AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN I INNOVATIV KOMMUNIKATIONSTEKNIK OG ENTREPRENEURSKAB, 2024

CIVILINGENIØR
KØBENHAVN

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

SERVICES AND PLATFORMS

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

All students will be introduced to proper use of scientific methods. This project module therefore includes separate learning objectives for scientific methods.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have a holistic understanding of the ICT environment, i.e. the heterogeneous networks, Internet technologies and security, on which ICT solutions and services rely
- Must have knowledge about the key Internet technologies and standards for content networking: representation, identification and transport
- Must have knowledge about the characteristics of different networks and the technologies that are important to provide a good user experience for a service
- Must be able to understand the service architectures and platforms that are needed to provide future services and applications
- Must have knowledge of innovation and entrepreneurship
- Must have knowledge of IoT and cloud security

Scientific Methods:

- Must have knowledge about scientific methods and their applicability in ICT engineering
- Must have knowledge about main scientific paradigms and their applicability for different problems
- Must know methods for the iterative development and refining of project ideas and problem formulations
- Must know methods for quantitative and qualitative data gathering, data analysis and data presentation, e.g. interview techniques for expert interviews.
- Must know the consequences of plagiarism

SKILLS

- Must be able to specify requirements for innovative applications, services, solutions or service architectures based on a thorough analysis of the ICT environment and the needs of the target users
- Must be able to analyse and identify potential stakeholders and service providers of a proposed service
- Must be able to assess the network characteristics and limitations, which affect the delivery of content and services to the end users
- Must be able to discuss the technical aspects of services and service architectures
- Must be able to analyse and conceptually design service platforms that are realistic and viable

Scientific Methods:

- Must be able to extract scientific knowledge from academic publications, e.g. journal papers, conference proceedings and anthologies.
- Must be able to master good academic praxis for the use and presentation of sources
- Must be able to explain the applicability of qualitative and quantitative methods for a given ICT engineering problem
- Must be able to conduct a structured search for sources, e.g. peer-reviewed literature
- Must be able to assess the quality and applicability of a given source (e.g. peer-reviewed / non peer-reviewed sources, industry whitepapers, interviews, marketing texts)

COMPETENCES

- Must have the competency to assess the viability and potential of new ICT-related technologies, frameworks and concepts

- Must have the competency to identify the value proposition in ICT services and solutions and develop a technical realization of the value proposition
- Must have the competency to apply state-of-the-art technologies for innovation

Scientific Methods:

- Must have the competency to identify and apply relevant scientific methods in relation to ICT engineering problems and projects
- Must have the competency to structure an academic presentation of project (e.g. semester project) in a report
- Must master the principles for correct academic citing

TYPE OF INSTRUCTION

Project work.

EXAM

EXAMS

Name of exam	Services and Platforms
Type of exam	Oral exam based on a project
ECTS	15
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Services og platforme
Module code	ESNICTEK1P3N
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

COMMUNICATION SYSTEMS

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about advanced PHY layer technologies and principles such as spectrum usage and limitations, advanced modulation and multiplexing techniques, and channel coding in selected systems
- Must have knowledge about mobile systems and technologies in the light of 3G, 4G and beyond 4G
- Must have knowledge about access technologies like mobile cellular access
- Must have knowledge about Machine Type Communication (MTC) and similar 5G technologies
- Must have knowledge about network architectures (densification, Cloud Radio Access Network, Software Defined Networking, Network Function Virtualization)
- Must have knowledge about Digital broadcast networks (radio and TV) such as cable, satellite and terrestrial networks
- Must have knowledge about wired (broadband) networks such as DSL-, cable TV- and fibre-based infrastructures

SKILLS

- Must be able to explain the principles and technologies used in advanced PHY layers
- Must be able to discuss the mobile systems / technologies, network architectures, access technologies, and MTC technologies
- Must be able to evaluate the strengths and weaknesses in the use of traditional mobile networks, wireless or broadcast networks for mobile TV/radio transmission.

COMPETENCES

- Must have the competency to analyse and assess the potentials and limitations of existing and future PHY layer technologies in selected systems
- Must have the competency to identify and discuss the key technologies and standards for broadband and broadcast networks and the properties of networks that are essential for supporting services
- Must have the competency to analyse and assess the potentials and limitations of existing and future mobile cellular technologies including MTC technologies.

