



Bachelor of Science in Information Technology

Module Handbook

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Qualification Objectives

Graduates of the Bachelor of Applied Science in Information Technology develop a systemic and coherent understanding of the field. Through their chosen specialization in Web Applications and Software Development, Network Engineering and Cyber Security, or Artificial Intelligence and Data Analytics, they acquire scientific knowledge and skills that can be immediately applied in professional settings.

Core Knowledge and Skills

Upon successful completion of the program, graduates will be able to:

- **Apply Critical Thinking and Make Informed Decisions:** Evaluate data, test hypotheses, and communicate solutions effectively to address diverse IT challenges.
- **Select, Adapt, and Integrate IT Solutions:** Configure and implement appropriate infrastructures, architectures, and development processes to meet organizational needs.
- **Manage Projects and Adapt to Constraints:** Oversee requirements analysis, design, development, implementation, and quality assurance while operating within organizational or external limitations.
- **Uphold Ethical and Professional Standards:** Incorporate ethical, legal, and social considerations into practice, demonstrating integrity and responsibility.
- **Collaborate and Lead Effectively:** Work constructively in teams or independently, providing leadership when needed to deliver solutions aligned with business or market objectives.
- **Offer Holistic, Interdisciplinary Solutions:** Address both technical and non-technical challenges through comprehensive, methodical problem-solving approaches.
- **Employ Scientific Methods and Design Thinking:** Use research-informed strategies and creative methodologies to foster innovation and develop client-focused solutions.
- **Pursue Lifelong Learning:** Continue professional development and academic growth beyond the bachelor's degree.
- **Apply Specialized Knowledge Across Technical Contexts:** Identify, analyse, and implement solutions using specialized expertise in areas such as security, systems deployment, and maintenance.
- **Lead Organizational Change:** Plan, coordinate, and execute effective change management procedures within a chosen specialization, ensuring adaptability and ongoing improvement.

Specialized Knowledge and Skills

Students can choose one of the three specializations: Web Applications and Software Development, Network Engineering and Cyber Security, or Artificial Intelligence and Data Analytics.

A: Web Applications and Software Development

Graduates specializing in **Web Applications and Software Development** will be able to:

- **Design, Develop, and Sustain Robust Software Solutions:** Architect, implement, and maintain high-quality software, web platforms, and mobile solutions by integrating best practices in software engineering, user experience, and performance optimization.
- **Critically Evaluate and Integrate Advanced Technologies:** Analyze, select, and implement modern tools, frameworks, and methodologies to deliver secure, scalable, and innovative software solutions in rapidly evolving technological environments.

B: Network Engineering and Cyber Security

Graduates specializing in **Network Engineering and Cyber Security** will be able to:

- **Diagnose and Resolve Complex Network Issues:** Troubleshoot and optimize local and wide-area enterprise networks, addressing advanced security, voice, wireless, and video solutions to ensure high performance and reliability.
- **Design, Implement, and Manage Scalable Network Infrastructures:** Plan, configure, install, and verify enterprise switched and routed networks using current architectures, emphasizing security, scalability, and compliance with industry standards.

C: Artificial Intelligence and Data Analytics

Graduates specializing in **Artificial Intelligence and Data Analytics** will be able to:

- **Master Advanced Analytics and AI Tools:** Demonstrate proficiency in data manipulation, visualization, and large-scale data processing using Python, R, Hadoop, Spark, and machine learning techniques to generate actionable insights.
- **Apply Ethical and Responsible Data Practices:** Communicate complex findings through clear visualizations while maintaining stringent data privacy, security, and ethical standards, remaining mindful of the broader social implications of data-driven decisions.

Concept of the degree program

The degree program comprises 7 semesters (standard period of study). The number of credit points required to obtain the bachelor's degree is 210 ECTS credits. One semester comprises a workload of 30 ECTS credit points.

The following subject areas are included in the degree program:

1. Academic Methods and Competencies (15 ECTS credit points)
2. Information Technology Fundamentals (20 ECTS credit points)
3. Common Core Modules (20 ECTS credit points)
4. Information Technology Specializations (55 ECTS credit points each)
 - A. Web Applications and Software Development
 - B. Network Engineering and Cyber Security
 - C. Artificial Intelligence and Data Analytics
5. Elective Modules (10 ECTS credit points)
6. Information Technology Projects (50 ECTS credit points)
7. Information Technology Internship (30 ECTS credit points).
8. Bachelor's Degree Thesis and Colloquium (10 ECTS credit points)

The aim of the Bachelor of Applied Science in Information Technology (B.Sc. in IT) is to prepare industry ready graduates who are specialists in their chosen field of Network Engineering and Cyber Security or Web Applications and Software Development or Artificial Intelligence and Data Analytics. They will bring advanced skills and specialist knowledge to industry and will be solution focused.

This degree provides students with a recognized applied science qualification in their chosen area of information technology specialization. The modules balance practical skills with academic knowledge and work-related competencies. Graduates will be technically knowledgeable, employable and skilled for IT-related positions in their chosen field or prepared for further study at postgraduate level. They will be able to contribute to their profession and society in an ethical manner.

The Core Common Modules—comprising Database Systems, Data Structures and Algorithms, Data and Cyber Security, and Cloud Computing—are designed to equip students with the essential concepts, methodologies, and skills required by every Information Technology professional. These modules build upon the foundational knowledge acquired in the IT Fundamentals modules, providing a deeper understanding of critical IT domains. By focusing on practical applications and theoretical frameworks, they lay the groundwork for advanced learning in the

specialization modules, enabling students to tackle complex challenges in their chosen fields with confidence and expertise.

