Mediadesign Hochschule

Master of Science in Information Technology

Module Handbook

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Content

Qualification Objectives

Students of the full-time master's degree program "Information Technology" can select one of the following specializations:

A) Front-end Development and Usability,

B) Cyber Security,

C) Artificial Intelligence and Data Analytics

Graduates of the full-time Master's degree program "Information Technology (M.Sc.)" possess the following expertise based on the current state of teaching and research in their field:

Knowledge and Skills

- Critically analyze theoretical principles and apply advanced technical knowledge to a specialized field of information technology.
- Evaluate advanced tools and techniques applied to creative initiatives and solutions in a specialized field of information technology.
- Apply and communicate novel concepts and solutions, to information technology related business challenges that comply with established industry standards.
- Apply legal, cultural, ethical, and social practices to research, management and solution design in diverse information technology business environments locally and globally.
  Contribute advanced specialized knowledge to information technology areas through independent research, professional skills, and implementation of novel solutions.

Competencies

- Steer, develop and monitor information technology business strategies and implementation to meet the needs of industry.
- Directly integrate and apply their knowledge and understanding in an ethical manner in the professional environment.
- Organize and implement their activities effectively and thus grow corresponding leadership responsibility.
- Apply scientific methods in practice and implement innovative developments in everyday professional life.
- Promote scientific discourse within the framework of scientific publications or other recognized platforms.

Specialized Knowledge and Skills

Specialization A: Front-end Development and Usability

- **Design and Develop Advanced, User-Centric Front-End Architectures:** Demonstrate the ability to architect, implement, and optimize sophisticated front-end applications using contemporary web technologies and frameworks (e.g., React, Angular, Vue.js). Ensure responsiveness, accessibility, and high performance to deliver superior user experiences across diverse platforms and devices.
- **Integrate Usability and User-Centered Design Principles into Development Processes:** Apply advanced usability engineering methodologies, user research techniques, and design thinking approaches to create intuitive and engaging user interfaces. Effectively incorporate user feedback and usability testing to iteratively enhance the functionality and aesthetic quality of front-end solutions.

Specialization B: Cyber Security

- **Design and Implement Robust Cyber Security Architectures and Solutions:** Demonstrate the ability to architect, deploy, and manage comprehensive cyber security frameworks that protect organizational assets against a wide range of threats. Utilize advanced security technologies and best practices to ensure confidentiality, integrity, and availability of information systems.

- **Lead and Manage Comprehensive Cyber Security Strategies within Organizations:** Apply strategic thinking and leadership skills to develop, implement, and oversee cyber security initiatives that align with organizational goals and mitigate risks. Foster a culture of security awareness and continuous improvement to enhance the organization's resilience against cyber threats.

Specialization C: Artificial Intelligence and Data Analytics

- **Develop and Implement Advanced AI and Data Analytics Solutions:** Demonstrate the ability to design, develop, and deploy sophisticated artificial intelligence and data analytics models that address complex real-world problems. Utilize state-of-the-art machine learning algorithms, deep learning architectures, and data processing techniques to generate actionable insights and drive data-informed decision-making.
- **Integrate Ethical, Legal, and Societal Considerations into AI and Data Analytics Practices:** Apply comprehensive ethical frameworks and legal standards to the development and deployment of AI and data analytics solutions. Ensure that all projects comply with data privacy regulations, mitigate biases in AI models, and consider the broader societal impacts of technological advancements.

Concept of the degree program

The Master of Science in Information Technology (M.Sc.) is a postgraduate program offering three specializations:

A) Front-end Development and Usability,

B) Cyber Security,

C) Artificial Intelligence and Data Analytics

The aim of the program is to enable Master's graduates to gain a higher-level qualification, extending specialized knowledge, skills and expertise, to meet industry needs through increased relevance in critical fields of IT. In addition, the program will enable the graduate to contribute to developing knowledge in the rapidly evolving field of I.T, becoming experts who are innovative, industry-ready with specialized skills, and focused on emerging technologies to fill the gaps in the information technology (IT) industry, particularly in front-end development and usability engineering, cyber security, and artificial intelligence and data analytics.

This M.Sc. IT is well suited to those seeking additional specialized knowledge, together with improved ability to critically analyze and solve problems. The combination of knowledge and experience will position graduates to take up senior technology roles in data-rich and security-sensitive industries and organizations.

The M.Sc. IT builds on a 3,5-year bachelor's degree in the same academic field and in some cases, relevant professional experience may qualify an applicant for entry into the master's program.

The program is achieved through advanced courses and related project work, followed by a thesis with a significant project integrating practical and research contexts for the advancement of knowledge. The courses provide advanced knowledge in a specialist field of enquiry, and require engagement in rigorous intellectual analysis, critique and problem-solving.

This qualification positions graduates to engage in specialist consulting roles, research positions, or leadership roles. The master's degree qualifies individuals who apply an advanced body of knowledge in a range of contexts, to follow a pathway of further learning, professional practice and/or scholarship.

Blended Learning at mdh

The blended approach contains a diverse range of delivery options to maximize access and flexibility for students while meeting the diverse needs of learners and providing the most suitable approach for content delivery. It includes face-to-face (in person/ lecture/ present) and a range of digital learning opportunities from technology enhanced through to online delivery. Delivery options are designed and proportioned to be appropriate for the learning levels and performance expectations.

Students are actively engaged in a range of individual and group activities to develop and consolidate knowledge, skills and competencies. Activities may include class and group discussion, lectures, practical activities, self-directed research, workshops, role playing, and contextualized practice of skills. Technological equipment and software are used in the learning environments, teaching, learning and assessment may take place in the classroom or online.

Online Learning is facilitated in a learning platform, it can be synchronous (together, same time, same place) or asynchronous (separately, different time, different place). It may include online discussions, webinars, collaboration tools, embedded links, interactive activities, image, text, infographics and videos, simulations, recorded demonstrations, appropriate software tools and instructions, educational resources and databases.

Resources such as online quizzes, online learning tools, and Internet research exercises, enhance the delivery of teaching and learning and reinforce digital literacy competencies. Collaborative group work together with technology supports learners to develop, reinforce and extend knowledge, skills and competencies, whilst developing meta-cognition and self-direction.

Course Structure and Modules

The course of study is conducted as a full-time course and concludes with a Master of Science. Students may opt to attend part time. The full-time program comprises of 3 semesters. The amount of credits required to obtain the master's degree is 90 ECTS credit points. One semester comprises a workload of 30 ECTS credit points.
The following subject areas are included in the degree program:

- **General Studies**: Provides foundational knowledge in management, innovation and research methods, ensuring graduates have both technical and business/innovation insights.
- **Information Technology Fundamentals**: Covers essential technical and methodological skills that every IT professional should master, ranging from programming to data analysis, and from cyber security basics to machine learning.
- **Information Technology Specialization**: Focus on deepening expertise within a chosen domain:
  A. **Front-end Development and Usability** emphasizes the creation of user-centric applications and interfaces.
  B. **Cyber Security** covers the protection of systems and data across the web, cloud, and mobile environments.
  C. **Artificial Intelligence and Data Analytics** focuses on advanced data processing, AI techniques, and ethical considerations.
- **Information Technology Projects**: Offer hands-on experience, progressing from a junior-level project (often team-based with guided support) to an advanced, senior-level project (with higher expectations of independence and complexity).
- **Master's Qualification**: This subject area equips students with the foundational skills, methodologies, and resources needed to undertake their thesis project effectively. It concludes with the completion of a substantial research project, which is then formally presented and defended during the colloquium.

This structure ensures a well-rounded curriculum, blending technical mastery, innovation and management skills, and hands-on project experience, preparing graduates for advanced roles in front-end engineering, cyber security, or AI and data analytics.

Course Content

1 Academic Methods and Competencies

Modules in the general studies group provide foundational knowledge in management and research methods ensuring graduates have business/innovation insights.

- **Scientific Research Methods**: This module introduces students to the core principles and techniques of conducting rigorous, ethical, and methodologically sound research. It equips students with the necessary skills to design research studies, collect and analyze data, and interpret results within the context of IT and broader scientific domains.
- **Master Thesis Setup**: This module is designed to equip students with the necessary skills and organizational framework to begin their master's thesis work. By guiding students through the process of refining a research question, constructing a preliminary proposal, and planning their research activities, this module ensures they are well-prepared to tackle the intellectual and methodological demands of their final thesis project.

2 Electives

- **Entrepreneurship**: This module prepares students to identify, evaluate, and pursue innovative business opportunities in technology-driven markets. By emphasizing a blend of practical frameworks (e.g., Lean Startup) and entrepreneurial mindsets, this module enables students to transform emerging technologies into viable products or services. Students will learn to navigate the unique challenges of starting and scaling tech ventures, including rapid prototyping, securing funding, and managing digital business models.
- **Interculturality and Diversity**: Students will know the significance of globalization and the increased importance of intercultural communication and intercultural competence. They will be familiar with problem areas, methods, theoretical approaches, and central concepts of the debates on gender and diversity.
- **Innovation & Emerging Technologies**: Students know and understand how to drive technological changes in creative industry companies. They take on the role of an intrapreneur – an independent entrepreneur within the company – to initiate, organize, and evaluate innovations.
- **Corporate Social Responsibility and Sustainability**: Introduction of students to sustainability, understanding of CSR and its importance in various areas such as the environment, economy, and society. Understanding how to apply the principles of sustainable and entrepreneurial business in various contexts.

3 Information Technology Fundamentals

Modules in the IT Fundamentals group cover essential technical and methodological skills that every IT professional should master, ranging from programming to machine learning.

- **Machine Learning and Intelligent Systems**: This module introduces students to the core principles, methodologies, and applications of machine learning (ML) and artificial intelligence (AI). By exploring both theoretical foundations and practical implementations, students gain the essential skills to develop intelligent systems capable of learning from data, adapting to new information, and making informed decisions. This foundational knowledge prepares students for advanced specializations in AI, data analytics, and related fields.
- **Cyber Security**: This Cyber Security module provides students with a comprehensive overview of the fundamental concepts, threats, and defense strategies in modern digital environments. By examining common attack vectors, exploring best practices for securing networks and applications, and understanding the organizational aspects of security (policy, compliance, and risk management), students gain the essential knowledge to recognize and address cyber threats effectively. This high-level introduction lays the groundwork for more specialized security topics later in the program.
- **Advanced Programming**: This module builds upon students' existing software development skills by introducing sophisticated design paradigms, programming techniques, and tool chains commonly used in professional, large-scale projects. Through exploration of advanced concepts—such as concurrency, design patterns, and performance optimization, students will learn to build robust, maintainable, and efficient software systems. This module also covers modern development workflows, testing strategies,

and best practices to prepare students for tackling complex programming challenges in their future careers.

4 Information Technology Specializations

Information Technology specialization modules focus on deepening expertise within the chosen domain.

4 A Front-end Development and Usability Modules

This specialization emphasizes the creation of user-centric applications and interfaces and involves four specialization modules:

- **Web Front-end Development**: This module builds upon students' foundational web development skills by introducing advanced concepts and best practices for creating modern, responsive, and high-performing web applications. With a focus on sophisticated UI frameworks, state management, performance optimization, and continuous integration, students gain the knowledge and tools needed to develop professional-grade front-end solutions.
- **Usability Engineering I**: This module introduces students to the fundamental principles and practices of designing user-centric digital products. The module focuses on understanding user needs, human cognitive processes, and the essential methodologies used to evaluate and improve interface usability. By laying a solid foundation, this course prepares students for deeper explorations of usability testing and advanced evaluation techniques in Usability Engineering II.
- **Mobile Front-end Development**: This module focuses on the design, implementation, and optimization of user interfaces for mobile platforms. Students learn how to build high-performance, responsive, and user-friendly applications for iOS, Android, or cross-platform environments. Emphasis is placed on understanding mobile-specific constraints, leveraging modern UI frameworks, and applying usability best practices tailored for on-the-go, touch-based interactions.
- **Usability Engineering II**: This module builds on the foundational concepts introduced in **Usability Engineering I**, exploring more advanced methods for designing, testing, and refining user interfaces. The module focuses on rigorous usability evaluation techniques, in-depth user experience (UX) research methods, and the integration of usability practices into the broader software development lifecycle. By applying these advanced concepts, students will learn how to create and maintain products that meet high standards of user satisfaction and overall user experience.