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Communication Systems
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Kommunikationssystemer
Module code	ESNICTEK1K4N
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

INTERNET TECHNOLOGIES AND SERVICE ARCHITECTURES

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the structure of the Internet and its design principles
- Must have knowledge about the principles and technologies of different web generations (Web 1.0, 2.0, 3.0, …) and their implications for services
- Must have knowledge of content networking principles, including representation, identification and transport of web objects
- Must have knowledge of the main standardisation bodies and the process of developing specifications and standards for Internet technologies
- Must have knowledge of user agents and their functionality, in particular the use of JavaScript and HTML5
- Must have knowledge about programming models and interfaces for Internet services, in particular REST, SOAP and Web Services
- Must have knowledge about session-based services such as instant messaging and streaming media, including session initiation and management and the main protocols
- Must be able to explain the concepts of "service", "service enablers" and "service architectures"
- Must have knowledge of different methods for "enrichment" of services: User involvement, personalisation, use of context information, extracting value from large amounts of data, etc.
- Must have knowledge of common service architectures, e.g. Service Delivery Platforms, Service-Oriented Architecture (SOA), and cloud architectures

SKILLS

- Must be able to analyse and discuss the relation between user needs and different types of services
- Must be able to analyse the requirements that a given service imposes on servers, networks and terminals and their relation to the user experience provided by the service
- Must be able to design ICT services with distributed content, including controlled exposure of resources and access to these, and making use of state-of-the-art Internet technologies
- Must be able to design services for real-time messaging and streaming media
- Must be able to analyse and discuss the characteristics of different service architectures

COMPETENCES

- Must have the competency to assess the potential and applicability of state-of-the-art Internet technologies, programming models and architectures in order to realise a given functionality

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Internet Technologies and Service Architectures
Type of exam	Written or oral exam
ECTS	5

Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Internetteknologier og tjenestearkitekturer
Module code	ESNICTEK1K6N
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

SECURITY IN IOT AND CLOUD ARCHITECTURES

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objectives:

- To provide the student with knowledge about Internet of Things (IoT) devices, their characteristics, functionalities, and the state-of-the-art security considerations for IoT systems
- To provide the student with knowledge about virtualization, cloud computing, edge computing, and their security aspects.
- To provide the student with knowledge about recent trends of IoT and cloud integration, with a focus on the privacy and security aspects.
- To provide the student with skills to perform analysis, design, and implementation of systems that integrate IoT and cloud computing, with a focus on privacy and security.
- To provide the student with knowledge about emerging technologies in the context of IoT systems

LEARNING OBJECTIVES

KNOWLEDGE

Must have knowledge about:

- the main concepts, technologies, protocols, frameworks related to IoT systems
- security threats in IoT, edge and cloud systems
- the usage of edge computing and cloud computing in complex IoT architectures
- the state-of-the-art virtualization methods, software architectures and orchestration tools in cloud environments, including security considerations of such models
- different emerging technologies in the context of IoT, edge, and cloud computing

SKILLS

Must be able to:

- use selected methods and tools to attack and protect IoT systems
- design and implement secure solutions for IoT devices that make use of the edge and cloud
- analyse and discuss the security aspects of IoT systems

COMPETENCES

Must have the competences to:

- design and implement secure IoT solutions that integrate with the cloud
- analyse and assess best practices in IoT and cloud architectures

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme

EXAM

EXAMS

Name of exam	Security in IoT and Cloud Architectures
Type of exam	Written or oral exam

ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Sikkerhed i IoT- og cloud-arkitekturer
Module code	ESNCYSK1K9
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

ICT SERVICE DEVELOPMENT: DESIGN AND ARCHITECTURES

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon knowledge obtained in the first semester project.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must understand how ICT services can solve user needs and generate value
- Must have knowledge about service providers and different ways to realize ICT services
- Must have knowledge about ICT service design with proper handling of personal data
- Must have knowledge about privacy and computer ethics in ICT service design
- Must have knowledge about ICT service architectures

SKILLS

- Must be able to follow a systematic development approach including analysis, requirements specification and prioritization, relevant UML diagrams, documentation, and testing
- Must be able to identify relevant data sources and integrate relevant data in a specific ICT service or solution
- Must be able to design and develop services with controlled exposure of web resources through APIs and endpoints
- Must be able to design ICT services and service architectures, including distributed resources, personal data, computer ethics and user privacy guidelines
- Must be able to develop a concrete ICT service or solution, either as a conceptual design or as a working prototype