The Elective Modules enable students to broaden their horizons by exploring topics beyond their primary specialization. These modules foster interdisciplinary insights, enhance adaptability, and provide students with the flexibility to tailor their education to personal interests and career goals, preparing them for the dynamic demands of the IT industry.

The B.Sc. in IT is an applied program that guides students through an authentic and practice-based experience that will best prepare them for their future career.

The specializations in this degree are the first step on the students' journey of building much needed qualifications in response to their own areas of interest and the employment opportunities in the IT sector.

The IT Project modules are contextualized to the industry and are designed to enable the student to apply these concepts, methods and practices in a real context. Projects are conducted in each semester (except the first one) and build on skills, knowledge and competencies as students' progress through the course on their specialization.

The purpose of this internship module in the 210 ECTS credits program is to provide students with an opportunity to gain practical, hands-on experience in a professional environment related to their field of study. By working on real-world projects and collaborating with industry professionals, students will bridge the gap between theoretical knowledge and practical application. This internship enables students to develop industry-relevant skills, enhance their employability, and gain insights into the professional standards and expectations of the IT sector.

The bachelor's thesis and colloquium demonstrate the student's acquired knowledge in research and related project work at a higher level of complexity. The thesis consists of a written component and presentation, it demonstrates that the students are capable of independent work.

The incorporation of design thinking processes provides students with understanding and insight into the workplace.

The mdh B.Sc. in IT program contributes to industry by providing the foundational learning needed to enter the sector. As a first degree, it is a pathway to higher qualifications and eventually senior roles. This degree plays a pivotal role as it is an introduction to foundational skills, knowledge and attributes. It is intended to serve the IT sector's needs by filling identified job shortages.

Design Thinking and Information Technology

A unique feature of this degree is the emphasis on Design Thinking. Design Thinking is a non-linear, iterative process which seeks to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. The method tackles problems that are ill-defined or unknown, and consists of 5 phases:

- Empathize
- Define
- Ideate
- Prototype
- Test

Activities in the IT industry require an understanding of what the user will want or need, adopting context analysis which informs solutions that are responsive to users or customers of an organization or entity. Design thinking is central to design methodologies used in IT, such as user centred design and human centred design and can play a significant role in software development.

Adopting Design Thinking as a process in the B.Sc. in IT means that students actively engage with:

- Problem solving
- Ideation
- Framing
- Reasoning

- Solution generation
- Modelling

Practicing these skills with peers and later in the context of the IT Project empowers students to develop many of the soft skills needed in their discipline and industry.

Opportunities to develop these capabilities are threaded through the courses in this program, including the assessment activities, and form the basis of an experience that prepares graduates for the workplace.

Developing these attributes and using design processes with students' supports their ability to:

- Articulate user needs
- Work in a team
- Initiate creative and innovative discussion
- Interpret user expectations
- Address 'sticky' or 'wicked' problems

The B.Sc. in IT is an applied program that guides the student through an authentic and practice-based experience that will best prepare them for their future career.

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.

Semester Course Structure

1 st Semester	Academic Methods and Competencies (10 ECTS) Information Technology Fundamentals (20 ECTS)		
Choose 1:	Specialization Web Applications and Software Development	Specialization Network Engineering and Cyber Security	Specialization Artificial Intelligence and Data Analytics
2 nd Semester	Specialization (15 ECTS) Information Technology Projects (10 ECTS) Common Core Modules (5 ECTS)		
3 rd Semester	Specialization (10 ECTS) Information Technology Projects (10 ECTS) Common Core Modules (10 ECTS)		
4 th Semester	Specialization (10 ECTS) Information Technology Projects (10 ECTS) Common Core Modules (5 ECTS) Elective Modules (5 ECTS)		
5 th Semester	Specialization (10 ECTS) Information Technology Projects (10 ECTS) Academic Methods and Competencies (5 ECTS) Elective Modules (5 ECTS)		
6 th Semester	Specialization (10 ECTS) Information Technology Projects (10 ECTS) Information Technology Internship (10 of 30 ECTS)		
7 th Semester	Information Technology Internship (20 of 30 ECTS) Bachelor's Thesis and Colloquium (10 ECTS)		

Semester Module Contents

SEMESTER 1: In the first semester, all students focus on foundational academic and fundamental and common information technology knowledge, skills and competencies.

1. Academic Methods and Competencies

- Scientific Work

Introduces scientific methods in practice and how to implement innovative developments in everyday professional life, to make rationally reasoned decisions and critically examine problems and potential solutions.

- Applied Research

Enables students to evaluate the values, potentials and risks of new technologies, recognize and assess the ethical, ideological, social and moral consequences of their decisions, find holistically and methodically efficient solutions, also applying these principles to interdisciplinary issues.

2. Information Technology Fundamentals

- Technical Support Fundamentals

Provides skills required to identify, resolve, and support technical support technology issues within an organization and communicate professionally with technical and non-technical clients.

- Web Concepts

Introduces students to the fundamentals of web technology and interactive media for web design, with a focus on industry requirements.

- Information Systems

Introduces the fundamental concepts of information systems, including business concepts, development of life cycles, data modelling and supporting organizational processes and systems. It also includes decision making and relevant professional communication skills.

- Software Development Fundamentals

Introduces fundamental components of software development and programming.

SEMESTER 2:

4. Information Technology Specialization (A or B or C)

At the beginning of the second semester students begin their specialization modules and do the first of their IT Projects. This pattern of modules will continue throughout semesters three, four, and five and finalize in semester six.

4.A Web Applications and Software Development

- Back-End Development

The purpose of this module is to provide students with a deep understanding of back-end development, focusing on server-side programming, database integration, and API design. Students will learn how to build scalable, secure, and maintainable back-end systems that support modern web applications. Through practical exercises, they will gain experience in implementing back-end solutions that integrate seamlessly with front-end interfaces and external systems.