4 B Cyber Security Modules

This specialization covers the protection of systems and data across the web, cloud, and mobile environments and involves four specialization modules:

- **Web Security**: This module equips students with advanced knowledge and hands-on skills to protect modern web applications and services from an array of cyber threats. Students learn to identify and mitigate common vulnerabilities, implement secure coding practices, and conduct thorough security assessments. This course provides the technical and strategic foundation needed to safeguard web infrastructures in both traditional and cloud-based environments.
- **Cloud Security**: This module provides students with a comprehensive understanding of how to safeguard data, applications, and infrastructures in cloud environments such as AWS, Azure, and Google Cloud. Emphasizing both technical and operational considerations, the module covers secure cloud architecture, identity and access management, compliance and governance, and incident response tailored to cloud-based systems.
- **Mobile Security**: This module provides an in-depth exploration of the techniques and challenges associated with securing mobile devices, applications, and data. Students gain hands-on experience identifying vulnerabilities, implementing robust defenses, and staying current with evolving threats in both iOS and Android ecosystems. Emphasis is placed on secure coding, device management, and alignment with organizational security policies, preparing students to protect mobile environments effectively in a professional context.

- **Data Security and Privacy**: This module provides students with a comprehensive understanding of how to protect sensitive information throughout its lifecycle and comply with relevant data protection regulations. Emphasizing both technical safeguards (e.g., cryptography, access controls) and organizational processes (e.g., risk assessment, governance), this module prepares students to design and implement strategies that secure data assets while respecting user privacy and meeting legal obligations.

4 C Artificial Intelligence and Data Analytics Modules

This specialization focuses on advanced data processing, AI techniques, and ethical considerations and involves four specialization modules:

- **Advanced Machine Learning and AI Techniques**: This module expands upon foundational machine learning principles, exploring state-of-the-art methods and architectures used in cutting-edge AI research and industry applications. Students will gain practical experience with complex model building, optimization, and deployment, alongside the ethical and interpretative frameworks required to apply these techniques responsibly in real-world scenarios.
- **Data Engineering and Big Data Systems**: This module equips students with the skills and knowledge required to design, implement, and manage scalable data pipelines and big data infrastructure. Building on foundational data analytics concepts, this course focuses on processing vast, diverse data sets efficiently using modern distributed systems, stream processing frameworks, and cloud-based solutions. Students will also learn strategies for data governance, quality, and overall lifecycle management in enterprise contexts.
- **Data Visualization and Data Analysis**: This module builds on students' existing data analytics skills, emphasizing effective techniques to explore, interpret, and communicate insights from complex datasets. By combining advanced visualization methodologies with robust analytical approaches, this module teaches students how to transform raw data into actionable knowledge, tailor visual narratives for diverse audiences, and inform strategic decision-making.
- **AI Ethics and Societal Implications**: This module provides students with a comprehensive understanding of the moral, legal, and social challenges posed by rapidly advancing AI technologies. By examining real-world case studies and theoretical frameworks, students learn how to identify, assess, and address the ethical and societal consequences of designing, deploying, and governing AI-driven systems.

5 Information Technology Projects

The two IT Projects (modules) offer hands-on experience, progressing from an applied project to an advanced, senior-level project (with higher expectations of independence and complexity). These two modules are:

- **Applied IT Project**: This module builds on the skills acquired in the Junior IT Project (or students' professional experience) by challenging students to work on a medium-scale application or system. Students deepen their understanding of the full development life cycle, enhance their technical proficiency, and learn to apply innovation and user-centricity in more complex environments. Emphasis is also placed on soft skills such as stakeholder management, user interaction, and advanced collaborative practices.
- **Senior IT Project**: This module represents the peak of the students' project-based learning, demanding a large-scale or complex IT solution that is closer to a market-ready product or a robust internal system. Students are expected to produce their solution to a greater extent, showcasing advanced innovation, technical depth, user-centric validation, and effective project management.

6 Master's Qualification (Master of Science)

- **Thesis and Colloquium**: Through this module, students conduct an independent research project on a topic relevant to their chosen specialization, applying rigorous research methods and critical analysis to produce a scholarly thesis. The module concludes in a colloquium, where students present and defend their research approach, findings, and contributions before an academic panel and peers.

Competency Matrix

The coherence of the program is evidenced by the relationships linking course content, learning outcomes, and graduate knowledge, skills and competency outcomes. Each module has learning outcomes that contribute to the courses graduate outcomes. The program is designed to ensure the learning experience progresses in a considered way, building towards a complete and coherent graduate profile.

GRADUATE OUTCOMES
Key to Graduate Outcomes (GOs)
KNOWLEDGE AND SKILLS
GO1: Critically analyze theoretical principles and apply advanced technical knowledge to a specialized field of information technology.
GO2: Evaluate advanced tools and techniques applied to creative initiatives and solutions in a specialized field of information technology.
GO3: Apply and communicate novel concepts and solutions, to IT related business challenges that comply with established industry standards.
GO4: Apply legal, cultural, ethical, and social practices to research, management and solution design in diverse IT business environments locally and globally.
GO5: Contribute advanced specialized knowledge to IT areas through independent research, professional skills, and implementation of novel solutions.
COMPETENCIES
GO6: Steer, develop and monitor information technology business strategies and implementation to meet the needs of industry.
GO7: Directly integrate and apply their knowledge and understanding in an ethical manner in the professional environment.
GO8: Organize and implement their activities effectively and thus grow corresponding leadership responsibility.
GO9: Apply scientific methods in practice and implement innovative developments in everyday professional life.
GO10: Promote scientific discourse within the framework of scientific publications or other recognized platforms.
SPECIALIZED KNOWLEDGE AND SKILLS
GO11A: Design and Develop Advanced, User-Centric Front-End Architectures
GO12A: Integrate Usability and User-Cantered Design Principles into Development Processes
GO13B: Design and Implement Robust Cyber Security Architectures and Solutions
GO13B: Lead and Manage Comprehensive Cyber Security Strategies within Organizations
GO13C: Develop and Implement Advanced AI and Data Analytics Solutions
GO14C: Integrate Ethical, Legal, and Societal Considerations into AI and Data Analytics Practices

Graduate Outcomes / Modules	GO1	GO2	GO3	GO4	GO5	GO6	GO7	GO8	GO9	GO10	GO11A	GO12A	GO13B	GO13B	GO13C	GO14C
Technology Management		X	X			X		X								
Scientific Research Methods	X			X					X	X						
Entrepreneurship		X	X			X	X	X								
Machine Learning and Intelligent Systems	X	X			X				X						X	
Advanced Programming	X	X	X		X											
Web Front-end Development	X	X									X	X				
Usability Engineering I		X									X	X				
Mobile Front-end Development	X	X									X	X				
Usability Engineering II		X									X	X				
Web Security	X	X		X									X	X		
Cloud Security	X	X		X									X	X		
Mobile Security	X	X		X									X	X		
Data Security and Privacy	X	X		X			X						X	X		
Advanced Machine Learning and AI Techniques	X	X			X				X						X	X
Data Engineering and Big Data Systems	X	X			X				X						X	X
Data Visualization and Data Analysis	X	X	X		X										X	X
AI Ethics and Societal Implications				X			X									X
Applied IT Project	X	X	X				X		X							
Senior IT Project	X	X	X			X	X	X	X							
Master Thesis Setup									X	X						
Thesis and Colloquium	X		X	X	X		X		X	X						

Examination concept in the Information Technology M.Sc. program

The use of exams that combine two examination formats, but whose proportion should not exceed the scope of a full examination and whose components complement each other meaningfully, is a key feature of the module examinations in this program. They form the basis of competency-based assessment.

This competency-based assessment can be justified by several key didactic principles:

- **Focus on competency demonstration:** Combined assessments directly address the core of competency-based learning by requiring students to demonstrate their ability to apply knowledge and skills in authentic contexts. This captures what students can actually do.
- **Promoting self-reflection and self-regulated learning:** The process of selecting artifacts and writing reflective statements encourages students to critically evaluate their own learning. This promotes metacognitive skills and supports self-regulated learning, as students become more aware of their strengths, weaknesses, and learning processes.
- **Constructive Alignment:** Combined assessments can be effectively aligned with the principles of constructive alignment. The learning activities within the module should provide students with opportunities to develop the competencies assessed in the portfolio. The portfolio content and assessment criteria are then directly linked to these learning objectives and activities, creating a coherent learning experience.
- **Authenticity and practical relevance:** Combined exams can include papers that reflect real-life tasks and problems, increasing the authenticity of the assessment. This helps students recognize the relevance of their learning to future professional practice and increases their motivation.
- **Reducing test anxiety:** The combination of various practical and written assessment formats in the combined exam, along with the option of a final discussion/defense, promotes plausibility of performance and can reduce the intense pressure often associated with traditional exams. Discussion can also foster a more dialogic and less hierarchical relationship between examiner and student.
- **Assessment of a broader range of skills:** Combined exams are well suited to assessing not only subject-specific knowledge and skills, but also interdisciplinary, social and personal skills such as reflection, communication and self-management.
- **Meaningfulness of content-related examination forms in times of generative AI:** With traditional examination forms, such as term papers or media products, the examiner will not have sufficient means at his or her disposal in the future to evaluate the influence or weighting of the use of generative AI tools in the examination performance in a differentiated manner.

Module exams combine various competency assessments. Thus, factual and methodological knowledge is combined with practical skills and/or the ability to present one's work. Examinations that apply this approach are characterized by the following requirements/learning objectives:

1. Examination part	2. Examination part	3. Examination part	Didactic purpose
Majority in writing			
Written part as concept, elaboration	Oral or practical task		The development of a concept demonstrates the ability to apply a methodical approach. The presentation demonstrates how the students present and reflect on their ideas and topics.
Seminar paper	Presentation		After extensive research, a written essay, etc., is developed on a topic, demonstrating the ability to engage in discussion, research sources, evaluate, and abstract themes related to a topic and its discourse in the professional world and society. In

1. Examination part	2. Examination part	3. Examination part	Didactic purpose
			the presentation, students demonstrate how they illustrate these theoretical approaches and express their informed opinions. Questions are used to assess their ability to critically examine their own work.
Practical task	Written task	Oral task	The development of a project encompasses various competencies in a single task. The approach to the practical task is documented and reflected upon in writing. It demonstrates the planned approach and the critical analysis of creative work.
Project work, practical tasks,	Report	Presentation	In a project work with a practical assignment, students demonstrate their ability to plan and develop a task-appropriate solution and critically reflect on it. The project work also includes the development of program code, technical solutions (depending on the specialization), and an appropriate number of iterations. In the documentation, the presentation and reflection of one's own approach is an essential part of the examination. In the presentation, students demonstrate their ability to illustrate their work results to a non-involved audience and address critical questions.