COMPETENCES

- Must have the competences to identify, propose and design viable ICT services to solve different user needs
- Must have the competences to critically assess the use of ICT in services and service architectures, including ethical, legal and privacy implications
- Must have competences in applying machine learning aspects in ICT service development

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	ICT Service Development: Design and Architectures
Type of exam	Oral exam based on a project
ECTS	15
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	External examination

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

FACTS ABOUT THE MODULE

Danish title	IKT serviceudvikling: Design og arkitekturer
Module code	ESNICTEK2P7
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

IDENTITY AND ACCESS MANAGEMENT

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module is offered jointly with the MSc programme in Innovative Communication Technologies and Entrepreneurship (ICTE). It builds on knowledge obtained in the ICTE module “Internet Technologies and Service Architectures” or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Must have knowledge about:

- physical identities, digital identities and credentials
- key identity concepts such as linkability, personally identifiable information, personal data, attributes, claims, and assertions
- state-of-the-art principles, laws, guidelines and frameworks for protecting users’ privacy, including fine-grained management of personal attributes
- security objectives and methods to achieve them
- principles and methods for identification, authentication, and authorisation, including assurance levels and methods for strong authentication
- policies, policy architectures, and access control schemes
- identity management systems, identity federation and single sign-on systems
- state-of-the-art technologies and frameworks for managing access to protected resources, including identity and access management (IAM) in enterprises

SKILLS

Must be able to:

- identify the personal attributes that are needed to perform a given task
- apply methods and technologies for privacy protection as a part of service development, including “privacy by design” principles
- identify resource sets and protect them with secure interfaces
- apply state-of-the-art technologies for realising advanced services with authentication, authorisation and access control
- design applications and services incorporating authenticators, different assurance levels, and management of user identities (authentication, authorisation, privacy protection)
- analyse and design information flows and architectures for ICT services and solutions

COMPETENCES

Must have the competences to:

- design secure services and policy architectures with controlled exchange of attributes between stakeholders and minimal disclosure of personal information
- discuss and reflect on management of personal information for access to resources and for personalisation of services

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Identity and Access Management
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Identitets- og adgangshåndtering
Module code	ESNCYSK2K3
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

USER EXPERIENCE AND COMPUTER ETHICS

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must understand the concepts of human computer interaction, interaction design and user experience and the relation between them
- Must have knowledge of different input and output modes for interactive systems, also in a historical perspective
- Must have knowledge of different methods for designing interaction of ICT systems
- Must have knowledge of different strategies for planning the interaction design of ICT systems
- Must understand the concept and applicability of computer ethics
- Must have an understanding of user-informed and user-driven innovation

SKILLS

- Must be able to apply the concepts of usability and user experience both to screen-based and non-screenbased interactive systems
- Must master different design methods and techniques for creating and testing interactive systems, including non-screen-based systems
- Must be able to identify possible computer ethical issues related to a ICT system and / or its use context
- Must be able to discuss user cognitive models and other descriptions of users
- Must be able to reflect critically on methodological challenges in data from and about users as a source for design
- Must be able to reflect on the role of innovation for the praxis of design
- Must be able to evaluate interactive systems using techniques from interaction design and Human Computer Interaction

COMPETENCES

- Must have the competency to reflect on the implications of using different methods and techniques for interaction design, including user involvement, and for evaluating systems

- Must have the competency to analyse the social context in which the use of ICT takes place
- Must have the competency to discuss concepts of privacy, user sovereignty and personalisation in relation to design dilemmas in the design of interactive systems
- Must be able to assess business perspectives in design innovations

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	User Experience and Computer Ethics
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale

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

FACTS ABOUT THE MODULE

Danish title	Brugeroplevelse og computer-etik
Module code	ESNICTEK2K9N
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

MACHINE LEARNING

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on mathematical knowledge obtained in the bachelor courses “Linear Algebra” and “Introduction to Probability and Applied Statistics“ (bachelor in IT, Communication and New Media), or similar.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Must have knowledge about:

- data modelling in form of preparing data, modelling data, and evaluating and disseminating the results.
- key machine learning concepts such as feature extraction, cross-validation, generalization and over-fitting, prediction and curse of dimensionality.
- different machine learning principles, algorithms, techniques and be able to define and describe fundamental problems and consequences within machine learning.
- basic recommender system principles, techniques, algorithms and be able to define and describe fundamental problems and consequences within these.