- Front-End Development

The purpose of this module is to equip students with the skills and knowledge required to design and develop interactive, user-friendly, and responsive front-end interfaces for modern web applications. Emphasis is placed on mastering modern front-end frameworks. Through hands-on projects, students will learn to create visually appealing and functional user interfaces that enhance the user experience.

- Agile Project Management

The purpose of this module is to introduce students to the principles and practices of Agile project management. Students will gain hands-on experience with Agile methodologies, tools, and techniques for managing IT and software development projects. This module emphasizes adaptability, collaboration, and iterative progress to successfully deliver high-quality products in dynamic and complex environments.

OR

4.B Network Engineering and Cyber Security

- Computer Servicing Skills

The purpose of this module is to provide students with practical knowledge and hands-on experience in computer hardware and software servicing. Students will learn how to assemble, maintain, and troubleshoot personal computers and related devices. This foundational module equips students with the essential skills required for diagnosing and repairing common hardware and software issues, which are critical for network engineering and cybersecurity roles.

- Operating Systems

Provides experience in working with operating systems, maintenance procedures and client-side virtualization.

- Networking

Introduces students to the fundamental networking concepts, technologies and skills needed to implement and maintain a simple network in a secure manner.

OR

4.C Artificial Intelligence and Data Analytics

- Fundamentals of AI and Data Analytics

Introduces students to the fundamental principles, concepts, and techniques of Artificial Intelligence (AI) and Data Analytics (DA). This module provides a foundational understanding of how AI systems work and how data analytics is applied to derive meaningful insights. Through theoretical knowledge and practical exercises, students will learn the basics of AI and DA, which will serve as a cornerstone for advanced modules in this specialization.

- Programming for Data Analytics

The purpose of this module is to equip students with programming skills specific to data analytics tasks. Students will learn to use Python, one of the most widely used programming languages for data analytics, to manipulate, analyze, and visualize data. This module provides hands-on experience in working with real-world datasets and lays a strong foundation for advanced topics in machine learning and data-driven decision-making.

- Data Mining

Introduces students to the concepts, techniques, and tools of data mining, which involve extracting meaningful patterns and knowledge from large datasets. Students will learn various data mining methods, including classification, clustering, and association analysis, and gain hands-on experience applying these techniques to solve real-world problems in business, healthcare, finance, and other domains.

AND

3. Common Core Modules

- Database Systems

Introduce and apply fundamental components of software development and programming, including logic and the process of creating program design and resolved solutions.

6. Information Technology Project

- IT Project I

Prepares the students for team cooperation and individual contributions in information technology settings. Students choose an area of interest in IT to apply and deepen the knowledge acquired from the respective assigned courses.

SEMESTER 3:

4. Information Technology Specialization (A or B or C)

4.A Web Applications and Software Development

- Mobile Development

Allows students to develop cross platform mobile apps using appropriate software architectural patterns, including relevant language and/or frameworks.

- Web Services

Allows students to select and apply appropriate software architectures, tools and technologies for a software solution. It provides knowledge and understanding to implement web services and microservices

OR

4.B Network Engineering and Cyber Security

- Network Security

Provides students with knowledge and skills to secure local area networks (LANs).

- Network Management

Provides students with specialized knowledge of device security, network management, and network planning to be able to manage and protect small and medium sized networks.

OR

4.C Artificial Intelligence and Data Analytics

- Data Acquisition and Visualization

The purpose of this module is to equip students with the skills and knowledge necessary to collect, process, and visualize data from various sources. Students will learn techniques for data acquisition, including APIs, web scraping, and database querying, and develop skills in creating meaningful and impactful visualizations to communicate insights effectively. This module bridges the gap between raw data and decision-making, enabling students to present data in a clear and engaging manner.

- Machine Learning

Provides students with a comprehensive introduction to machine learning (ML), focusing on its principles, algorithms, and practical applications. Students will learn how to build predictive models, evaluate their performance, and apply them to solve real-world problems in domains such as finance, healthcare, and marketing. This module emphasizes both theoretical understanding and hands-on implementation of ML techniques using popular tools and frameworks.

AND

3. Common Core Modules

- Data Structures and Algorithms

Equips students with a solid understanding of fundamental data structures and algorithms, focusing on their implementation, application, and optimization. This practical-oriented module emphasizes problem-

solving skills and efficient programming techniques. Students will learn to select appropriate data structures and algorithms to solve computational problems effectively and efficiently.

- Data and Cyber Security

The purpose of this module is to introduce students to the fundamental principles of data and cybersecurity. The module provides a practical understanding of how to protect digital assets, secure systems, and mitigate cybersecurity risks. Students will explore common security threats, cryptographic techniques, and best practices to design and maintain secure systems.

6. Information Technology Projects

- IT Project II

Students will experience professional and interdisciplinary cooperation within the field of information technology. Expectations regarding the complexity of the project are increasing. The focus is on further expanding and deepening practical skills and knowledge in their chosen area of specialization. They will know and understand interdisciplinary relationships in the context of the specific project.

SEMESTER 4:

4. Information Technology Specialization (A or B or C)

4.A Web Applications and Software Development

- Advanced Mobile Development

Allows students to explore advanced concepts in the design and development of mobile applications using appropriate software and architectural patterns.

- Software Testing and Maintenance

Allows students to develop skills in various testing techniques, defect tracking, version control procedures, and other software maintenance techniques.

OR

4.B Network Engineering and Cyber Security

- Wireless Networking

Provides students with specialized knowledge and application of wireless networking.