Subject areas and Modules

Subject area	**Academic Methods and Competencies**	**MIT 1.**
Module	**Scientific Research Methods**	**MIT 1.1**

Responsible person	
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	1
Prerequisites	None
Teaching methods	100% - Blended
Prerequisite for the award of credit points	
Form of examination	Assignments (30%), Report, 3 -5 pages (40%), Presentation, min. 15 minutes (30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Scientific Research Methods module introduces students to the core principles and techniques of conducting rigorous, ethical, and methodologically sound research. It equips students with the necessary skills to design research studies, collect and analyze data, and interpret results within the context of IT and broader scientific domains. Students will be able to ▪ Formulate clear research questions, hypotheses, and objectives, and select the appropriate qualitative and/or quantitative methods. ▪ Utilize a variety of data collection techniques - such as surveys, experiments, interviews, and case studies - and choose suitable methods for data analysis. ▪ Critically assess the validity, reliability, and limitations of research designs, methodologies, and outcomes. ▪ Apply fundamental statistical and analytical tools to interpret data sets accurately and draw evidence-based conclusions. ▪ Understand and adhere to ethical guidelines and regulations associated with conducting and publishing research. ▪ Communicate research findings effectively through structured reports, papers, and presentations adhering to academic standards and conventions.
Contents	1. Foundations of Scientific Inquiry ▪ Nature and purpose of scientific research

	▪ Research paradigms (positivist, interpretivist, mixed methods) ▪ Critical thinking and scientific skepticism 2. Research Design and Planning ▪ Formulating research questions and objectives ▪ Hypothesis development and operational definitions ▪ Sampling strategies and research scope 3. Data Collection Methods ▪ Qualitative methods (interviews, focus groups, observations) ▪ Quantitative methods (surveys, experiments, secondary data) ▪ Triangulation and mixed methods approach 4. Data Analysis Techniques ▪ Descriptive and inferential statistics ▪ Qualitative data coding and thematic analysis ▪ Use of software tools (e.g., SPSS, R, NVivo) for data analysis 5. Ethics in Research ▪ Informed consent, data privacy, and confidentiality ▪ Ethical considerations for research involving human subjects ▪ Responsible conduct of research and plagiarism prevention 6. Writing and Presenting Research ▪ Structuring academic papers and reports ▪ Referencing styles (APA, IEEE, etc.) and citation management ▪ Effective oral presentations and poster sessions 7. Critical Evaluation of Literature ▪ Conducting systematic literature reviews ▪ Synthesizing research findings and identifying gaps ▪ Developing theoretical frameworks and conceptual models

Subject area	**Academic Methods and Competencies**	**MIT 1.**
Module	**Master Thesis Setup**	**MIT 1.2**

Responsible person	
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	Scientific Research Methods
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Report 5 -10 pages (60%), Presentation, min. 15 minutes (40%)
Grading Scheme	Undifferentiated

Learning outcomes and competencies	The Master Thesis Setup module is designed to equip students with the necessary skills and organizational framework to begin their master's thesis work. By guiding students through the process of refining a research question, constructing a preliminary proposal, and planning their research activities, this module ensures they are well-prepared to tackle the intellectual and methodological demands of their final thesis project. Students will be able to ▪ Choose and refine a thesis topic that aligns with personal interests and program objectives, while evaluating its practicality and scope. ▪ Conduct a focused review of existing research to identify gaps, build a theoretical foundation, and clarify the relevance of their proposed topic. ▪ Select and justify appropriate qualitative and/or quantitative methods, including data collection and analysis approaches. ▪ Develop a structured plan and timeline that details milestones, deliverables, and resource allocation for the thesis. ▪ Recognize and address ethical guidelines, data privacy concerns, and institutional review board (IRB) or similar requirements. ▪ Formulate a concise proposal outlining objectives, methods, anticipated outcomes, and potential limitations, resulting in a clear roadmap for the thesis.
Contents	1. Topic Selection & Scope Definition ▪ Strategies for identifying relevant research areas in IT ▪ Aligning personal interests with academic and industry priorities

	▪ Ensuring topic feasibility and manageability 2. Literature Scoping & Gap Analysis ▪ Techniques for searching academic databases and industry reports ▪ Summarizing and critiquing key findings to highlight research gaps ▪ Developing conceptual frameworks or hypotheses 3. Research Design & Method Selection ▪ Comparing qualitative, quantitative, and mixed-method approaches ▪ Deciding on data sources (primary vs. secondary), sampling techniques, and analytical tools ▪ Pilot testing and feasibility checks 4. Ethical & Regulatory Framework ▪ Informed consent, data protection, and privacy considerations ▪ Intellectual property rights and collaboration guidelines ▪ Compliance with university and external review bodies 5. Thesis Proposal & Planning ▪ Structuring the thesis proposal (objectives, rationale, methodology, expected outcomes) ▪ Crafting a realistic timeline and milestone chart ▪ Securing resources (software, equipment, access to data) and planning for contingencies 6. Academic Writing & Presentation Techniques ▪ Outline creation, referencing standards, and citation tools ▪ Effective communication of research scope, methodology, and anticipated contributions ▪ Peer review and iterative refinement of the proposal 7. Individual Advisory & Feedback Sessions ▪ One-on-one discussions with faculty/supervisors to fine-tune ideas ▪ Formal review and approval of the thesis proposal ▪ Action plans for the next stages of the Master Thesis

Subject area	**Electives**	**MIT 2.**
Module	**Entrepreneurship**	**MIT 2.1**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	1
Prerequisites	None
Teaching methods	100% - Blended
Prerequisite for the award of credit points	
Form of examination	Report 5 – 10 pages (50%), Presentation, min 15 minutes (50%)
Grading Scheme	Undifferentiated (at least the grade 4,0)

Learning outcomes and competencies	The Entrepreneurship module prepares students to identify, evaluate, and pursue innovative business opportunities in technology-driven markets. By emphasizing a blend of practical frameworks (e.g., Lean Startup) and entrepreneurial mindsets, this module enables students to transform emerging technologies into viable products or services. Students will learn to navigate the unique challenges of starting and scaling tech ventures, including rapid prototyping, securing funding, and managing digital business models. Students will be able to ▪ Recognize and evaluate technology-based business opportunities through market analysis and user-centric approaches. ▪ Cultivate an innovative and resilient mindset, effectively leading teams and stakeholders in fast-paced entrepreneurial settings. ▪ Develop and refine digital business models (e.g., subscription, platform-based, data-driven) that leverage cutting-edge technologies. ▪ Apply iterative methods (Lean Startup, agile prototyping) to rapidly test assumptions, minimize risk, and validate product-market fit. ▪ Identify various funding sources - including venture capital, angel investors, and crowdfunding - and develop compelling investor pitches. ▪ Plan for sustainable growth, addressing challenges related to intellectual property, competitive positioning, and global expansion.
Contents	1. Foundations of Tech Entrepreneurship ▪ The entrepreneurial ecosystem (incubators, accelerators, venture capital)

	▪ Key trends and disruptive innovations in the tech sector 2. Innovative Idea Generation and Validation ▪ Techniques for technology-focused ideation (design sprints, user stories, brainstorming) ▪ Market research, competitive analysis, and feasibility studies 3. Lean Startup and Agile Methods ▪ Rapid prototyping and minimum viable product (MVP) development ▪ Agile methodologies and continuous feedback loops 4. Business Models in the Digital Age ▪ Platform models, SaaS, freemium, and other tech-centric revenue strategies ▪ Balancing user growth and monetization 5. Financial Planning and Funding Strategies ▪ Budgeting, forecasting, and financial modelling for startups ▪ Preparing pitch decks and strategies for venture capital, angel investors, and crowdfunding 6. Growth, Marketing, and Scaling ▪ Customer acquisition channels (digital marketing, SEO, social media, partnerships) ▪ Scaling operations, global market entry, and strategic alliances 7. Legal and Ethical Considerations ▪ Intellectual property protection (patents, trademarks) ▪ Ethical and social responsibilities of tech entrepreneurs (data privacy, AI ethics) 8. Case Studies and Practical Exercises ▪ Real-world examples of successful and failed tech ventures ▪ Group projects to prototype and pitch a technology startup idea

Subject area	**Electives**	**MIT 2**
Module	**Interculturality and Diversity**	**DL 1.1.A**

Responsible person	Prof. Dr Roland Frank
Frequency	Once in the academic year
Applicability	All Master programs
ECTS credits	5
Total workload (h)	130
Teaching time (h)	40,5
Learning time (h)	89,5
Study semester	2
Type	Elective
Prerequisites	none
Forms of teaching and learning	Blended
Prerequisite for the award of credit points	
Form of examination	Oral examination (20 minutes)
Grading scheme	Undifferentiated

Learning outcomes and competencies	Students will know the significance of globalization and the increased importance of intercultural communication and intercultural competence. They will be familiar with problem areas, methods, theoretical approaches, and central concepts of the debates on gender and diversity. Students have knowledge of ▪ the significance of globalization and the increased importance of intercultural communication and intercultural competence. ▪ problem areas, methods, theoretical approaches, and central concepts of the debates on gender and diversity. Students will be able to ▪ understand and analyze gender equality and integration concepts. ▪ identify and communicate competitive advantages through the implementation of gender equality and inclusion concepts. ▪ independently develop, plan, and communicate concepts for integrative entrepreneurial action.

Contents	1. Basics of globalization 2. Intercultural competence 3. Basics of intercultural communication 4. Discourses and perspectives of the gender and diversity debate 5. Gender-related management concepts 6. Diversity-related management concepts 7. Theoretical implementation approaches 8. Case studies of German and international companies
Literature recommendations	Krell, Gertraude, Renate Ortlieb and Barbara Sieben (2018): Gender and Diversity in Organizations – Fundamentals of Equal Opportunities through Personnel Policy, Wiesbaden. Lüsebrink, Hans-Jürgen (2016): Intercultural Communication – Interaction, Perception of Others, Cultural Transfer, 4th ed., Stuttgart. Plummer, Deborah (2018): Handbook of Diversity Management: Inclusive Strategies for Driving Organizational Excellence, Boston.

Subject area	**Electives**	**MIT 2**
Module	**Corporate Social Responsibility and Sustainability**	**DL 1.1.B**

Responsible person	Prof. Dr Helmar Baum
Frequency	Once in the academic year
Usability	All Master programs
ECTS points	5
Total workload (h) Teaching time (h) Learning time (h)	130 40,5 89,5
Study semester	2
Type	Elective
Prerequisites	none
Forms of teaching and learning	Blended
Prerequisite for the award of credit points	
Form of examination	Oral examination (20 minutes)
Grading scheme	Undifferentiated

Learning outcomes and competencies	Introduction of students to sustainability, understanding of CSR and its importance in various areas such as the environment, economy, and society. Understanding how to apply the principles of sustainable and entrepreneurial business in various contexts. Students will be able to ▪ understand and analyze CSR and sustainability concepts, this applies to the interrelationships between social, ecological, and economic aspects. ▪ develop possible planning approaches for sustainable, entrepreneurial action.
Contents	1. Theoretical foundations of responsible corporate governance 2. Management approaches for CSR 3. Discourses and perspectives in CSR 4. CSR and corporate communication 5. Fundamentals and strategies for sustainable action in corporate management 6. Conceptual and theoretical approaches
Literature recommendations	Brüggemann, Stefan; Brüssel, Christoph et al. (Hrsg.) (2018): Nachhaltigkeit in der Unternehmenspraxis: Impulse für Wirtschaft und Politik, Wiesbaden Hinrichs, Bernd (2021): Nachhaltigkeit als Unternehmensstrategie: Roadmap für nachhaltiges Wirtschaften und Innovation, Freiburg

	Schneider, Andreas, Schmidpeter, René (Hrsg.) (2015): Corporate Social Responsibility – Verantwortungsvolle Unternehmensführung in Theorie und Praxis, 2. Aufl., Berlin

Subject area	**Electives**	**MIT 2**
Module	**Innovation & Emerging Technologies**	**DL 2.3**

Responsible person	Prof. Dr Roland Frank
Frequency	Once in the academic year
Usability	All master programs
ECTS points	5
Total workload (h)	130
Teaching time (h)	40,5
Learning time (h)	89,5
Study semester	2
Type	Elective
Prerequisites	none
Teaching and learning methods	Blended
Prerequisite for the award of credit points	
Form of examination	Written (written exam 90 minutes)
Grading scheme	Undifferentiated

Learning outcomes and competencies	The students know and understand how to drive technological change in companies in the creative industry. They take on the role of an intrapreneur - an independent entrepreneur within the company - to initiate, organize and evaluate innovations. Students can ▪ identify, abstract, structure and holistically solve both innovative and creative tasks within companies in the creative industry. ▪ steer and monitor innovation efforts of companies. This includes the conceptualization and implementation of product developments; market launches and the controlling of measures. ▪ develop scientific arguments in the of innovation management and independently design further learning processes. ▪ consider ethical and moral aspects of technology development into the decision-making process.
Contents	1. Disruption and change through emerging technologies 2. Conceptual foundations of innovation management 3. Innovation management in Companies - Case Studies 4. Digital transformation as a management task

	5. Innovation management methods 6. Idea development with the help of design thinking 7. Prototyping 8. Evaluation of innovation and strategic innovation management 9. Planning of internal communication measures 10. Anchoring innovation processes in companies
Literature recommendations	Christensen (2016): The Innovator ‘s Dilemma: When New Technologies Cause Great Firms to Fail, Harvard. Disselkamp (2012): Innovationsmanagement: Instrumente und Methoden zur Umsetzung im Unternehmen, Wiesbaden. Hauschildt et al. (2016): Innovationsmanagement, München. Lewrick, Michael (2017): Das Design Thinking Playbook: Mit traditionellen, aktuellen und zukünftigen Erfolgsfaktoren. Vahlen. Moore (2014): Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers, New York. Ries (2014): Lean Startup: Schnell, risikolos und erfolgreich Unternehmen gründen, München.

