AALBORG UNIVERSITET

STUDIEORDNING FOR NORDIC MASTER IN SUSTAINABLE ICT SOLUTIONS, 2021

CIVILINGENIØR
KØBENHAVN

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

ICT SOLUTIONS FOR SDGS

2023/2024

EXAM

EXAMS

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

FACTS ABOUT THE MODULE

Danish title	ICT Solutions for SDGs
Module code	ESNNORK1P1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Location of the lecture	Other location
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

INTRODUCTION TO SUSTAINABILITY

2023/2024

EXAM

EXAMS

Name of exam	Introduction to Sustainability
Type of exam	Written or oral exam
ECTS	3
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	Introduction to Sustainability
Module code	ESNNORK1K1
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	3
Language of instruction	English
Location of the lecture	Other location
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

REQUIREMENTS ENGINEERING

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://sis-lut.funidata.fi/student/courseunit/otm-97e6fa8e-deb0-4a24-9f7c-42043b3a2618/brochure

EXAM

EXAMS

Name of exam	Requirements Engineering
Type of exam	Written or oral exam
ECTS	6
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	Requirements Engineering
Module code	ESNNORK1K2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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

RESEARCH DESIGN AND METHODS

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://sis-lut.funidata.fi/student/courseunit/otm-82f1fc9b-436c-45ab-86cc-fb11476ee6fb/brochure

EXAM

EXAMS

Name of exam	Research Design and Methods
Type of exam	Written or oral exam
ECTS	6
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	Research Design and Methods
Module code	ESNNORK1K3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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
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Faculty	The Technical Faculty of IT and Design

ICT SERVICE DEVELOPMENT: DESIGN AND ARCHITECTURES FOR SUSTAINABILITY

2023/2024

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
- Must have knowledge about concepts relating to sustainable design
- Must have knowledge about different ways of looking at design and architectures with sustainable concepts and measures

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 ICT services with controlled exposure of web resources through APIs and endpoints
- Must be able to develop a concrete ICT service or solution, either as a conceptual design or as a working prototype, including at least one of the following elements:
    - Machine learning and algorithms
    - ICT governance aspects
- Must be able to design and develop ICT services and service architectures, including
    - distributed resources and personal data
    - computer ethics and user privacy guidelines
    - one or more specific sustainability concepts, purposes and contexts

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 as well as their business potential
- Must have competences in applying machine learning and/or analyzing governance aspects in ICT service development
- Must have competences in using concepts relating to sustainability when designing services and solutions
- Must have competences to critically assess and discuss the application of sustainability metrics to design services and service architectures

TYPE OF INSTRUCTION

Project work

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- An approved PBL competency profile is a prerequisite for participation in the project exam

EXAMS

Name of exam	ICT Service Development: Design and Architectures for sustainability
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	IKT servicesudvikling: Design og arkitekturer for bæredygtighed
Module code	ESNICTEK2P6
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

2023/2024

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
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

2023/2024

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

SKILLS

- Must be able to apply the concepts of usability and user experience both to screen-based and non-screen-based 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 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

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
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	ESNICTEK2K8N
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	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

SUSTAINABLE DIGITAL TRANSFORMATION

2023/2024

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 be able to understand technologies as a socio-technical system
- Must be able to discuss economic and social potentials and challenges in the implementation of advanced ICT solutions
- Must have knowledge on the importance of including technology solutions as well as regulatory solutions and the implications of norms and behavioural patterns in digital problems solving
- Must have knowledge on environmentally, socially and economically sustainable business development including one or more of these aspects
- Must understand implications of the collaborative nature of business development including business ecosystems and product-service systems
- Must understand the interrelationships between product, process and market innovation

SKILLS

- Must be able to discuss the socio-technical choices made in connection with issues regarding sustainability, algorithmic content exposure or security and trust concerning ICT systems
- Must be able to apply approaches from managerial economics to the development of digital service provision, e.g. business planning and marketing aspects
- Must be able to apply methods and approaches from the courses on sustainability, cyber security and trust or algorithmic content exposure
- Must be able to analyse the role of business eco-systems in sustainable value creation and improvement of service quality

