of probability spaces
- Must have knowledge about the conceptual models of estimation and hypothesis testing
- Must be able to understand the basic concepts of probability theory, i.e., probability of events, random variables, etc.
- Must be able to understand basic concepts of statistics such as binary hypothesis testing.

SKILLS

- Must be able to apply/compute
  - Bayes rule in simple contexts
  - The probability that Binomial, Poisson, and Gaussian random variables take values in a specified interval
  - The mean and variance of Binomial, Poisson, and Gaussian random variables
  - The marginal distributions of multi-variate Gaussian variables
- Must be able to apply and interpret
  - ML-estimation in simple contexts involving the Binomial, Poisson, and Gaussian distribution
  - Binary-hypothesis tests in simple contexts involving the Binomial, Poisson, and Gaussian distribution

COMPETENCES

- Must be able to apply the general concepts of probability theory and statistics in a new, simple context. This includes choosing suitable methods, evaluating outcomes, and drawing the appropriate conclusions

TYPE OF INSTRUCTION

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

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	Introduction to Probability Theory and Statistics
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Introduktion til sandsynlighedsregning og statistik
Module code	N-ED-B6-3
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Daniel Ortiz Arroyo

ORGANISATION

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

MATRIX COMPUTATION AND CONVEX OPTIMIZATION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Linear algebra, Calculus

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Purpose
Engineering systems and design problems can often be compactly described analysed and manipulated using matrices and vectors. Moreover, tractable solutions to design problems can be obtained by casting the design problems as optimization problems. For the class of linear and quadratic problems, the solutions can be obtained by solving systems of equations. In computer programs, this is achieved via matrix factorizations. For the larger class of convex problems, no closed-form solution may exist and numerical methods must be applied. This course aims at teaching numerically robust methods for solving systems of equations and, more generally, convex optimization problems, including also standard constrained problems.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about convex functions and sets, norms, special matrices
- Must have understanding of how to classify and solve systems of equations and convex optimization problems
- Must have understanding of numerical aspects of solving systems of equations and convex optimization problems
- Must have knowledge about Lagrange multipliers
- Must have understanding of matrix factorizations and their properties

SKILLS

- Must be able to identify optimization problems and cast them into standard form
- Must be able to identify types of extrema (minima, maxima, local, global, etc.)
- Must be able to apply Eigen value and singular value decomposition to relevant matrix problems
- Must have understanding of state space descriptions of systems of linear differential equations
- Shall be able to apply numerically robust methods to solve systems of equations
- Shall be able to apply and implement the following numerical optimization methods to unconstrained optimization problems: Steepest Descent, Newton's method, Gauss-Newton method
- Shall be able to apply and interpret least-squares solutions when solving over-determined systems of equations
- Shall be able to apply the Lagrange multiplier method to constrained convex optimization problems

COMPETENCES

- Are able to apply linear algebra theory to analyse engineering systems in their field
- Can state and analyse engineering design problems in their field as systems of equations or standard optimization problems
- Are able to select appropriate matrix factorization or numerical optimization methods to solve engineering design problems in their field

TYPE OF INSTRUCTION

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

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	Matrix Computation and Convex Optimization
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. http://www.engineering.aau.dk/uddannelse/studieadministration/

FACTS ABOUT THE MODULE

Danish title	Matrix beregninger og Convex optimering
Module code	N-ED-B6-4
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	John-Josef Leth

ORGANISATION

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