Subject area	**Information Technology Fundamentals**	**MIT 3.**
Module	**Machine Learning and Intelligent Systems**	**MIT 3.1**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	1
Prerequisites	none
Teaching methods	100% - Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Machine Learning and Intelligent Systems module introduces students to the core principles, methodologies, and applications of machine learning (ML) and artificial intelligence (AI). By exploring both theoretical foundations and practical implementations, students gain the essential skills to develop intelligent systems capable of learning from data, adapting to new information, and making informed decisions. This foundational knowledge prepares students for advanced specializations in AI, data analytics, and related fields. Students will be able to ▪ Explain the key concepts and algorithms in machine learning, including supervised, unsupervised, and reinforcement learning. ▪ Implement and evaluate ML models using common frameworks (e.g., scikit-learn, TensorFlow, or PyTorch), and interpret their performance. ▪ Recognize how intelligent agents, knowledge representation, and AI techniques can be combined to solve complex problems. ▪ Apply best practices for data preprocessing, feature selection, and dimensionality reduction to improve model accuracy. ▪ Employ metrics (accuracy, precision, recall, F1, RMSE, etc.) and hyperparameter tuning methods to optimize ML models. ▪ Understand the ethical, societal, and regulatory implications of deploying AI and ML systems on a scale.
Contents	1. Foundations of AI and Intelligent Systems

	▪ History and evolution of artificial intelligence ▪ Intelligent agents, problem-solving, and search algorithms ▪ Overview of applications in various industries 2. Introduction to Machine Learning ▪ Supervised vs. unsupervised learning: key distinctions and use cases ▪ Reinforcement learning: basics of reward-based training ▪ Overview of typical ML workflows (data, model, evaluation) 3. Data Preprocessing & Feature Engineering • Data cleaning, handling missing values, and outlier detection • Feature scaling, encoding categorical variables, and dimensionality reduction (PCA) • Balancing datasets and dealing with bias in data 4. Supervised Learning Algorithms ▪ Linear and logistic regression, decision trees, random forests, gradient boosting ▪ Neural networks (introduction to deep learning concepts) ▪ Evaluation metrics (accuracy, precision, recall, F1, ROC-AUC) 5. Unsupervised Learning Algorithms ▪ Clustering (K-means, hierarchical clustering, DBSCAN) ▪ Association rule mining and anomaly detection ▪ Dimensionality reduction techniques beyond PCA (e.g., t-SNE) 6. Model Optimization and Tuning ▪ Cross-validation, grid search, and random search for hyperparameter tuning ▪ Regularization methods (L1, L2) and dropout (in neural networks) ▪ Overfitting prevention and model selection strategies 7. Implementation and Tools ▪ Hands-on exercises with Python libraries (NumPy, Pandas, scikit-learn, TensorFlow/PyTorch) ▪ Data pipeline creation and deployment considerations ▪ Version control and reproducible research practices 8. Intelligent Systems Architecture ▪ Basic concepts in knowledge representation and reasoning ▪ Intelligent agents, rule-based systems, and expert systems ▪ Combining ML models with symbolic AI approaches 9. Ethical and Societal Implications ▪ Bias in AI and machine learning systems ▪ Data privacy, security, and regulatory concerns ▪ Frameworks for responsible AI development and deployment 10. Practical Projects and Case Studies ▪ Real-world scenarios involving classification, regression, and clustering ▪ Discussion of advanced topics such as NLP, computer vision, or robotics (overview level)

Subject area	**Information Technology Fundamentals**	**MIT 3.**
Module	**Cyber Security**	**MIT 3.2**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h) Teaching time (h) Learning time (h)	130 36 94
Study Semester	1
Prerequisites	none
Teaching methods	100% - Blended
Prerequisite for the award of credit points	
Form of examination	Practical: (50%), Written: Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Cyber Security module provides students with a comprehensive overview of the fundamental concepts, threats, and defense strategies in modern digital environments. By examining common attack vectors, exploring the best practices for securing networks and applications, and understanding the organizational aspects of security (policy, compliancy, and risk management), students gain the essential knowledge to recognize and address cyber threats effectively. This high-level introduction lays the groundwork for more specialized security topics later in the program. After completing this module, students are expected to: ▪ Identify common cyber threats and vulnerabilities, including malware, social engineering, and network exploits. ▪ Explain the principles of confidentiality, integrity, and availability (CIA), and how they guide security strategies. ▪ Use fundamental cryptographic methods (encryption, hashing, key management) to protect data in transit and at rest. ▪ Assess technical and organizational controls (firewalls, intrusion detection, access control, ISO 27001, etc.) to mitigate risks. ▪ Integrate best practices for application and network security into system architectures and development processes. ▪ Understand how to identify, assess, and manage security risks while adhering to relevant legal and regulatory requirements.

	▪ Outline basic incident response procedures, including detection, containment, eradication, and recovery.
Contents	1. Introduction to Cyber Security ▪ Definitions and scope of cyber security ▪ Threat actors, attack surfaces, and motivation 2. Threat Landscape and Common Attack Vectors ▪ Malware (viruses, ransomware, trojans) and social engineering (phishing) ▪ Network-based attacks (DDoS, MITM) and web application exploits (SQL injection, XSS) 3. Fundamental Security Concepts ▪ CIA triad (confidentiality, integrity, availability) ▪ Principle of least privilege, defense in depth, and zero-trust architecture 4. Cryptography Basics ▪ Symmetric vs. asymmetric encryption ▪ Hash functions, digital signatures, and PKI ▪ Key management and secure communication protocols (SSL/TLS) 5. Network and Application Security ▪ Firewalls, intrusion detection/prevention systems (IDPS), and virtual private networks (VPNs) ▪ Secure coding practices, code reviews, and vulnerability scanning ▪ Web and API security basics 6. Risk Management and Compliance ▪ Identifying and assessing security risks ▪ Security frameworks and standards (ISO 27001, NIST CSF, GDPR, etc.) ▪ Policies, procedures, and governance for enterprise security 7. Incident Response and Recovery ▪ Stages of incident response (preparation, detection, containment, eradication, recovery) ▪ Communication plans, forensic analysis, and lessons learned ▪ Business continuity and disaster recovery 8. Practical Exercises and Case Studies ▪ Analysis of real-world cyber-attacks and security breaches 9. Group discussions on ethics, privacy, and the social impact of security

Subject area	**Information Technology Fundamentals**	**MIT 3.**
Module	**Advanced Programming**	**MIT 3.3**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (100%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Advanced Programming module builds upon students' existing software development skills by introducing sophisticated design paradigms, programming techniques, and tool chains commonly used in professional, large-scale projects. Through exploration of advanced concepts—such as concurrency, design patterns, and performance optimization, students will learn to build robust, maintainable, and efficient software systems. This module also covers modern development workflows, testing strategies, and best practices to prepare students for tackling complex programming challenges in their future careers. Students will be able to ▪ Use higher-level constructs, generics, lambda expressions, and advanced object-oriented or functional paradigms (depending on the chosen language). ▪ Recognize common software design patterns (e.g., Singleton, Factory, Observer, MVC) and apply them effectively to solve recurrent design problems. ▪ Write and manage threads, processes, or asynchronous tasks; understand concurrency models and synchronization mechanisms. ▪ Profile applications and apply optimization techniques to improve execution speed, resource usage, and responsiveness. ▪ Adhere to coding standards, practice test-driven development (TDD) or behavior-driven development (BDD), and use static analysis tools. ▪ Employ advanced debugging techniques and tools to identify, diagnose, and fix complex software defects.

Contents	1. Review of Core Programming Concepts ▪ Recap of key object-oriented/functional principles ▪ Advanced language constructs and best practices ▪ Introduction to modern development environments and tooling 2. Software Design and Architectural Patterns ▪ Creational, structural, and behavioral design patterns ▪ Architectural styles (layered, microservices, event-driven) ▪ Trade-offs in selecting patterns for different use cases 3. Concurrency and Parallelism ▪ Thread management, synchronization primitives (locks, semaphores, mutexes) ▪ Asynchronous programming models (futures, promises, async/await) ▪ Distributed processing and task scheduling frameworks 4. Performance Tuning and Profiling ▪ Identifying bottlenecks using profilers and monitoring tools ▪ Memory management, garbage collection tuning, and object pooling ▪ Algorithmic complexity analysis and optimization strategies 5. Advanced Testing and Quality Assurance ▪ Unit testing with mocking frameworks and automated coverage analysis ▪ Integration and system testing (continuous integration flows) ▪ Static code analysis, linting, and code review processes 6. Debugging and Troubleshooting ▪ Logging frameworks, monitoring, and alerting systems ▪ Systematic approach to diagnosing complex bugs or performance issues ▪ Handling failures gracefully and implementing fault-tolerance 7. Practical Labs and Project Work ▪ Hands-on coding challenges to apply advanced techniques ▪ Collaborative team projects

Subject area	**IT Specialization A: Front-End Development and Usability**	**MIT 4 A**
Module	**Web Front-End Development**	**MIT 4.1 A**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 - 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Web Front-end Development module builds upon students' foundational web development skills by introducing advanced concepts and best practices for creating modern, responsive, and high-performing web applications. With a focus on sophisticated UI frameworks, state management, performance optimization, and continuous integration, students gain the knowledge and tools needed to develop professional-grade front-end solutions. Students will be able to ▪ Develop Complex, Scalable UIs: Construct web interfaces using advanced front-end frameworks (e.g., React, Angular, Vue) that support modular, component-based architectures. ▪ Implement robust state management patterns (e.g., Redux, Vuex, RxJS) and handle asynchronous data seamlessly. ▪ Utilize techniques like code splitting, lazy loading, and efficient rendering strategies to ensure fast load times and smooth user experiences. ▪ Create layouts that adapt to various devices and screen sizes, adhering to Web Content Accessibility Guidelines (WCAG) standards. ▪ Leverage modern build pipelines (Webpack, Vite, or similar) for bundling, minification, and automated testing. ▪ Identify and mitigate common front-end security risks (XSS, CSRF) and maintain secure handling of user data.