SKILLS

Must be able to:

- discuss how the data modelling methods work and describe their assumptions and limitations.
- map practical problems to standard data models such as regression, classification, density estimation, clustering and association mining.
- select and apply a range of different machine learning algorithms and techniques on specific problems.
- select and apply the basic recommender system algorithms and techniques on specific problems
  OR

  select and apply relevant machine learning algorithms and techniques for detection of cyber attacks or anomalous behaviour in cyber systems

COMPETENCES

Must have the competency to:

- solve machine learning related problems in a practical context.
- apply machine learning algorithms and analyse the results

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Machine Learning
Type of exam	Written or oral exam

ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Maskinlæring
Module code	ESNICTEK2K7A
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

ADVANCED ICT SOLUTIONS

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The project builds on knowledge obtained during the first two semester projects.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about design and development of advanced ICT solutions, including knowledge about how the institutional and market-related circumstances interact with technology development, to take it into account in the design process
- Must have knowledge of methods and algorithms for data processing and analysis
- Must have knowledge about how ICT applications and solutions can be deployed in order to address specific needs and improve efficiency in different application areas
- Must have knowledge about one or more of following topics:
    - Sustainability
    - Privacy engineering
    - Enterprise architectures and compliance

SKILLS

- Must be able to design and develop an ICT service or solution, including one or more of the following elements:
    - Acquisition and processing of sensor information
    - Handling of large amounts of data to extract relevant information
    - Recommender systems
    - Advanced programming tools
    - Complex usage scenarios including access control, resource management and personal data protection
- Must be able to develop advanced ICT services and solutions targeting a specific application domain and considering scalability, state-of-the-art technologies and the use of different devices, networks and platforms.
- Must be able to identify, select and apply suitable programming languages and software development strategies and justify their choices
- Must be able to undertake a holistic analysis of the chosen solution with respect to technology choices, strategic decisions, innovation, and issues related to entrepreneurship

COMPETENCES

- Must have the competency to clearly identify relevant problems within different application areas, which can be solved by the use of ICT technologies and methods

- Must have the competency to develop innovative and viable services/solutions based on solid engineering knowledge and skills and involving both technical, commercial and user aspects

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Advanced ICT Solutions
Type of exam	Oral exam based on a project
ECTS	15
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Avancerede IKT-løsninger
Module code	ESNICTEK3P5
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

DATA MINING AND ANALYSIS

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

This module builds upon knowledge of algorithms, data structures, databases, distributed systems, and programming. Moreover, a good understanding of math principles is recommended to grasp the time and memory complexity of processing large amounts of data.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The course teaches a systematic way of approaching problems that deal with large and/or scattered data. The students will initially learn about the concepts of big data, data lake, and structured and unstructured data. Then, the data collection process is introduced, which is composed of different steps such as Extract, Load, and Transform. The course will dive into each of these steps, teaching techniques on how to extract/mine the data from various sources, how and where to load/store them afterwards, and, finally, how and where to process/transform them. Furthermore, different data structures and databases for working with large amounts of data will be taught. Finally, principles of data visualization will also be covered in the course.
The course will make use of real-world datasets with practical examples by using the latest data analysis tools such as Python libraries.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about different data types such as big data, data lakes, etc.
- Must have knowledge about data streams
- Must have knowledge about systems and software that can be used to collect data from various sources
- Must have knowledge about restrictions when accessing online data, such as API limitations or privacy considerations
- Must have knowledge about different standards for data formatting and interchanging such as JSON, XML, protocol buffers, etc.
- Must have knowledge about diverse ways to store structured and unstructured data
- Must have knowledge about different programming tools to be used for processing data
- Must have knowledge about different algorithms for analyzing data
- Must have knowledge about the time and memory complexity of the algorithms
- Must have knowledge about diverse ways to visualize data

SKILLS

- Must be able to design, develop, and deploy a system for data collection/mining
- Must be able to work with real-time data streams
- Must be able to use online APIs to retrieve data from various sources
- Must be able to analyze several types of databases for storing the data
- Must be able to use programming tools and libraries to handle the data correctly
- Must be able to identify and use the appropriate data structures for processing the data in an efficient way
- Must be able to use data processing algorithms and analyze their complexity
- Must be able to scale the system as needed vertically or horizontally depending on the amount of data and algorithms used
- Must be able to perform diverse types of data analysis such as clustering, classification, and prediction, among others
- Must be able to use programming tools to visualize results and findings from the data via scientific plots