- Unified Communications

Provides students with specialized knowledge and application of unified communications and network convergence.

OR

4.C Artificial Intelligence and Data Analytics

- Data Ethics and Law

Provides students with a comprehensive understanding of the ethical, legal, and societal implications of working with data and deploying AI and data analytics solutions. Students will explore principles of ethical decision-making, data privacy regulations, and the responsibilities of AI practitioners. By analyzing real-world cases and frameworks, students will develop the skills to navigate the ethical and legal challenges associated with data-driven technologies.

- Big Data Analytics

Provides students with the knowledge and skills to process, analyze, and derive insights from large-scale datasets. Students will learn the principles, tools, and frameworks essential for working with big data systems. This module emphasizes the practical application of big data analytics techniques in real-world

scenarios, enabling students to address complex problems across various domains using scalable solutions.

AND

3. Common Core Modules

- Cloud Computing

Provides students with comprehensive knowledge and practical skills in cloud computing concepts, architecture, and services. The module emphasizes the design, deployment, and management of scalable, reliable, and secure cloud-based systems. Students will gain hands-on experience with leading cloud platforms and learn how to leverage cloud technologies to solve real-world business and IT challenges.

5. Elective Modules

- Elective I

Enables students to broaden their horizons by exploring topics beyond their primary specialization.

6. Information Technology Projects

- IT Project III

This module aims at professional standards in the planning, preparation and execution of an IT project. The focus is on aligning practical knowledge in the areas of design, art and programming with the requirements for later career entry.

The students will know and understand interdisciplinary relationships in the context of the specific project and are able to compare their own specialist knowledge and procedures with the requirements for career starters and thus identify personal growth areas.

SEMESTER 5:

4. Information Technology Specialization (A or B or C)

4.A Web Applications and Software Development

- Advanced Programming

Enables the student to design and develop efficient applications that are derived from advanced programming techniques to meet real world business requirements.

- Interaction Design

Enables the student to critically examine the techniques, tools and skills required to design and develop a product prototype while recognizing the theory underlying interaction design and products.

OR

4.B Network Engineering and Cyber Security

IP Switched Networks

Students will gain specialized knowledge in planning, configuring, and verifying the implementation of complex enterprise switching solutions. This course will enable them to configure, optimize and secure a switched infrastructure.

- IP Routing

Students will gain specialized knowledge using advanced IP addressing and routing in implementing scalable and highly secure routers that are connected to LANs, WANs, and IPv6. This course will enable them to select, optimize, configure and implement the correct routing and redistribution solutions when needed.

OR

4.C Artificial Intelligence and Data Analytics

- Data Warehousing

The purpose of this module is to introduce students to the concepts, design, and implementation of data warehousing systems. Students will learn how data warehouses are used to store, organize, and manage large volumes of historical and transactional data for analysis and decision-making. The module emphasizes data modeling, Extract-Transform-Load (ETL) processes, and the use of data warehouses in business intelligence applications.

- Computational Intelligence

Introduces students to the principles, techniques, and applications of Computational Intelligence (CI), focusing on algorithms inspired by natural and biological systems. Students will explore methods such as neural networks, evolutionary algorithms, and fuzzy logic, and their applications in solving complex optimization and decision-making problems. The module emphasizes both theoretical foundations and practical implementation of CI techniques.

AND

1. Academic Methods and Competencies

- Bachelor Thesis Set Up

Prepares senior students for their bachelor thesis, which they will undertake in the following semester. The module focuses on equipping students with the necessary research skills, academic writing techniques, and project management strategies to develop a clear and feasible thesis proposal. By the end of the module, students will have a well-defined research question, methodology, and structured plan for their bachelor thesis, and they will be able to present it.

5. Elective Modules

- Elective II

Enables students to broaden their horizons by exploring topics beyond their primary specialization.

6. Information Technology Project

- IT Project IV

This project enables students to demonstrate the expertise acquired during the course in their chosen area of specialization in information technology. Working with a portfolio project that students can use to recommend themselves after graduation.

SEMESTER 6:

4. Information Technology Specialization (A or B or C)

4.A Web Applications and Software Development

- Web Technologies

Enables the student to design, develop and evaluate contemporary data-driven web applications, select web architecture, scripting languages, database interaction and information security.

OR

4.B Network Engineering and Cyber Security

- Troubleshooting IP Networks

Students will gain specialized knowledge in planning and performing regular maintenance on complex enterprise routed and switched networks. This course will enable them to use technology-based practices, implement a systematic ITIL-compliant approach to perform network troubleshooting and to be able to

describe, identify and resolve issues in complex enterprise networks.

OR

4.C Artificial Intelligence and Data Analytics

- Advanced AI and Data Analytics

Provides students with an advanced understanding of Artificial Intelligence (AI) and Data Analytics (DA), consolidating their knowledge and skills acquired throughout the specialization. As the capstone module with, it bridges any remaining gaps in concepts, techniques, and methods, while emphasizing emerging trends and cutting-edge advancements in the field. This module prepares students to address complex, real-world challenges using innovative AI and DA approaches and equips them with the expertise to stay at the forefront of this rapidly evolving domain.

AND

6. Information Technology Projects

- IT Project

This project will enable students to explicitly apply the design thinking principles by evaluating, designing, and developing a solution to an industry-based IT project within their specialist field, utilizing advanced information technology principles and techniques. They will manage a project and the associated risks from inception to implementation, appraise, justify and mitigate decision making.

7. Information Technology Internship

- IT Internship*

The purpose of this internship module is to provide students with an opportunity to gain practical, hands-on experience in a professional environment related to their field of study. By working on real-world projects and collaborating with industry professionals, students will bridge the gap between theoretical knowledge and practical application. This internship enables students to develop industry-relevant skills, enhance their employability, and gain insights into the professional standards and expectations of the IT sector.