	▪ Employ linting, testing, code review, and continuous integration to maintain a sustainable codebase.
Contents	1. Advanced Front-End Frameworks ▪ Component-based architecture, props/state, lifecycle hooks ▪ Routing, modularization, and code splitting ▪ Reusable design patterns and styling approaches 2. State Management and Data Handling ▪ Centralized state management solutions (e.g., Redux, Vuex, MobX) ▪ Asynchronous data flows (REST/GraphQL APIs, websockets) ▪ Caching strategies and offline capabilities (Service Workers, IndexedDB) 3. Performance Optimization ▪ Identifying and resolving performance bottlenecks (rendering, network, CPU) ▪ Techniques for lazy loading, tree shaking, and image optimization ▪ Profiling tools in browsers (Lighthouse, DevTools) 4. Responsive Design and Accessibility ▪ Advanced CSS techniques (Flexbox, Grid, preprocessors like SASS/LESS) ▪ Mobile-first design, adaptive layouts, and fluid typography ▪ Accessibility standards (ARIA roles, keyboard navigation, semantic structure) 5. Security in Front-End Applications ▪ Recognizing common vulnerabilities (XSS, CSRF, third-party scripts) ▪ Sanitizing and validating user inputs, secure cookie handling ▪ Integrating security measures with front-end frameworks and libraries 6. Tooling and Workflow ▪ Build pipelines and bundlers (Webpack, Rollup, Vite) ▪ Package management and versioning (npm, Yarn) ▪ CI/CD integration for automated testing and deployment 7. Testing and Quality Assurance ▪ Unit and integration testing (Jest, Mocha, Cypress) ▪ Automated UI testing and snapshot testing ▪ Code reviews, linting (ESLint), and continuous quality checks 8. Hands-On Projects and Case Studies ▪ Developing a feature-rich single-page application (SPA) ▪ Applying best practices in performance, accessibility, and security ▪ Peer reviews, group presentations, and iterative design sprints

Subject area	**IT Specialization A: Front-End Development and Usability**	**MIT 4 A**
Module	**Usability Engineering I**	**MIT 4.2 A**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report 3 -5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	Usability Engineering I introduces students to the fundamental principles and practices of designing user-centric digital products. The module focuses on understanding user needs, human cognitive processes, and the essential methodologies used to evaluate and improve interface usability. By laying a solid foundation, this course prepares students for deeper explorations of usability testing and advanced evaluation techniques in Usability Engineering II. Students can ▪ Define usability and its importance in software and product development, distinguishing it from related concepts like UX (User Experience). ▪ Implement core User-Cantered Design (UCD) methods (e.g., iterative design, user personas, scenario-based design) to guide product development. ▪ Recognize the basic cognitive, perceptual, and behavioral factors that influence user interactions with digital interfaces. ▪ Develop sketches, wireframes, and simple interactive prototypes that facilitate early user feedback. ▪ Plan and carry out formative usability evaluations (e.g., heuristic evaluations, think-aloud testing) to identify interface problems. ▪ Analyze qualitative and quantitative feedback from usability studies and communicate recommendations effectively to stakeholders. ▪ Demonstrate awareness of accessibility standards and best practices to ensure inclusivity in design.

Contents	1. Introduction to Usability and User-Cantered Design ▪ Definitions of usability, user experience, and human-cantered design ▪ Benefits of usability engineering for product success and user satisfaction ▪ Stages of the UCD lifecycle (requirements, design, evaluation, iteration) 2. Human Factors and Interaction Design ▪ Basic cognitive and perceptual principles (attention, memory, mental models) ▪ Visual design principles (layout, typography, color theory) ▪ Human error and interface design considerations 3. Requirements Gathering and User Research ▪ Qualitative and quantitative research methods (interviews, surveys, observational studies) ▪ User personas, empathy mapping, and journey mapping ▪ Translating research insights into design requirements 4. Prototyping Techniques ▪ Low-fidelity prototypes (paper sketches, wireframes) vs. high-fidelity prototypes ▪ Rapid prototyping tools and techniques (digital wireframing, click-through mock-ups) ▪ Iterative design approaches for refining early concepts 5. Usability Evaluation Methods (Introductory) ▪ Heuristic evaluations and expert reviews ▪ Think-aloud protocol and cognitive walkthroughs ▪ Gathering and analyzing user feedback for incremental improvements 6. Accessibility Fundamentals ▪ Overview of accessibility guidelines (WCAG) ▪ Inclusive design principles and assistive technologies ▪ Practical steps for evaluating and improving accessibility in early prototypes 7. Documentation and Reporting ▪ Effective techniques for documenting usability findings and design decisions ▪ Communicating results to diverse stakeholders (developers, product managers, clients) ▪ Preparing recommendations for the next design iterations 8. Practical Exercises and Collaborative Projects ▪ Group activities to conduct small-scale user studies ▪ Hands-on sessions for sketching, wireframing, and prototyping ▪ Peer evaluations and iterative refinement of interface designs

Subject area	**IT Specialization A: Front-End Development and Usability**	**MIT 4 A**
Module	**Mobile Front-End Development**	**MIT 4.3 A**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Mobile Front-end Development module focuses on the design, implementation, and optimization of user interfaces for mobile platforms. Students learn how to build high-performance, responsive, and user-friendly applications for iOS, Android, or cross-platform environments. Emphasis is placed on understanding mobile-specific constraints, leveraging modern UI frameworks, and applying usability best practices tailored for on-the-go, touch-based interactions. Students can ▪ Create feature-rich and visually appealing mobile front ends using native or cross-platform frameworks (e.g., React Native, Flutter, SwiftUI, Jetpack Compose). ▪ Apply best practices for efficient rendering, memory usage, and network performance to deliver smooth user experiences on varying device capabilities. ▪ Adapt application layouts and components to different screen sizes, orientations, and device form factors (phones, tablets, wearables). ▪ Integrate camera, sensors, push notifications, offline capabilities, and other platform-specific APIs into the application flow. ▪ Utilize touch-based interaction patterns, gesture handling, and mobile usability heuristics to create intuitive, accessible, and engaging mobile interfaces. ▪ Recognize and mitigate mobile-specific security risks (e.g., data storage vulnerabilities, insecure communication) and comply with relevant data protection standards.

Contents	1. Overview of Mobile Ecosystems ▪ Differences between iOS and Android environments ▪ Cross-platform vs. native development approaches ▪ Mobile UI guidelines (Apple Human Interface Guidelines, Material Design) 2. Core Frameworks and Libraries ▪ Introduction to popular frameworks (React Native, Flutter, SwiftUI, Jetpack Compose) ▪ Architecture patterns (MVC, MVVM, Redux-like) in mobile apps ▪ Integrating third-party libraries and SDKs for extended capabilities 3. Mobile UI/UX Design Principles ▪ Usability heuristics for mobile contexts (touch targets, gesture-based navigation) ▪ Adaptive layouts and responsive design for multiple screen sizes ▪ Accessibility considerations (screen readers, color contrast, dynamic type) 4. Performance and Optimization Techniques ▪ Rendering optimizations (e.g., virtualized lists, lazy loading) ▪ Memory management, caching strategies, and offline-first approaches ▪ Network performance and offline synchronization 5. Platform-specific Features and APIs ▪ Using device sensors (GPS, accelerometer, camera) ▪ Push notifications, background services, and local storage ▪ Secure handling of permissions and user data 6. Security in Mobile Front-end Development ▪ Common mobile vulnerabilities (insecure data storage, man-in-the-middle attacks) ▪ Secure communication (HTTPS, certificate pinning) ▪ Best practices for authentication and authorization 7. Testing and Debugging ▪ Unit, UI, and integration testing frameworks (e.g., Jest, XCTest, Espresso) ▪ Debugging tools and device simulators/emulators ▪ Continuous integration and automated testing for stable releases 8. Hands-on Projects and Case Studies ▪ Designing and implementing a fully functional mobile app from scratch ▪ Collaborative development and code reviews ▪ Presentations and peer evaluations of app usability and performance

Subject area	**IT Specialization A: Front-End Development and Usability**	**MIT 4 A**
Module	**Usability Engineering II**	**MIT 4.4 A**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	Usability Engineering II builds on the foundational concepts introduced in Usability Engineering I, exploring more advanced methods for designing, testing, and refining user interfaces. The module focuses on rigorous usability evaluation techniques, in-depth user experience (UX) research methods, and the integration of usability practices into the broader software development lifecycle. By applying these advanced concepts, students will learn how to create and maintain products that meet high standards of user satisfaction and overall user experience. Students will be able to ▪ Plan and execute comprehensive usability tests, including remote testing, eye-tracking, and A/B testing, to gather deeper insights into user behavior. ▪ Combine metrics (e.g., task success rate, time-on-task) with qualitative feedback (e.g., user interviews) to form data-driven design recommendations. ▪ Employ high-fidelity prototyping platforms and sophisticated analytics/tracking solutions to refine the user experience. ▪ Implement techniques such as diary studies, field observations, and ethnographic research to understand user contexts and motivations at a deeper level. ▪ Work effectively with designers, developers, and stakeholders to embed usability in best practices throughout the product lifecycle. ▪ Establish ongoing UX/UI improvement cycles, ensuring user feedback is integrated seamlessly into iterative product enhancements.

	▪ Extend foundational accessibility principles to more complex interactive features, ensuring inclusivity for a broad range of user needs.
Contents	1. Review of Core Usability Concepts ▪ Recap of User-Cantered Design (UCD) and key usability metrics from Usability Engineering I ▪ Refresher on low-fidelity vs. high-fidelity prototyping and formative vs. summative evaluation 2. Advanced Evaluation Techniques ▪ Remote usability testing (asynchronous and synchronous) ▪ Eye-tracking studies for visual attention analysis ▪ A/B testing and multivariate testing strategies ▪ Usability metrics (time on task, success rates, error rates) and how to interpret them 3. User Experience Research Methods ▪ Diary studies to capture longitudinal user data ▪ Field studies and ethnographic research for in-depth user context ▪ Data triangulation: combining quantitative analytics with qualitative insights 4. High-Fidelity Prototyping and Tooling ▪ Advanced prototyping tools (e.g., Figma, Sketch, Axure) with interactive features ▪ Integrating real or simulated data into prototypes for richer user testing ▪ Conducting iterative testing sessions and rapid prototyping loops 5. Collaboration with Development Teams ▪ Embedding usability testing feedback into agile or DevOps workflows ▪ Communication best practices for bridging design, development, and product management ▪ Establishing UX “definition of done” in sprints and product backlogs 6. Accessibility in Complex Interactions ▪ Extending WCAG principles to dynamic UI elements (e.g., ARIA for custom widgets) ▪ Testing interactive elements with assistive technologies (e.g., screen readers, switch controls) ▪ Handling accessibility in collaborative environments and continuous integration pipelines 7. Continuous Improvement and UX Governance ▪ Designing processes for iterative refinement and versioning of design guidelines ▪ Measuring usability and UX over time with analytics and user feedback loops ▪ Creating and maintaining a “design system” that captures usability patterns and standards 8. Case Studies and Practical Projects ▪ In-depth evaluations of real-world applications, including analysis of complex workflows ▪ Group projects requiring planning, executing, and reporting on advanced usability tests

	▪ Presentations to simulate stakeholder buy-in and demonstrate ROI of usability improvements

Subject area	**IT Specialization B: Cyber Security**	**MIT 4 B**
Module	**Web Security**	**MIT 4.1 B**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Web Security module equips students with advanced knowledge and hands-on skills to protect modern web applications and services from an array of cyber threats. Students learn to identify and mitigate common vulnerabilities, implement secure coding practices, and conduct thorough security assessments. This course provides the technical and strategic foundation needed to safeguard web infrastructures in both traditional and cloud-based environments. Students will be able to ▪ Recognize and classify prevalent security threats (e.g., SQL injection, cross-site scripting, cross-site request forgery) and apply strategies to prevent them. ▪ Integrate security-by-design principles into web development lifecycles, following guidelines such as OWASP Top 10. ▪ Conduct vulnerability assessments and penetration tests using industry-standard tools, interpreting results to propose and implement remediations. ▪ Configure web servers, application frameworks, and network components (WAFs, reverse proxies) securely, minimizing attack surfaces. ▪ Design robust authentication systems, session management, and access control mechanisms that align with best practices. ▪ Use logging, monitoring tools, and incident response procedures to detect breaches, contain damage, and recover swiftly. ▪ Stay updated on evolving attack techniques (e.g., supply-chain attacks, advanced phishing) and adapt defenses accordingly.