COMPETENCES

- Must have the competence to work with real datasets in order to extract useful information
- Must have the competence to design a scalable mining system, a reliable data storage platform, an efficient processing tool, and an insightful visualization framework

- Must have the competence to apply the knowledge and skills gained through the course to problems from various domains such as healthcare, smart city, industry, etc.
- Must have the competence to document the systematic approach followed during the process in a clear way

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Data Mining and Analysis
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Data mining og analyse
Module code	ESNICTEK3K10
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

PROJECT-ORIENTED STUDY IN AN EXTERNAL ORGANISATION

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student stays in a company with the purpose of learning and applying theories and methods to address engineering problems in an industrial context. In addition, the student will be introduced to business procedures and policies.

A Project-Oriented Study in an External Organisation agreement must be approved by the company, an AAU supervisor and the study board for Electronics and IT (ESN).

The Project-Oriented Study in an External Organisation must have a scope that corresponds to the ECTS load.

LEARNING OBJECTIVES

KNOWLEDGE

- Has knowledge about the organisation of the company and business procedures and policies.
- Has knowledge about performance measures in the company.
- Has developed a fundamental business sense.
- Has knowledge of the competence profile of the programme and how the project oriented study in an external organisation contributes to the competence profile.
- Has gained deepened knowledge into engineering theories and methods within the programme

SKILLS

- Can initiate and ensure the completion of an agreement for the project oriented study in an external organisation, with learning objectives corresponding to the semester at the master's programme.
- Can apply analytic, methodological and/or theoretic skills to address advanced engineering problems in an industrial context.
- Can contribute in a professional manner to company objectives as an individual and in teams in accordance with the project management model applied in the company.
- Can collaborate and communicate with peers, managers and others.
- Can document the project oriented study in an external organisation in a report and defend it orally.

COMPETENCES

- Can discuss and reflect on the learning outcomes of the project oriented study in an external organisation.
- Can discuss the need for knowledge transfer between academia and industry.
- Has a deepened understanding of the academic interests to pursue in the master's thesis and possible job positions to aim at after graduation.

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Project-Oriented Study in an External Organisation
Type of exam	Oral exam based on a project
ECTS	25

Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	ESNICTEK3P3N
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	25
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

MASTER'S THESIS

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The project builds on knowledge obtained during the 3rd semester project.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge on state-of-the-art and prospective technology solutions within the ICT field, allowing for technology and service development, and understanding of the contexts in which technologies and services are conceived and developed.
- Must have well-founded knowledge of relevant theories and methodologies at specific level as well as at synthesis level, forming the basis for the analysis and development of technology and service solutions that relate to different application areas.

SKILLS

- Must be able to apply the mentioned knowledge and methods to analyse, design, develop and propose innovative applications, services and solutions within specific application areas of ICT, that are technologically well-founded and meet end-user requirements.
- Must be able to analyse the potential and the implications of new technologies for the end users and relevant stakeholders.
- Must be able to analyse relevant methods to solve the problem, describe and assess the application of the chosen methods and discuss how the chosen methods influence the project results.

COMPETENCES

- Must have competencies in innovation and entrepreneurship within the field of ICT
- Must have the competency to identify and delimit relevant problems within ICT with an engineering approach and apply relevant theories, methods and experimental data
- Must have the competency to contribute to the creative use of technologies to resolve user needs and improve organizational processes.

TYPE OF INSTRUCTION

The project is carried out individually or in a small group of maximum three members. At least one internal supervisor is assigned, who works with the primary subject within his/her research. Moreover, additional supervisors e.g. from industry can be involved in the project.

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	45
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale

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

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	ESNICTEK4P5
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	45
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

MASTER'S THESIS

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The project builds on knowledge obtained during the 3rd semester project.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge on state-of-the-art and prospective technology solutions within the ICT field, allowing for technology and service development, and understanding of the contexts in which technologies and services are conceived and developed.
- Must have well-founded knowledge of relevant theories and methodologies at specific level as well as at synthesis level, forming the basis for the analysis and development of technology and service solutions that relate to different application areas.

SKILLS

- Must be able to apply the mentioned knowledge and methods to analyse, design, develop and propose innovative applications, services and solutions within specific application areas of ICT, that are technologically well-founded and meet end-user requirements.
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- Must be able to analyse relevant methods to solve the problem, describe and assess the application of the chosen methods and discuss how the chosen methods influence the project results.