* 10 of 30 ECTS credit points in this semester.

SEMESTER 7:

8. Bachelors´ Qualification (Bachelor of Science in Information Technology)

- Bachelor's Thesis and Colloquium

The bachelor's thesis usually consists of two components. In the written, theoretical part, a self-selected problem is analyzed, the focus of the problem is narrowed down, and possible proposed solutions are prepared in a well-founded manner. This part is more scientifically exploratory oriented and shows the ability of the students as future Information Technology specialists to work in a problem-oriented and innovative way. The practical part shows the proposed solution that has been developed as being the most suitable for the problem focus. The written component explores current research, describes the relevant findings and demonstrates well-founded conclusions. In the colloquium, which follows the thesis, the students present and defend their bachelor's thesis. In exceptional cases, it is possible to write a purely written thesis. The decision on this is made by the examination board as part of the selection of topics.

AND

7. Information Technology Internship

- IT Internship*

*20 of 30 ECTS credit points this semester.

Examination concept in the Information Technology B.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 meta-cognitive skills and supports self-regulated learning, as students become more aware of their strengths, weaknesses, and learning processes.
- **Alignment with 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 and power imbalance:** 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:

Examination part 1	Examination part 2	Examination part 3	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.
Paper, case study, report	Presentation		After extensive research, a written essay, etc., is developed on a topic, demonstrating the ability to engage in discussion, research sources,

Examination part 1	Examination part 2	Examination part 3	Didactic purpose
			evaluate, and abstract themes related to a topic and its discourse in the professional world and society. In 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, with increasing requirements from the second semester	Documentation	Presentation	In a project assignment, students demonstrate their ability to plan and develop an appropriate task solution and critically reflect on it. The project assignment 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 assessment. In the presentation, students demonstrate their ability to illustrate their work results to a non-involved audience and address critical questions.
Project work, with increasing requirements from the second semester	Technical documentation or report or documentation		<p>In a project, students demonstrate their ability to plan and create an appropriate task solution and critically reflect on it. The project also includes the development of program code, technical solutions (depending on the specialization), and an appropriate number of iterations. In the technical documentation, students abstract the essential components of their project work.</p> <p>The report demonstrates the ability to track one's own procedures in written form and to document criteria for correcting one's own work.</p> <p>The documentation should show that you are able to write down your own procedure in an abstract and structured manner to prepare it for further project steps or later processing.</p>

Examination part 1	Examination part 2	Examination part 3	Didactic purpose
Project work, with increasing requirements from the second semester	Presentation		<p>In a project, students demonstrate their ability to plan and develop a task-appropriate solution and critically reflect on it. The project also includes the development of program code, technical solutions (depending on the specialization), and an appropriate number of iterations.</p> <p>The presentation demonstrates how students design and reflect on their approach to a project task until the final version. They demonstrate appropriate communication skills in presenting the project results and can answer questions thoughtfully.</p>
Practical exam	Documentation		<p>Test: a technical solution must be found within a given time, or the practical task must be solved.</p> <p>The procedure is documented in writing.</p>
Practical exam	Written exam		<p>Examination, within a given time, one or more technical solutions must be found, or the practical tasks must be solved.</p> <p>A supplementary written examination to assess the level of knowledge.</p>

Subject areas and Modules

1 ECTS = 26 h = 34,66 teaching units (1 teaching unit corresponds to 45 minutes)

Subject area	Academic Methods and Competencies	BIT 1
Module	Scientific Work	BIT 1.1

Responsible	Prof. Dr. Michael Bhattu	
Frequency	Once in the academic year	
Applicability	In all bachelor's degree programs of the mdh.	
ECTS credits	5	
Total Workload (h)	130	
Teaching time (h)	36	
Learning Time (h)	94	
Study Semester	1	
Requirements	None	
Forms of teaching and learning	50% - Seminar // 50% - Exercise // Blended	
Prerequisite for the award of credit points		
Form of examination	Written (academic paper 10 - 15 pages, 100% weighting)	
Grading Scheme	Differentiated (at least the grade 4,0)	

Learning outcomes and competencies	<p>Students will be able to</p> <ul style="list-style-type: none"> • find, justify and formulate a topic for a scientific paper • carry out necessary research work in scientific databases and on-line library catalogues (WISO, Springer, Emerald, etc.) and formulate optimal queries in search engines (e.g. google/scholar and google /books) • confidently use of scientific literature (papers, journal articles, dissertations, etc.) and scientific methods (interviews, observations, content analysis, etc.) • construct a scientific paper logically and write it according to the basic rules of argumentation and formulation • plan the time for writing a scientific paper and to work efficiently and effectively in terms of this time management • demonstrate the importance of plagiarism when writing an academic paper and know the consequences of not citing it correctly.
Contents	1. Introduction to the world of scientific work (research question, planning)

	<ol style="list-style-type: none">2. Form and formatting (formal structure, instructions for formatting in Word)3. Process of scientific work and research (hypotheses, argumentation, sources)4. Flawless citation (citation, bibliography)5. Methodology, aims and benefits of empirical communication research, research process and research organization6. Qualitative and quantitative research (research questions, hypothesis formation and implementation)7. Survey; content analysis; observation8. Presentation and visualization of research results9. Presentations and lectures
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Subject area	Academic Methods and Competencies	BIT 1
Module	Applied Research	BIT 1.2