Contents	1. Introduction to Web Security Fundamentals ▪ Threat landscape and common web security terminologies ▪ Anatomy of a web application (front-end, back-end, databases, APIs) ▪ Overview of the OWASP Top 10 vulnerabilities 2. Secure Web Application Development ▪ Best practices for coding secure input validation, error handling, and logging ▪ Secure frameworks and libraries (e.g., security modules in popular web frameworks) ▪ Session management, cookies, and token-based authentication (JWT, OAuth) 3. Vulnerability Assessment and Penetration Testing ▪ Methodologies and tools (Burp Suite, OWASP ZAP, SQLMap, etc.) ▪ Automated and manual scanning techniques ▪ Reporting findings and prioritizing remediation 4. Server and Network Security ▪ Secure server configuration (SSL/TLS, hardening, HTTPS enforcement) ▪ Web application firewalls (WAFs) and intrusion detection/prevention systems ▪ Content delivery networks (CDNs) and their role in mitigating DDoS attacks 5. Advanced Threats and Attack Vectors ▪ Cross-Site Request Forgery (CSRF), Clickjacking, XML External Entities (XXE) ▪ Supply-chain attacks, dependency vulnerabilities, and zero-day exploits ▪ Client-side attacks (e.g., Magecart, malicious scripts) 6. Incident Response and Recovery ▪ Monitoring and logging (SIEM, real-time alerting) ▪ Forensic analysis, threat intelligence, and lessons learned post-incident ▪ Business continuity and disaster recovery from a web security perspective 7. Compliance and Regulatory Requirements ▪ Data protection regulations (GDPR, CCPA) and their implications for web security ▪ Industry-specific standards (PCI DSS, HIPAA) ▪ Documenting security controls and audit readiness 8. Emerging Trends and Future Directions ▪ Cloud-based and serverless web security considerations ▪ Microservices security (API gateways, service meshes) ▪ AI-driven attack detection and adaptive defense strategies 9. Practical Projects and Case Studies ▪ Hands-on labs: setting up secure test environments, performing penetration tests ▪ Simulation of real-world attacks and live incident response drills ▪ Group project: designing, implementing, and defending a secure web application

Subject area	**IT Specialization B: Cyber Security**	**MIT 4 B**
Module	**Cloud Security**	**MIT 4.2 B**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Cloud Security module provides students with a comprehensive understanding of how to safeguard data, applications, and infrastructures in cloud environments such as AWS, Azure, and Google Cloud. Emphasizing both technical and operational considerations, the module covers secure cloud architecture, identity and access management, compliance and governance, and incident response tailored to cloud-based systems. Students can ▪ Plan and implement cloud-native security solutions that follow best practices and leverage built-in services for robust, scalable protection. ▪ Configure identity and access management (IAM) policies, roles, and permissions to enforce the principle of least privilege in multi-tenant environments. ▪ Interpret relevant regulations (GDPR, ISO 27017, SOC 2, etc.) and apply governance frameworks to maintain compliance in public, private, and hybrid clouds. ▪ Deploy secure virtual networks, firewalls, and encryption for data at rest and in transit, while monitoring for suspicious activity. ▪ Conduct risk assessments, vulnerability scans, and penetration tests specific to cloud resources and address identified weaknesses. ▪ Utilize cloud-native monitoring, logging, and threat detection tools to detect breaches and execute incident response plans in a cloud setting. ▪ Balance security requirements with operational efficiency, ensuring cost-effective resource utilization without compromising protection.

Contents	1. Introduction to Cloud Computing and Security Concepts ▪ Cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid) ▪ Shared responsibility model and implications for security ▪ Fundamental differences between on-premises and cloud security 2. Secure Cloud Architecture and Design ▪ Principles of layered security (defense in depth) in cloud environments ▪ Multi-tenant isolation and secure configuration baselines ▪ Cloud reference architectures and best practices from major providers 3. Identity and Access Management (IAM) ▪ Policy-based permissions and role-based access control (RBAC) ▪ Multi-factor authentication (MFA) and single sign-on (SSO) ▪ Federated identity and OAuth/OpenID Connect in cloud contexts 4. Network and Perimeter Security ▪ Virtual networks, subnets, and network access control lists (ACLs) ▪ Secure ingress/egress controls, load balancers, and application gateways ▪ Web application firewalls (WAF) and distributed denial-of-service (DDoS) protection 5. Data Protection and Encryption ▪ Encryption at rest (KMS, HSM) and encryption in transit (TLS, VPN) ▪ Key management strategies and lifecycle ▪ Data classification, masking, and secure data backup/restore procedures 6. Monitoring, Logging, and Threat Detection ▪ Cloud-native logging services (CloudTrail, CloudWatch, Azure Monitor, etc.) ▪ Real-time alerting and intrusion detection/prevention (IDS/IPS) systems ▪ Automated incident response and orchestration (Lambda, Functions, Logic Apps) 7. Security Assessments and Vulnerability Management ▪ Conducting cloud-specific vulnerability scans and audits ▪ Penetration testing rules of engagement in public clouds ▪ Managing and remediating identified risks 8. Compliance, Governance, and Risk Management ▪ Overview of key cloud security standards (ISO 27017/18, CSA STAR) ▪ Mapping regulatory requirements (GDPR, PCI DSS, HIPAA) to cloud controls ▪ Governance frameworks and best practices for policy enforcement 9. Incident Response and Disaster Recovery in the Cloud ▪ Cloud incident response playbooks and escalation procedures ▪ Business continuity and disaster recovery planning (DRaaS) ▪ Forensics and log retention in distributed environments 10. Emerging Trends and Future Directions ▪ Serverless architectures and container security (Docker, Kubernetes) ▪ AI-driven security analytics and automated threat hunting ▪ Zero Trust and Software Defined Perimeter (SDP) concepts 11. Practical Labs and Projects (Examples)

	▪ Configuring secure environments on major cloud platforms (AWS/Azure/GCP) ▪ Implementing IAM policies, encryption, and network segmentation ▪ Performing a cloud security audit and presenting remediation strategies

Subject area	**IT Specialization B: Cyber Security**	**MIT 4 B**
Module	**Mobile Security**	**MIT 4.3 B**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Mobile Security module provides an in-depth exploration of the techniques and challenges associated with securing mobile devices, applications, and data. Students gain hands-on experience identifying vulnerabilities, implementing robust defenses, and staying current with evolving threats in both iOS and Android ecosystems. Emphasis is placed on secure coding, device management, and alignment with organizational security policies, preparing students to protect mobile environments effectively in a professional context. Students will be able to ▪ Understand the security architectures of common mobile operating systems (iOS, Android) and how they differ from traditional desktop platforms. ▪ Recognize common mobile vulnerabilities (e.g., malicious apps, root exploits, insecure data storage) and apply appropriate countermeasures. ▪ Implement secure coding practices and frameworks for mobile apps, including input validation, encryption, and secure session handling. ▪ Configure mobile device management (MDM) solutions, enforce corporate security policies, and handle bring your own device (BYOD) scenarios. ▪ Perform penetration testing, vulnerability scanning, and code reviews to detect and remediate security issues throughout the development lifecycle. ▪ Align mobile security strategies with relevant regulations (e.g., GDPR, HIPAA) and industry-specific guidelines. ▪ Monitor and respond to evolving mobile security threats, including those targeting IoT devices and wearable technologies.

Contents	1. Introduction to Mobile Security Ecosystems ▪ Overview of Android, iOS, and alternative mobile platforms ▪ Differences in platform security models and permission systems ▪ Threat actors, typical attack vectors, and the broader mobile threat landscape 2. Secure Mobile App Development ▪ Best practices for secure coding (input validation, session management, data encryption) ▪ Utilizing secure APIs, SDKs, and libraries ▪ Framework-specific security features (Keychain, Android Keystore) 3. Mobile Device Management (MDM) and Enterprise Mobility ▪ Deployment and configuration of MDM solutions ▪ Policy enforcement, app whitelisting/blacklisting, and remote wipe capabilities ▪ BYOD environments and balancing user privacy with organizational security 4. Mobile Application Vulnerabilities and Testing ▪ Identifying common vulnerabilities (insecure data storage, weak encryption, insecure communication) ▪ Tools and methodologies for mobile app penetration testing (e.g., MobSF, Drozer, Frida) ▪ Dynamic and static analysis techniques for Android and iOS apps 5. Network and Communication Security ▪ Secure communication protocols (HTTPS, TLS, certificate pinning) ▪ VPNs and secure channels for mobile devices ▪ Threats from public Wi-Fi and man-in-the-middle (MITM) attacks 6. Advanced Threat Detection and Incident Response ▪ Logging, monitoring, and anomaly detection in mobile contexts ▪ Forensic analysis of mobile devices and apps ▪ Incident response workflows tailored for mobile ecosystems 7. Compliance and Legal Considerations ▪ Data protection regulations and best practices (GDPR, HIPAA, PCI DSS) ▪ Handling user consent, data minimization, and location-based information ▪ Legal issues around encryption, device ownership, and user privacy 8. Emerging Trends and Future Directions ▪ IoT, wearables, and edge computing security challenges ▪ Mobile-based payment systems and related vulnerabilities ▪ AI-driven mobile security solutions and threat intelligence 9. Hands-On Labs and Group Projects ▪ Configuring and testing MDM setups in a lab environment ▪ Conducting security assessments on real or simulated mobile applications ▪ Designing, implementing, and presenting a secure mobile solution or proof of concept

Subject area	**IT Specialization B: Cyber Security**	**MIT 4 B**
Module	**Data Security and Privacy**	**MIT 4.4 B**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Data Security and Privacy module provides students with a comprehensive understanding of how to protect sensitive information throughout its lifecycle and comply with relevant data protection regulations. Emphasizing both technical safeguards (e.g., cryptography, access controls) and organizational processes (e.g., risk assessment, governance), this module prepares students to design and implement strategies that secure data assets while respecting user privacy and meeting legal obligations. Students can ▪ Interpret and apply frameworks such as GDPR, CCPA, and other industry-specific standards to ensure compliance. ▪ Implement methods for identifying, classifying, and handling data according to its sensitivity and criticality. ▪ Utilize encryption, hashing, digital signatures, and key management to protect data in transit and at rest. ▪ Design robust role-based or attribute-based access controls and governance policies to maintain data integrity and confidentiality. ▪ Conduct data security risk assessments, implement relevant controls, and formulate strategies for incident response and breach reporting. ▪ Integrate privacy considerations into system architectures and software development lifecycles (SDLC) from the outset. ▪ Address the complexities of big data, cloud storage, data anonymization, and cross-border data transfers in modern IT environments.

Contents	1. Recap of Data Security and Privacy ▪ The role of data in modern organizations ▪ Core principles: confidentiality, integrity, availability (CIA), and privacy by design ▪ Overview of key regulations (GDPR, CCPA, HIPAA, PCI DSS) 2. Data Classification and Governance ▪ Identifying and categorizing data based on sensitivity and regulatory requirements ▪ Data mapping and inventory management ▪ Data lifecycle management (creation, storage, processing, deletion) 3. Cryptography and Key Management ▪ Symmetric vs. asymmetric encryption, hashing, and digital signatures ▪ Secure key generation, distribution, and storage ▪ Certificate authorities and Public Key Infrastructure (PKI) 4. Access Control Models and Implementation ▪ Role-based access control (RBAC), attribute-based access control (ABAC) ▪ Identity and Access Management (IAM) frameworks and tools ▪ Policy enforcement, logging, and monitoring of user activities 5. Anonymization and De-Identification ▪ Techniques to protect personal data while retaining utility (tokenization, pseudonymization) ▪ Re-identification risks and countermeasures ▪ Balancing data analytics needs with privacy controls 6. Risk Assessment and Incident Response ▪ Threat modelling and risk analysis methods (ISO 27005, NIST frameworks) ▪ Developing and testing incident response plans ▪ Legal and regulatory obligations for breach notification 7. Privacy-by-Design and Secure SDLC ▪ Integrating privacy requirements early in the development process ▪ Data protection impact assessments (DPIA) ▪ Secure coding and continuous security testing in agile and DevOps environments 8. Cloud and Big Data Security ▪ Challenges in cloud storage and processing (shared responsibility model) ▪ Security considerations for distributed and scalable data platforms (Hadoop, Spark) ▪ Cross-border data transfers and jurisdictional complexities 9. Emerging Trends and Case Studies ▪ AI-driven privacy solutions and automated data classification ▪ Blockchain-based data security approaches ▪ Lessons learned from high-profile data breaches and enforcement actions 10. Practical Labs and Projects ▪ Setting up encryption and key management solutions (e.g., KMS) ▪ Conducting privacy impact assessments and access reviews ▪ Designing and implementing a data security plan for a simulated organization

Subject area	**IT Specialization C: Artificial Intelligence and Data Analytics**	**MIT 4 C**
Module	**Advanced Machine Learning and AI Techniques**	**MIT 4.1 C**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Advanced Machine Learning and AI Techniques module expands upon foundational machine learning principles, exploring state-of-the-art methods and architectures used in cutting-edge AI research and industry applications. Students will gain practical experience with complex model building, optimization, and deployment, alongside the ethical and interpretative frameworks required to apply these techniques responsibly in real-world scenarios. Students will be able to ▪ Utilize and compare sophisticated algorithms (e.g., ensemble methods, gradient boosting, deep neural networks) for a variety of predictive and descriptive tasks. ▪ Implement complex architectures (CNNs, RNNs, Transformers, GANs) for tasks such as computer vision, natural language processing, and generative modelling. ▪ Apply hyperparameter tuning, performance monitoring, and MLOps practices to ensure scalable and reliable AI solutions. ▪ Use model explainability tools and fairness metrics to interpret model behavior, identify bias, and propose remediation strategies. ▪ Leverage parallel and distributed computing frameworks (GPU/TPU clusters, Spark, etc.) to manage and analyze large, complex datasets efficiently. ▪ Critically assess recent advances in AI (e.g., reinforcement learning, multimodal learning, self-supervised learning) and adapt solutions to evolving technologies.