COMPETENCES

- Must have the competences to apply a combination of socio-technical considerations regarding sustainability, algorithmic content exposure or cybersecurity and trust with skills in managerial economics
- Must have the competences to explore the opportunities and barriers in organizations when innovating for viable and sustainable development
- Must have the competency to consider the potentials and challenges of an entrepreneurial approach to digital business development

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Sustainable Digital Transformation
Type of exam	Oral exam based on a project
ECTS	15

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

FACTS ABOUT THE MODULE

Danish title	Bæredygtig digital transformation
Module code	ESNICTEK3P4N
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	Ove Kjeld Andersen

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

GREEN ICT - SUSTAINABLE BUSINESS DEVELOPMENT

2023/2024

RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The course builds on knowledge obtained in the module “Innovation and Business Models” (formerly “Entrepreneurship, Innovation and Business Models”).

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

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	ESNICTEK3K7N
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

INNOVATION AND DIGITAL SUSTAINABILITY

2023/2024

EXAM

EXAMS

Name of exam	Innovation and Digital Sustainability
Type of exam	Oral exam based on a project
ECTS	12
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	Innovation and Digital Sustainability
Module code	ESNNORK3P1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	12
Language of instruction	English
Location of the lecture	Other location
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

SOFTWARE ENGINEERING MODELS AND METHODS 2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://sis-lut.funidata.fi/student/courseunit/otm-d90b9fbe-7ac2-432a-840b-86e8f3d0e955/brochure

EXAM

EXAMS

Name of exam	Software Engineering Models and Methods
Type of exam	Written or oral exam
ECTS	6
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	Software Engineering Models and Methods
Module code	ESNNORK3K1
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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
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PROJECT-ORIENTED STUDY IN AN EXTERNAL ORGANISATION

2023/2024

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

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

2023/2024

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, including user requirements, market circumstances, and policy and regulation.
- 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 application areas and social and business challenges.

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,
    - meet end-user requirements, and
    - are validated from a market and business perspective
- Must be able to analyse the potential and the implications of new technologies for the end users and stakeholders and contribute to ICT strategies and decision-making.
- 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
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	ESNICTEK4P1
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	Ove Kjeld Andersen

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

INTERNET SERVICES AND GOVERNANCE

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objectives:

The student shall have knowledge about the economics of provision of electronic communication services and infrastructures.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about e-government services and citizen access
- Must have knowledge about the techno-economics of Internet infrastructures
- Must be able to demonstrate insight into governance structures of the Internet
- Must have knowledge about convergence and its impact on regulation and governance
- Must have knowledge about regulation of competition, user access, and scarce resources
- Must have knowledge about Internet organisations and the standardization process for internet technologies
- Must have knowledge about network neutrality, unbundling and vertical separation of Internet infrastructures
- Must have knowledge about consumer rights issues in relation to provision of Internet services

SKILLS

- Must be able to analyse the economic and technological conditions which influence governance and market structure of electronic communication infrastructures
- Must be able to apply economic theory for analysis of market conditions for provision of Internet services
- Must be able to analyse the role of data protection and privacy in provision of public and private internet services
- Must be able to analyse the digital transformation of the public sector and policy issues involved in this process.

COMPETENCES

- Must be able to discuss and evaluate Internet policies at the national and international level
- Must be able to demonstrate development of his/her knowledge, understanding, and ability to make use of socio-economic methods within the fields of Internet services and governance

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

FACTS ABOUT THE MODULE

Danish title	Internet-services og regulering
Module code	ESNICTEK2K6N
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	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

MACHINE LEARNING

2023/2024

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
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

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

MANAGERIAL ECONOMICS AND ENTREPRENEURSHIP 2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge on theories of entrepreneurship
- Must have knowledge on technology management
- Must have knowledge on product, process and market innovation
- Must have knowledge on servitization of manufacturing industries and industrialization of service industries
- Must have knowledge on internationalization strategies
- Must have knowledge on business eco-systems
- Must have knowledge on financial analysis including accounting