COMPETENCES

- Must have competencies in innovation and entrepreneurship within the field of ICT
- Must have the competency to identify and delimit relevant problems within ICT with an engineering approach and apply relevant theories, methods and experimental data
- Must have the competency to contribute to the creative use of technologies to resolve user needs and improve organizational processes.

TYPE OF INSTRUCTION

The project is carried out individually or in a small group of maximum three members. At least one internal supervisor is assigned, who works with the primary subject within his/her research. Moreover, additional supervisors e.g. from industry can be involved in the project.

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	50
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale

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

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	ESNICTEK4P6
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	50
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

MASTER'S THESIS

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The project builds on knowledge obtained during the 3rd semester project.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge on state-of-the-art and prospective technology solutions within the ICT field, allowing for technology and service development, and understanding of the contexts in which technologies and services are conceived and developed.
- Must have well-founded knowledge of relevant theories and methodologies at specific level as well as at synthesis level, forming the basis for the analysis and development of technology and service solutions that relate to different application areas.

SKILLS

- Must be able to apply the mentioned knowledge and methods to analyse, design, develop and propose innovative applications, services and solutions within specific application areas of ICT, that are technologically well-founded and meet end-user requirements.
- Must be able to analyse the potential and the implications of new technologies for the end users and relevant stakeholders.
- Must be able to analyse relevant methods to solve the problem, describe and assess the application of the chosen methods and discuss how the chosen methods influence the project results.

COMPETENCES

- Must have competencies in innovation and entrepreneurship within the field of ICT
- Must have the competency to identify and delimit relevant problems within ICT with an engineering approach and apply relevant theories, methods and experimental data
- Must have the competency to contribute to the creative use of technologies to resolve user needs and improve organizational processes.

TYPE OF INSTRUCTION

The project is carried out individually or in a small group of maximum three members. At least one internal supervisor is assigned, who works with the primary subject within his/her research. Moreover, additional supervisors e.g. from industry can be involved in the project.

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Master's thesis/final project
ECTS	30
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale

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

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	ESNICTEK4P4
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Innovative Communication Technologies and Entrepreneurship)
Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

ALGORITHMIC CONTENT EXPOSURE

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The course builds on knowledge obtained in the modules “Internet Technologies and Service Architectures” and “Machine Learning”.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge of principles for algorithmic selection of content, e.g. as used in recommender systems
- Must have knowledge of the key standards of media formats and representation of digital
- content
- Must have knowledge of standards for metadata and annotation
- Must have knowledge of methods for dealing with Digital Rights Management (DRM)
- Must have knowledge of methods for indexing and handling of unstructured content, e.g.
- user generated content, in combination with structured media content
- Must be able to understand how to manage and optimise content adaptation and delivery to meet the limitations of various types of networks and terminals and dynamic context

SKILLS

- Must be able to discuss strategies for algorithmically managed exposure of digital content
- Must be able to prepare and integrate multimedia content in a service, including associated metadata
- Must be able to analyse the role and interests of content producers, aggregators and providers in the value chain or value network of a service
- Must be able to analyse problems and solutions for the distribution of digital media content and select appropriate strategies for media distribution

COMPETENCES

- Must have the competency to analyse and evaluate systems and solutions for algorithmically managed exposure of content, e.g. recommender systems
- Must have the competency to advice content providers and non-technical persons on systems for algorithmic management of content.
- Must have the competency to analyse technical aspects of content and media management in a larger political-social-economical context

TYPE OF INSTRUCTION

Types of instruction are listed in § 17.

EXAM

EXAMS

Name of exam	Algorithmic Content Exposure
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification

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

FACTS ABOUT THE MODULE

Danish title	Algoritmisk eksponering af indhold
Module code	ESNICTEK3K6N
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

ENTERPRISE SECURITY AND COMPLIANCE

2024/2025

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

It is recommended to have a basic understanding of network security to participate in the module.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Must have knowledge of:

- standards addressing information security and cyber security challenges
- technologies already embedded in enterprise endpoints
- security services and policies within public and private cloud networks

SKILLS

Must be able to:

- identify and manage risks in combination with security requirements
- design, implement and verify enterprise security solutions
- identify and illustrate an IT system landscape end-to-end and pinpoint risks to be considered
- carry out an information security review and an IT audit

COMPETENCES

Must have the competency to:

- design requirements and controls for an enterprise security solution based on a risk assessment
- discuss end-to-end standards to create trust and controls in a large enterprise IT solution.
- discuss the business needs and willingness to accept risks based on an Enterprise Risk Management solution
- discuss risks, security and compliance in a cloud environment.