	▪ Incorporate ethical considerations, data privacy concerns, and regulatory compliance into the design and deployment of advanced AI systems.
Contents	1. Review of Foundational ML Concepts ▪ Brief recap of key ML algorithms, model evaluation metrics, and data preprocessing ▪ Connections between foundational and advanced techniques 2. Advanced Supervised and Unsupervised Techniques ▪ Ensemble methods (e.g., gradient boosting, stacking) ▪ Advanced clustering and dimensionality reduction (e.g., DBSCAN, t-SNE, UMAP) ▪ Semi-supervised and active learning approaches 3. Deep Learning Architectures ▪ Convolutional Neural Networks (CNNs) for image and video tasks ▪ Recurrent Neural Networks (RNNs, LSTM, GRU) and sequence modelling ▪ Transformers for NLP, computer vision, and multimodal data ▪ Generative models (GANs, VAEs) for data synthesis and augmentation 4. Reinforcement Learning (Introductory/Intermediate) ▪ Fundamentals of RL (Markov decision processes, policy/value functions) ▪ Q-learning, policy gradients, and advanced algorithms (DQN, PPO) ▪ Practical applications (robotics, recommendation systems, game AI) 5. Model Explainability and Responsible AI ▪ Interpretable ML techniques (LIME, SHAP, feature importance) ▪ Fairness metrics, bias detection, and mitigation strategies ▪ Ethical considerations, privacy, and compliance (GDPR, AI regulations) 6. Scaling and Deployment of ML Systems ▪ Distributed training (data parallelism, model parallelism) ▪ MLOps: CI/CD pipelines, containerization, and orchestrators (Kubernetes) ▪ Monitoring, logging, and real-time inference in production environments 7. Performance Tuning and Hyperparameter Optimization ▪ Automated hyperparameter tuning (grid search, random search, Bayesian optimization) ▪ Hardware acceleration (GPUs, TPUs) and memory optimization ▪ Model compression and pruning for efficient deployment 8. Emerging Research and Trends ▪ Advances in self-supervised and unsupervised representation learning ▪ Transfer learning, few-shot and zero-shot learning ▪ Adversarial attacks and defenses (adversarial robustness) 9. Practical Labs and Projects ▪ Hands-on implementation of advanced deep learning architectures and reinforcement learning solutions ▪ End-to-end project incorporating data ingestion, model selection, tuning, and deployment ▪ Group presentations to demonstrate solutions, focusing on interpretability and ethical considerations

Subject area	**IT Specialization C: Artificial Intelligence and Data Analytics**	**MIT 4 C**
Module	**Data Engineering and Big Data Systems**	**MIT 4.2 C**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The Data Engineering and Big Data Systems module equips students with the skills and knowledge required to design, implement, and manage scalable data pipelines and big data infrastructure. Building on foundational data analytics concepts, this course focuses on processing vast, diverse data sets efficiently using modern distributed systems, stream processing frameworks, and cloud-based solutions. Students will also learn strategies for data governance, quality, and overall lifecycle management in enterprise contexts. Students can ▪ Design end-to-end data workflows to collect, transform, and store large volumes of structured and unstructured data. ▪ Leverage tools such as Apache Hadoop, Spark, and Kafka to process big data in batch and real-time scenarios. ▪ Develop efficient Extract-Transform-Load (ETL) or ELT pipelines that ensure data accuracy, reliability, and timeliness. ▪ Apply best practices in data cataloging, metadata management, lineage tracking, and compliance with relevant regulations (GDPR, etc.). ▪ Employ partitioning, caching, and cluster management strategies to balance resource usage, speed, and cost in on-premises or cloud-based environments. ▪ Build systems for continuous data ingestion, monitoring, and on-the-fly analytics to support instantaneous decision-making.

	▪ Prepare big data outputs for machine learning pipelines, business intelligence tools, and AI-driven applications.
Contents	1. Introduction to Data Engineering and Big Data ▪ Evolution of data processing: from traditional RDBMS to big data ecosystems ▪ Overview of high-level architectures for data-intensive applications ▪ Key big data use cases in industry (IoT analytics, clickstream analysis, etc.) 2. Data Ingestion and Storage ▪ Batch data ingestion vs. real-time/stream ingestion ▪ Structured, semi-structured, and unstructured data handling ▪ Distributed file systems (HDFS), NoSQL databases (HBase, Cassandra), and object storage (S3) 3. Processing Frameworks and Technologies ▪ Hadoop ecosystem components (YARN, MapReduce, Hive, Pig) ▪ Apache Spark and its core concepts (RDDs, DataFrames, Spark SQL) ▪ Stream processing platforms (Apache Kafka, Flink, Spark Streaming) 4. Designing ETL/ELT Pipelines ▪ Data extraction from diverse sources (databases, APIs, logs, IoT devices) ▪ Transformation techniques (cleansing, filtering, aggregation) ▪ Workflow orchestration tools (Airflow, Luigi, Oozie) 5. Data Quality and Governance ▪ Defining data quality dimensions (completeness, accuracy, consistency) ▪ Metadata management and data lineage tracking ▪ Regulatory compliance (GDPR, CCPA) and governance frameworks (e.g., DAMA-DMBOK) 6. Performance Optimization and Cost Management ▪ Cluster sizing, resource allocation, and autoscaling in cloud environments ▪ Partitioning, indexing, and caching strategies ▪ Monitoring and logging for performance bottlenecks (Ganglia, Prometheus) 7. Real-Time Analytics and Stream Processing ▪ Building low-latency pipelines with Kafka, Spark Streaming, Flink, or Kinesis ▪ Windowing, stateful processing, and handling event-time vs. processing-time ▪ Use cases: fraud detection, live dashboards, recommendation systems 8. Cloud-Based Data Engineering ▪ Managed services for data ingestion (AWS Kinesis, Azure Event Hubs, GCP Pub/Sub) ▪ Cloud data warehouses (Redshift, BigQuery, Snowflake) ▪ Serverless data processing (AWS Lambda, Azure Functions) 9. Integrating Advanced Analytics and ML ▪ Preparing big data outputs for machine learning workflows ▪ Feature engineering at scale and distributed model training ▪ Supporting BI and reporting tools with large-scale datasets 10. Practical Labs and Projects ▪ Hands-on implementation of a data pipeline using distributed computing frameworks

	▪ Stream processing project with real-time dashboards and analytics ▪ Group presentations showcasing optimized, end-to-end data engineering solutions

Subject area	**IT Specialization C: Artificial Intelligence and Data Analytics**	**MIT 4 C**
Module	**Data Visualization and Data Analysis**	**MIT 4.3 C**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	Data Visualization and Data Analysis builds on students' existing data analytics skills, emphasizing effective techniques to explore, interpret, and communicate insights from complex datasets. By combining advanced visualization methodologies with robust analytical approaches, this module teaches students how to transform raw data into actionable knowledge, tailor visual narratives for diverse audiences, and inform strategic decision-making. Students will be able to ▪ Select and implement appropriate visual representations (charts, interactive dashboards, geospatial maps) that clarify data patterns, trends, and relationships. ▪ Employ statistical and exploratory data analysis (EDA) methods—including clustering, correlation, and segmentation—to derive nuanced insights from diverse datasets. ▪ Develop dynamic, user-friendly dashboards (e.g., Tableau, Power BI, Python-based frameworks) that enable real-time data exploration and monitoring. ▪ Craft coherent data narratives and presentations tailored to technical and non-technical stakeholders, highlighting key insights and actionable recommendations. ▪ Implement best practices for data cleaning, wrangling, and feature engineering to ensure accuracy and integrity in visual and analytical outputs. ▪ Assess various visualization libraries and analytics platforms (D3.js, Plotly, Matplotlib, Qlik, etc.) based on project requirements and user needs.

	▪ Understand the implications of data bias, privacy, and confidentiality when creating visualizations and conducting analytical projects.
Contents	1. Foundations of Data Visualization ▪ History, principles, and theories of visual communication ▪ Key design elements (color theory, layout, typography, Gestalt principles) ▪ Visualization pitfalls and common misrepresentations 2. Data Preprocessing and Exploration ▪ Data cleaning and transformation techniques (handling missing values, outliers) ▪ Exploratory Data Analysis (EDA) to uncover patterns and anomalies ▪ Feature selection, dimensionality reduction, and correlation analysis 3. Visual Exploration Techniques ▪ Static vs. interactive charts (line, bar, scatter, bubble, treemap, etc.) ▪ Geospatial data visualization (maps, choropleths, heatmaps) ▪ Visualization for time-series, network, and textual data 4. Advanced Analytical Methods ▪ Statistical modelling (hypothesis testing, regression) ▪ Clustering, classification, and other data mining approaches (beyond foundational ML) ▪ Combining traditional analytics with modern AI-driven insights 5. Interactive Dashboards and Tools ▪ Overview of popular platforms (Tableau, Power BI, Qlik, Looker) ▪ Open-source libraries and frameworks (D3.js, Plotly, Bokeh, Dash) ▪ Best practices for building responsive and user-centric dashboards 6. Storytelling and Communication ▪ Structuring data narratives (setting context, highlighting key insights, calls to action) ▪ Tailoring presentations to different audiences (executives, technical teams, public) ▪ Design thinking for data storytelling (iterative feedback, user testing) 7. Ethics, Privacy, and Responsible Use ▪ Identifying and mitigating data bias in visual analysis ▪ Ensuring compliance with privacy regulations (GDPR, CCPA) when sharing or publishing dashboards ▪ Responsible data sourcing and confidentiality 8. Real-World Case Studies and Projects ▪ Hands-on labs focusing on end-to-end data analysis and visualization tasks ▪ Group project to develop a dashboard for a real or simulated business or social dataset ▪ Presentations demonstrating data-driven storytelling and actionable insights

Subject area	**IT Specialization C: Artificial Intelligence and Data Analytics**	**MIT 4 C**
Module	**AI Ethics and Societal Implications**	**MIT 4.4 C**

Responsible person	Mohammed AbuJarour
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Prerequisites	none
Teaching methods	80% - Seminar // 20% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	The AI Ethics and Societal Implications module provides students with a comprehensive understanding of the moral, legal, and social challenges posed by rapidly advancing AI technologies. By examining real-world case studies and theoretical frameworks, students learn how to identify, assess, and address the ethical and societal consequences of designing, deploying, and governing AI-driven systems. Students will be able to ▪ Evaluate AI systems using established ethical theories (deontological, consequentialist, virtue ethics) and guidelines (e.g., IEEE, UNESCO). ▪ Identify potential biases in AI datasets and models and propose strategies to mitigate unfair or discriminatory outcomes. ▪ Advocate for explainable AI (XAI) and design mechanisms that promote accountability and auditability in automated decision-making. ▪ Recognize privacy concerns, comply with relevant regulations (GDPR, CCPA), and implement ethical data handling practices in AI projects. ▪ Investigate the broader ramifications of AI on employment, social justice, healthcare, and other key sectors, proposing equitable policy responses. ▪ Formulate guidelines that integrate legal, ethical, and safety considerations into AI governance and lifecycle management. ▪ Communicate and collaborate effectively with stakeholders (e.g., legal experts, ethicists, policymakers) to address AI's societal implications.
Contents	1. Foundations of AI Ethics