Responsible person	Prof. Dr. J. Martin	
Frequency	Once in the academic year	
Applicability	Only in this degree program	
ECTS credits	5	
Total Workload (h)	130	
Teaching time (h)	45	
Learning time (h)	85	
Study Semester	1	
Requirements	none	
Forms of teaching and learning	50% - Seminar // 50% - Exercise // Blended	
Prerequisite for the award of credit points		
Form of examination	Written 10 – 15 pages (100% weighting)	
Grading Scheme	Undifferentiated	

Learning outcomes and competencies	<p>Students will be able to</p> <ul style="list-style-type: none"> • evaluate the values, potentials and risks of new technologies for the development of the IT industry, the media landscape and society, to predict the development curve of new technologies in the context of cost-effectiveness, availability, sustainability and acceptance, to analyze the functional and integration conditions of new technologies for pipelines, workflows and automation in game development and to identify competing • categorize, contrast and critique technologies using insights and methods from the history of technology, philosophy of science and philosophy of science. You will be able to design application examples for new technologies and illustrate them with a proof-of-concept in the context of the chosen specialization.
Contents	The contents of the module follow current technological trends, their significance for information technology development and their practical applicability in the context of the specializations.

Subject area	Academic Methods and Competencies	BIT 1
Module	Bachelor Thesis Set Up	BIT 1.3

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	In all bachelor's degree programs of the mdh.
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Requirements	1.1 Scientific work, 1.2 Applied Research
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Written 5 -10 pages (70% weighting), Presentation min. 15 minutes (30% weighting)
Grading Scheme	Undifferentiated

Learning outcomes and competencies	<p>The purpose of this module is to prepare senior students for their bachelor thesis, which they will undertake in the following semester. The module focuses on equipping students with the necessary research skills, academic writing techniques, and project management strategies to develop a clear and feasible thesis proposal. By the end of the module, students will have a well-defined research question, methodology, and structured plan for their bachelor thesis, and they will be able to present it.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Define a research problem relevant to their area of specialization. • Conduct a literature review to contextualize their research within the academic and industry landscape. • Select and justify appropriate methodologies and tools for their research. • Develop a detailed project plan, including objectives, timeline, and milestones. • Present and defend a thesis proposal in a clear, structured, and professional manner. • Understand academic integrity principles and apply proper citation practices in their work.
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	<ul style="list-style-type: none"> • Develop and deliver a professional presentation of the thesis proposal.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Research and Academic Writing <ul style="list-style-type: none"> • Characteristics of academic research and writing. • Principles of formulating research questions and hypotheses. • Importance of aligning research with specialization areas. 2. Literature Review <ul style="list-style-type: none"> • Identifying, analyzing, and synthesizing academic and industry sources. • Techniques for organizing literature to support the research problem. 3. Research Methodology and Tools <ul style="list-style-type: none"> • Overview of qualitative, quantitative, and mixed-method approaches. • Tools for data collection, analysis, and presentation (e.g., software, frameworks). 4. Thesis Planning and Proposal Development <ul style="list-style-type: none"> • Structuring a thesis proposal (introduction, objectives, methodology, timeline). • Creating a realistic project timeline with milestones. 5. Presentation and Feedback <ul style="list-style-type: none"> • Crafting a professional presentation of the thesis proposal. • Receiving and incorporating feedback from peers and instructors. 6. Ethics and Academic Integrity <ul style="list-style-type: none"> • Ethical considerations in research. • Understanding plagiarism and mastering proper citation techniques

Subject area	Information Technology Fundamentals	BIT 2
Module	Technical Support Fundamentals	BIT 2.1

Responsible person	Mohammed AbuJarour
Frequency	Once in the academic year
Usability	Degree programs
ECTS points	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study semester	1
Type	Compulsory
Requirements	None
Teaching methods	Blended
Prerequisite for the award of credit points	
Form of examination	Written Exam, Duration: 90 minutes
Grading scheme	Differentiated (at least the grade 4.0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive overview of the field of Information Technology (IT), its foundational concepts, and its role in modern society. This module introduces key topics such as computer systems, software, networks, and cybersecurity, laying the groundwork for advanced IT topics. Students will gain an understanding of the fundamental principles of IT and its applications across various industries.</p> <p>Students can</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and components of IT, including hardware, software, and networks. • Explain the role and impact of IT in modern society and various industries. • Identify and describe common IT systems and their applications. • Understand the basics of data representation, storage, and processing. • Demonstrate an awareness of cybersecurity principles and ethical considerations in IT. • Apply basic troubleshooting techniques to common IT problems. • Develop a foundation for further studies in IT and related specializations
Contents	1. Introduction to IT and Its Role in Society

	<ul style="list-style-type: none">• Definition and scope of Information Technology.• Historical evolution of IT and its influence on society and industries.• Overview of IT career paths and specializations. <ol style="list-style-type: none">2. Computer Systems and Hardware<ul style="list-style-type: none">• Basic components of a computer: CPU, memory, storage, and peripherals.• Input/output devices and their functions.• Overview of hardware specifications and performance metrics.3. Software and Operating Systems<ul style="list-style-type: none">• Introduction to system software and application software.• Role and functions of operating systems (e.g., Windows, Linux, macOS).• Common Unix Command Lines• Basics of software development and programming.4. Networking and Internet Basics<ul style="list-style-type: none">• Fundamentals of computer networks: LAN, WAN, and the Internet.• Key networking devices and protocols (e.g., routers, switches, TCP/IP).• Introduction to cloud computing and web technologies.5. Data and Databases<ul style="list-style-type: none">• Basics of data representation (binary, hexadecimal).• Overview of data storage and processing.• Introduction to databases and data management concepts.6. Cybersecurity and Ethics<ul style="list-style-type: none">• Basic principles of cybersecurity: confidentiality, integrity, and availability.• Recognizing common security threats (e.g., phishing, malware).• Ethical considerations and legal aspects in IT.7. Troubleshooting and Problem-Solving<ul style="list-style-type: none">• Identifying and resolving common IT issues.• Using diagnostic tools and resources.• Effective communication of technical problems and solutions.8. Practical Sessions and Hands-On Activities<ul style="list-style-type: none">• Hardware Workshop.• Basic software installation and configuration.• Setting up a simple local area network (LAN).9. Future of IT and Emerging Technologies<ul style="list-style-type: none">• Overview of trends like artificial intelligence, IoT, and blockchain.• Understanding the impact of IT innovation on society and industries
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Subject area	Information Technology Fundamentals	BIT 2
Module	Web Concepts	BIT 2.2