SKILLS

- Must be able to apply a costing and pricing strategy for products and services
- Must be able to apply a basic financial analysis and investment and risk analysis
- Must be able to evaluate the benefits and disadvantages of a change management process
- Must be able to evaluate the pros and cons of insourcing and outsourcing

COMPETENCES

- Must have competences in how to apply economic terms to practical managerial circumstances
- Must have competences in preparing a business plan
- Must have competences in assessing a competitive business strategy

TYPE OF INSTRUCTION

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

EXAM

EXAMS

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

FACTS ABOUT THE MODULE

Danish title	Erhvervsøkonomi og entrepreneurskab
Module code	ESNICTEK3K8N
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

COMMUNICATION SYSTEMS

2023/2024

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
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

PRIVACY ENGINEERING

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Informational privacy is today an integrated element of digital services. Businesses and organisations that store or process personal information must protect users' privacy. The privacy engineering course examines privacy as a concept and its practical implications. Furthermore, the relation to cyber security and trust is discussed. Specifically, the course addresses GDPR and its implications for software developers and organizations. The course discusses technical solutions to provide privacy, the integration of privacy into the design process and privacy as expressed in interface design.

LEARNING OBJECTIVES

KNOWLEDGE

The student must have knowledge of:

- The concept "privacy", as understood in application contexts such as: service development, finance, legislation, etc.
- The concept of "privacy" from a moral-ethical perspective
- The concept of "privacy" in technical solutions
- System development-relevant principles for “privacy by design” and “privacy by default”
- Principles for privacy assessments (risk assessments)
- Privacy controlling / privacy protective technologies
- The relationship between privacy and the concepts of cyber-security, trust and risk
- User profiling and privacy
- Conflicts of interest related to the development of privacy protection solutions
- Communicating privacy issues and choices to users via interfaces

SKILLS

The student should be able to:

- Analyse cases from both technical, business and user perspectives
- Apply the different understandings of privacy in analyses of technologies
- Explain the principles of "privacy by design" and "privacy by default"
- Evaluate different privacy principles in selected cases
- Classify various privacy control / protective technologies
- Use different methods to investigate and assess privacy

COMPETENCES

The student must have competences to:

- Assess different privacy understandings in various examples
- Apply different privacy principles to selected examples
- Understand the difference between different privacy principles and security principles
- Apply privacy assessment principles in selected cases and assess their suitability

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
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	ESNCYSK3K2
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

INTERNET TECHNOLOGIES AND SERVICE ARCHITECTURES

2023/2024

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

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

ALGORITHMIC CONTENT EXPOSURE

2023/2024

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
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
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Faculty	The Technical Faculty of IT and Design

PERSONAL LITERATURE STUDY

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://sis-lut.funidata.fi/student/courseunit/otm-b29abb98-0f33-46b8-8572-78845fe5dad1/brochure

EXAM

EXAMS

Name of exam	Personal Literature Study
Type of exam	Written or oral exam
ECTS	6
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	Personal Literature Study
Module code	ESNNORK3K2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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

SUSTAINABILITY AND IT

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://sis-lut.funidata.fi/student/courseunit/otm-9a0b0594-c676-45b1-b876-df68bebec1ef/brochure

EXAM

EXAMS

Name of exam	Sustainability and IT
Type of exam	Written or oral exam
ECTS	6
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	Sustainability and IT
Module code	ESNNORK3K3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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

SUSTAINABILITY ASSESSMENT IN SOFTWARE AND SERVICES

2023/2024

EXAM

EXAMS

Name of exam	Sustainability Assessment in Software and Services
Type of exam	Written or oral exam
ECTS	6
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	Sustainability Assessment in Software and Services
Module code	ESNNORK3K4
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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

DIGITALISATION AND SUSTAINABILITY

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Please see: https://studiegids.vu.nl/en/Master/2020-2021/information-sciences/XM_0089

EXAM

EXAMS

Name of exam	Digitalisation and Sustainability
Type of exam	Written or oral exam
ECTS	6
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	Digitalisation and Sustainability
Module code	ESNNORK3K5
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	6
Language of instruction	English
Location of the lecture	Other location
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