	▪ Overview of ethical principles and theoretical frameworks ▪ Historical context: from early machine ethics debates to modern AI guidelines ▪ Key ethics standards and initiatives (IEEE, EU AI Ethics guidelines) 2. Bias and Fairness in AI ▪ Types of algorithmic bias (data, design, outcome) ▪ Case studies: discriminatory outcomes in hiring, lending, and law enforcement ▪ Techniques for bias detection, mitigation (re-sampling, re-weighting, algorithmic adjustments) 3. Explainability and Transparency ▪ Concepts of Explainable AI (XAI) and model interpretability ▪ Balancing trade-offs between model complexity and comprehensibility ▪ Tools and methods (LIME, SHAP, counterfactual explanations) 4. Privacy and Data Protection ▪ Data ethics principles: consent, data minimization, ownership ▪ Legal frameworks and compliance (GDPR, CCPA, etc.) ▪ Anonymization and privacy-preserving techniques (differential privacy, federated learning) 5. Accountability and Governance ▪ Assigning responsibility for AI-driven decisions (developers, organizations, users) ▪ Risk assessment and governance models (AI oversight committees, audit trails) ▪ Role of governmental and international bodies in AI regulation 6. Societal and Economic Impacts ▪ AI-driven automation and the future of work ▪ Ethical challenges in healthcare, finance, education, and other sectors ▪ Socio-economic disparities, digital divides, and policy interventions 7. Safety, Security, and Future Concerns ▪ Potential risks of autonomous systems (self-driving cars, drones, robotics) ▪ Long-term concerns (superintelligence, lethal autonomous weapons) ▪ Responsible innovative approaches and scenario planning 8. Practical Frameworks and Case Studies ▪ Examining real-world AI ethics failures and successes ▪ Discussion of codes of conduct and AI charters in leading tech firms ▪ Hands-on projects to identify and remedy ethical issues in AI prototypes 9. Collaborative Policy and Strategy Development ▪ Creating organizational AI ethics committees and action plans ▪ Engaging with diverse stakeholders (communities, NGOs, regulators) ▪ Presentations of policy proposals and AI ethics guidelines for hypothetical or real organizations

Subject area	**IT Projects**	**MIT 5**
Module	**Applied IT Project**	**MIT 5.1**

Responsible person	
Frequency	Once in the academic year
Applicability	MSc. IT
ECTS credits	10
Total Workload (h)	260
Apprenticeship (h)	81
Learning Time (h)	179
Study Semester	1
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Undifferentiated

Learning outcomes and competencies	The Applied IT Project challenges students to work on a medium-scale application or system. Students deepen their understanding of the full development life cycle, enhance their technical proficiency, and learn to apply innovation and user-centricity in more complex environments. Emphasis is also placed on soft skills such as stakeholder management, user interaction, and advanced collaborative practices. Student can ▪ Execute End-to-End Project Development: Manage all phases of a larger project (requirements, design, implementation, testing, deployment). ▪ Integrate Innovation and Technology: Explore and incorporate emerging technologies or innovative features into the project solution. ▪ Apply Advanced Teamwork and Leadership Skills: Coordinate tasks and roles in a more complex team environment, possibly including sub-teams. ▪ Enhance User-Centric Processes: Implement iterative design approaches (user testing, feedback loops) to refine product usability and functionality. ▪ Deploy Intermediate Productization Steps: Prepare a project for potential real-world deployment, incorporating minimal documentation and versioning practices. ▪ Present and Document Thoroughly: Produce comprehensive documentation and deliver professional presentations showcasing technical details and outcomes.

Contents	1. Project Definition and Stakeholder Analysis ▪ Clarifying scope, setting measurable objectives ▪ Identifying key stakeholders and their requirements 2. Refined Development Processes ▪ Employing agile sprints or iterative cycles (Scrum, Kanban) ▪ Continuous integration and testing strategies 3. Technical Implementation ▪ Adopting suitable technology stacks (programming languages, frameworks, databases) ▪ Ensuring scalability and maintainability in design 4. Innovation and Usability ▪ Introducing novel features or using emerging tech (e.g., AI components, cloud-based services) ▪ Conducting user testing sessions, collecting iterative feedback 5. Collaboration and Communication ▪ Coordinating larger teams, including management of sub-teams or specialized roles ▪ Regular stand-ups, sprint reviews, retrospectives 6. Quality Assurance and Testing ▪ More sophisticated testing methods (automated tests, integration testing) ▪ Handling bug reports and code reviews 7. Deployment and Partial Productization ▪ Setting up basic deployment environments (on-premise or cloud) ▪ Documenting setup, usage guides, and known limitations 8. Final Presentation and Evaluation ▪ Structured demonstration of the working product ▪ Written report detailing technical, user, and project management aspects

Subject area	**IT Projects**	**MIT 5**
Module	**Senior IT Project**	**MIT 5.2**

Responsible person	
Frequency	Once in the academic year
Applicability	In this degree program
ECTS credits	15
Total Workload (h)	390
Apprenticeship (h)	117
Learning Time (h)	273
Study Semester	2
Prerequisites	none
Teaching methods	30% - Seminar // 70% - Exercise
Prerequisite for the award of credit points	
Form of examination	Practical (50%), Report, 3 – 5 pages (20-30%), Presentation, min. 15 minutes (20-30%)
Grading Scheme	Differentiated (at least the grade 4.0)

Learning outcomes and competencies	The Senior IT Project represents the peak of the students' project-based learning, demanding a large-scale or complex IT solution that is closer to a market-ready product or a robust internal system. Students are expected to produce their solution to a greater extent, showcasing advanced innovation, technical depth, user-centric validation, and effective project management. Students will be able to ▪ Lead Comprehensive IT Initiatives: Oversee and execute complex projects from concept to near-production readiness, managing extensive resource planning and risk assessment. ▪ Demonstrate High-Level Technical Mastery: Apply and integrate advanced tools, frameworks, or architectures (e.g., microservices, AI/ML, big data pipelines) for complex solutions. ▪ Implement Full Productization Strategies: Develop deployment pipelines, incorporate continuous delivery, and plan for ongoing maintenance or scaling. ▪ Conduct Rigorous Usability and User Testing: Gather and analyze extensive user feedback, refine features based on real-world user scenarios, and demonstrate iterative improvements. ▪ Produce Professional Documentation and Presentations: Deliver comprehensive artifacts (technical specs, user manuals, architecture diagrams) and persuasive final presentations.

	▪ Exhibit Strategic and Innovative Thinking: Align project outcomes with potential business models, market needs, and strategic objectives.
Contents	1. Project Planning and Management ▪ Detailed project charter, Gantt charts or advanced agile planning ▪ Resource allocation, budgeting considerations, and risk analysis 2. Advanced System Architecture ▪ Using cutting-edge frameworks or architectures (cloud-native, microservices, containerization) ▪ High availability, scalability, and security requirements 3. Deep Technical Implementation ▪ Incorporating specialized components (ML models, distributed systems, IoT, AR/VR, etc.) ▪ Performance optimization, load testing, and advanced debugging 4. Extensive User-Centric Validation ▪ Conducting advanced usability tests, A/B testing, or pilot deployments ▪ Continuous user feedback loops and iterative improvements 5. Productization and Deployment ▪ Continuous delivery (CI/CD) pipelines, automated deployment scripts ▪ Documentation for maintainers, potential users, and support staff ▪ Licensing, versioning, and potential integration with third-party services 6. Innovation and Market Readiness ▪ Exploring monetization strategies, market research for product fit ▪ Potential pitch or demo to external parties (industry mentors, sponsors) 7. Team Dynamics and Leadership ▪ Managing a cross-functional team, possibly including design, QA, and deployment roles ▪ Handling conflict resolution, advanced communication strategies 8. Comprehensive Reporting and Presentation ▪ Executive summary, technical documentation, architecture diagrams ▪ Formal presentation to academic and/or industry panels ▪ Reflection on project achievements, challenges, and lessons learned

Subject area	**Master's Qualification**	**MIT 6**
Module	**Thesis and Colloquium**	**MIT 6.1**

Responsible person	
Frequency	Once in this program.
Applicability	Only in this degree
ECTS credits	15
Total Workload (h)	390
Teaching Time (h)	0
Learning Time (h)	390
Study Semester	3
Prerequisites	MIT 1: General Studies MIT 2: Electives MIT 3: Information Technology Fundamentals MIT 4 A IT Specialization: Front-end Development and Usability **or** MIT 4 B IT Specialization: Cyber Security **or** MIT 4 C IT Specialization: Artificial Intelligence and Data Analytics MIT 5 IT Projects
Teaching methods	Blended
Prerequisite for the award of credit points	
Form of examination	Thesis and Colloquium: Written (Master Thesis), Oral (colloquium, 60 minutes)
Grading Scheme	Differentiated (at least the grade 4.0)

Learning outcomes and competencies	Through this module, students conduct an independent research project on a topic relevant to their chosen specialization, applying rigorous research methods and critical analysis to produce a scholarly thesis. The module concludes with a colloquium, where students present and defend their research approach, findings, and contributions before an academic panel and peers. Students will be able to ▪ Formulate a Research Problem: Identify and articulate a specific, feasible research question or problem within their specialization domain. ▪ Conduct a Comprehensive Literature Review: Systematically review and synthesize existing academic and industry literature, establishing a solid theoretical foundation and identifying research gaps. ▪ Design and Implement a Research Methodology: Select and apply appropriate qualitative or quantitative methods, ensuring methodological rigor and ethical compliance.

	▪ Analyze and Interpret Findings: Collect and analyze data using relevant analytical tools or frameworks, deriving meaningful insights and conclusions. ▪ Produce a Scholarly Thesis: Demonstrate advanced academic writing skills, structuring the thesis according to established academic standards and including robust discussion of limitations and future work. ▪ Present and Defend Research: Deliver a clear and concise oral presentation of the research approach, findings, and significance, fielding questions effectively during the colloquium. ▪ Reflect on Ethical and Societal Implications: Critically assess the broader impact of their research, including any ethical, legal, or social considerations.
Contents	1. Thesis Topic and Proposal Development ▪ Selecting a pertinent research topic aligned with the student's specialization. ▪ Conducting initial scoping and feasibility assessments. ▪ Drafting a thesis proposal (problem statement, objectives, methodology). 2. Literature Review and Theoretical Framework ▪ Systematic search and selection of scholarly articles, industry reports, and relevant case studies. ▪ Establishing theoretical underpinnings and identifying key research gaps or controversies. ▪ Referencing and citation best practices (APA, IEEE, or institutional guidelines). 3. Research Methodology and Ethical Considerations ▪ Designing a data collection strategy (surveys, interviews, experiments, etc.) or system implementation approach. ▪ Ensuring compliance with ethical standards (informed consent, data privacy) and university guidelines. ▪ Addressing potential biases, limitations, and risk management. 4. Data Collection and Analysis ▪ Gathering qualitative or quantitative data using the chosen research design. ▪ Employing appropriate statistical tests, coding procedures, or algorithmic analysis tools. ▪ Validating results through reliability checks, triangulation, or peer review. 5. Discussion of Findings and Implications ▪ Interpreting results in the context of existing literature and theoretical frameworks. ▪ Identifying practical applications, implications for the field, and directions for future research. ▪ Highlighting project limitations and lessons learned. 6. Thesis Writing and Review Process ▪ Structuring chapters (introduction, literature review, methodology, results, discussion, conclusion). ▪ Drafting and revising under supervisor feedback. ▪ Formatting, proofreading, and preparing for final submission. 7. Colloquium Preparation ▪ Organizing research content into a coherent presentation.

	▪ Practicing presentation skills, addressing potential questions, and refining visual aids (slides, demos). ▪ Engaging with feedback from peers, supervisors, or preliminary mock presentations. 8. Thesis Défense and Colloquium ▪ Delivering a formal oral defense to an examination panel, demonstrating clarity and depth of understanding. ▪ Answering questions regarding methodology, theoretical basis, and practical relevance. ▪ Reflecting on the research journey and receiving final evaluation/feedback.