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	1
Type	Compulsory
Requirements	None
Teaching methods	Blended
Prerequisite for the award of credit points	
Form of examination	Practical (project: wireframe, prototype, website)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the foundational concepts, technologies, and structures that form the basis of the World Wide Web. This module provides an overview of how the web works, including its protocols, architecture, and tools, while laying the groundwork for advanced topics in web development. Students will gain a fundamental understanding of the web's structure and its applications in modern digital environments.</p> <p>Students can</p> <ul style="list-style-type: none"> • Understand the fundamental architecture and functioning of the World Wide Web. • Explain key web technologies, protocols, and standards. • Describe the role of servers, clients, and web browsers in web communication. • Identify the basic components of web pages and how they are structured. • Understand the importance of web standards, accessibility, and usability. • Apply basic tools and techniques to create and manage simple web pages. • Recognize current trends and emerging technologies in web development.
Contents	1. Introduction to the World Wide Web

	<ul style="list-style-type: none">• Overview of the history and evolution of the web.• Difference between the Internet and the World Wide Web.• Web applications and their role in modern society. <ol style="list-style-type: none">2. Web Architecture and Communication<ul style="list-style-type: none">• Client-server model and the role of web servers and browsers.• HTTP/HTTPS protocols and their functionalities.• Domain Name System (DNS) and how URLs work.3. Web Standards and Accessibility<ul style="list-style-type: none">• Role of organizations like W3C and WHATWG in defining web standards.• Importance of accessibility and usability in web design.• Introduction to Web Content Accessibility Guidelines (WCAG).4. HTML: The Building Block of the Web<ul style="list-style-type: none">• Basic structure of an HTML document.• Common tags and their usage (e.g., headings, paragraphs, links, images).• Creating simple web pages with semantic HTML.5. Introduction to CSS<ul style="list-style-type: none">• Basics of styling web pages using CSS.• Inline, internal, and external style sheets.• Applying simple styles to enhance web page presentation.6. Introduction to JavaScript<ul style="list-style-type: none">• Overview of JavaScript as a scripting language for the web.• Basic concepts like variables, functions, and events.• Adding interactivity to web pages using simple JavaScript examples.7. Web Tools and Resources<ul style="list-style-type: none">• Introduction to text editors and integrated development environments (IDEs).• Inspecting web pages using browser developer tools.• Using online resources and libraries to enhance learning.8. Web Development Processes<ul style="list-style-type: none">• Overview of prototyping techniques (static and dynamic) and tools (Miro, Figma, etc.).• Understanding the role of Content Management Systems, e.g., WordPress and use it in practical projects.• Exploring career paths in web development.
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Subject area	Information Technology Fundamentals	BIT 2
Module	Information Systems	BIT 2.3

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	1
Type	Compulsory
Requirements	None
Teaching methods	Blended
Prerequisite for the award of credit points	
Form of examination	Practical IS implementation (50%) Documentation, 5 pages (25%) Presentation, min. 15 minutes (25%)
Grading scheme	Differentiated (at least grade 4,0)

Purpose	To introduce and apply the fundamentals of information systems to organizational processes and systems, including decision making and relevant professional communication skills.
Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the fundamental concepts, components, and roles of Information Systems (IS) in organizations and society. Students will explore how IS integrates technology, people, and processes to support decision-making, improve efficiency, and drive innovation.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • understand the core concepts and components of information systems. • identify the different types of information systems and their purposes. • explain the role of information systems in supporting organizational operations, decision-making, and strategy. • understand how data is collected, stored, and processed in information systems.

	<ul style="list-style-type: none"> • analyze the impact of information systems on businesses, society, and ethics. • apply basic tools and techniques for working with data in information systems. • recognize trends and advancements in the field of information systems.
Contents	<ol style="list-style-type: none"> 1. Introduction to Information Systems <ul style="list-style-type: none"> • Definition and scope of information systems. • The role of information systems in organizations and society. • Key components: people, processes, hardware, software, and data. 2. Types of Information Systems <ul style="list-style-type: none"> • Transaction Processing Systems (TPS). • Management Information Systems (MIS). • Decision Support Systems (DSS) and Business Intelligence (BI). • Enterprise Systems (e.g., ERP, CRM, SCM). 3. Data and Information Management <ul style="list-style-type: none"> • Difference between data, information, and knowledge. • Basics of data collection, storage, and retrieval. • Introduction to databases and data management systems. 4. Information Systems in Organizations <ul style="list-style-type: none"> • The role of IS in operational efficiency and competitive advantage. • Supporting decision-making and strategic planning. • Examples of IS applications in different industries. 5. Ethics and Social Implications of IS <ul style="list-style-type: none"> • Privacy, security, and ethical concerns in information systems. • Impact of IS on workforce dynamics and societal change. • Legal and regulatory considerations. 6. Trends and Emerging Technologies in Information Systems <ul style="list-style-type: none"> • Cloud computing, Big Data, and Internet of Things (IoT). • Artificial intelligence and its integration with IS. • Blockchain technology and its applications in IS. 7. Practical Applications <ul style="list-style-type: none"> • Exploring and analyzing case studies of successful IS implementations. • Introduction to basic tools for managing information systems (e.g., Odo). • Group activity: designing a simple information system for a specific business scenario