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and Contents of the Programme.

EXAM

EXAMS

Name of exam	Enterprise Security and Compliance
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination

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

FACTS ABOUT THE MODULE

Danish title	Sikkerhed og compliance i virksomheder
Module code	ESNICTEK3K6
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

PRIVACY ENGINEERING

2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Data protection and privacy is today an integrated element of digital services. Businesses and organisations that for example store or process personal data must protect the privacy of natural persons (users) and provide possibilities for them to control their data. This course examines the process of privacy engineering from the understanding of what the data protection needs are to implementable solutions. Specifically, the course addresses the GDPR and/or other relevant legislative documents which can be said to state requirements for data protection and for any privacy engineering. The course has a focus on discussion and application of different data protecting solutions.

LEARNING OBJECTIVES

KNOWLEDGE

The student must have knowledge of:

- The concept of "privacy" in data protection
- Application of system development-relevant principles for “privacy by design” and “privacy by default”
- Principles for privacy impact assessments and data protection impact assessments
- Privacy controlling / privacy protective technologies such as minimization, anonymity and other central concepts and solutions
- Concepts such as for example data confinement and other privacy related concepts being discussed
- Communicating privacy issues and choices to users via interfaces

SKILLS

The student must be able to:

- Analyse cases from a data privacy engineering angle
- Explain the principles of "privacy by design" and "privacy by default"
- Evaluate different privacy principles in selected cases by use of risk assessments
- Distinguish between different privacy enhancing solutions
- Evaluate different privacy controlling principles in relation to a particular case
- Use different methods to investigate and assess data privacy

COMPETENCES

The student must have the competences to:

- Apply different data protection principles to selected examples
- Apply data impact assessment principles in selected cases and point to particular privacy enhancing or controlling solutions
- Apply the principles in for example minimization, anonymization and other technical solutions, in a case
- Reflect on various data protection principles and solutions
- Reflect on concepts such as for example Data Confinement and other related concepts related for privacy enhancing solutions

TYPE OF INSTRUCTION

Types of instruction are listed at the start of §17; Structure and contents of the programme.

EXAM

EXAMS

Name of exam	Privacy Engineering
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Privacy Engineering
Module code	ESNCYSK3K7
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design

GREEN ICT - SUSTAINABLE BUSINESS DEVELOPMENT 2024/2025

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to understand the concept of sustainability and perspectives relating to CSR
- Must have knowledge about various levels of ICT effects on the environment
- Must be able to identify existing, new and emerging hardware, software and communication technologies for energy saving
- Must have knowledge about the role of ICT in energy consumption and energy efficiency
- Must have knowledge about different energy/GHG management standards and guidelines
- Must have knowledge about sustainability maturity models
- Must have knowledge about methods for assessing the potential environmental impacts of ICT products and services

SKILLS

- Must be able to recognise the possible application area in which the deployment of ICT is expected to lead to better energy efficiency and to estimate their relative importance
- Must be able to apply theories, methodologies for analysing sustainable business development
- Must be able to understand and evaluate sustainability/CSR policies and practices
- Must be able to apply the green ICT strategies
- Must be able to estimate energy consumption impacts attributable to the introduction of various ICT services, considering both direct and indirect energy use
- Must be able to evaluate the rebound and induction effect within the ICT field
- Must be able to judge the usefulness of the different scientific methods for analysis of the ICT related energy efficient systems

COMPETENCES

- Must have the competency to apply and integrate sustainability in an interdisciplinary way, considering user, technology and market aspects.
- Must have the competency to independently define and analyse scientific problems within the area of Green ICT

TYPE OF INSTRUCTION

Types of instruction are listed in § 17.

EXAM

EXAMS

Name of exam	Green ICT - Sustainable Business Development
Type of exam	Written or oral exam
ECTS	5
Permitted aids	Find the information about the allowed tools on the exam specification
Assessment	7-point grading scale
Type of grading	Internal examination

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

FACTS ABOUT THE MODULE

Danish title	Grøn IKT - Bæredygtig forretningsudvikling
Module code	ESNICTEK3K11
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Copenhagen
Responsible for the module	Tatiana Kozlova Madsen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	The Technical Faculty of IT and Design