Subject area	Information Technology Fundamentals	BIT 2
Module	Software Development Fundamentals	BIT 2.4

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	1
Type	Compulsory
Prerequisites	None
Teaching methods	Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 2 – 3 assignments (60%) Written, 60 minutes (40%)
Grading scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the fundamental concepts of programming and software development. This module provides a strong foundation for understanding how software is designed, written, and tested. Students will learn the basics of programming, problem-solving techniques, and industry best practices, preparing them for more advanced modules in software development.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • understand the basic principles of programming and software development. • write and execute simple programs using a modern programming language. • apply fundamental programming constructs, such as variables, loops, and conditionals. • solve basic computational problems using structured programming techniques. • debug and troubleshoot code to identify and fix errors. • follow best practices in code organization, readability, and documentation. • understand the basics of version control systems and collaborative coding tools
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Contents	<ol style="list-style-type: none">1. Introduction to Software Development<ul style="list-style-type: none">• Overview of software development and its role in IT.• Introduction to programming languages and their applications.• Understanding the software development lifecycle (SDLC).2. Programming Basics<ul style="list-style-type: none">• Structure of a program: syntax, statements, and blocks.• Variables, data types, and constants.• Input and output operations.3. Control Structures<ul style="list-style-type: none">• Conditional statements (if, else, switch).• Loops (for, while, do-while).• Introduction to recursion.4. Functions and Modular Programming<ul style="list-style-type: none">• Defining and calling functions.• Function parameters, return values, and scope.• Organizing code into reusable modules.5. Data Structures and Algorithms<ul style="list-style-type: none">• Introduction to arrays and lists.• Basic operations: searching and membership.• Problem-solving with algorithms.6. Error Handling and Debugging<ul style="list-style-type: none">• Understanding syntax and runtime errors.• Debugging tools and techniques.• Writing error-handling code for robust applications.7. Introduction to Software Development Tools<ul style="list-style-type: none">• Setting up a programming environment (e.g., IDEs, text editors).• Introduction to version control systems (e.g., Git).• Collaborative coding tools and practices.8. Hands-On Programming Practice<ul style="list-style-type: none">• Writing simple programs to solve real-world problems.• Exercises in applying loops, conditionals, and functions.9. Foundations for Advanced Programming<ul style="list-style-type: none">• Overview of object-oriented programming concepts and GUI.• Preparing for advanced topics in software development.
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Subject area	Common Core Modules	BIT 3
Module	Database Systems	BIT 3.1

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical project (60% weighting) Written, 60 minutes (40% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>Data is at the core of every modern IT infrastructure. This module provides students with an in-depth understanding of relational databases and their central role in storing and processing information. Students will learn how to structure, efficiently manage, and securely retrieve data.</p> <p>A key focus is database modeling, where students design practical data structures using entity-relationship diagrams. These models are then implemented using SQL, the primary query language for relational databases. Students will master not only basic SQL commands for data entry and querying but also advanced concepts such as joins, groupings, and aggregations, which are essential for analyzing large datasets.</p> <p>In addition to hands-on work with modern database management systems (e.g., MySQL or PostgreSQL), students will explore performance optimization and data security. They will study indexing techniques to improve query efficiency and learn access control measures to protect data from unauthorized access. By the end of the module, students will be able to design, implement, and manage a fully functional database—an essential skill for software developers and IT professionals.</p>
Contents	1. Introduction to Database Systems

	<ul style="list-style-type: none">• Role and importance of databases in IT and business environments.• Overview of database types: relational, NoSQL, and hybrid systems. <p>2. Relational Database Concepts</p> <ul style="list-style-type: none">• Entities, attributes, and relationships.• Database schema design and Entity-Relationship (ER) modeling.• Principles of normalization (1NF, 2NF, 3NF). <p>3. Structured Query Language (SQL)</p> <ul style="list-style-type: none">• Data definition language (DDL) and data manipulation language (DML).• Basic SQL commands: SELECT, INSERT, UPDATE, DELETE.• Advanced queries: JOIN, GROUP BY, HAVING, and subqueries. <p>4. Database Management and Integrity</p> <ul style="list-style-type: none">• Primary keys, foreign keys, and constraints.• Indexing and its impact on database performance.• Ensuring data consistency and integrity. <p>5. Practical Database Implementation</p> <ul style="list-style-type: none">• Hands-on experience with a DBMS (e.g., MySQL, PostgreSQL).• Designing, creating, and managing databases. <p>6. Database Administration and Security</p> <ul style="list-style-type: none">• Securing databases: user roles, permissions, and encryption.• Backup and recovery strategies
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Subject area	Common Core Modules	BIT 3
Module	Data Structures and Algorithms	BIT 3.2

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 1 - 2 assignments (30% weighting) Written, 90 minutes (70% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>Algorithms are the building blocks of computer science, and efficient data structures determine an application's performance. In this module, students develop a deep understanding of algorithmic problem-solving principles and learn how to store and process data effectively.</p> <p>Using real-world applications, students explore fundamental and advanced data structures, ranging from arrays and linked lists to trees, graphs, and hash tables. They analyze various sorting and searching algorithms in terms of runtime complexity and optimize existing solutions for different scenarios. The Big-O notation is introduced as a key tool for assessing algorithmic efficiency.</p> <p>A hands-on approach ensures that students can apply their knowledge directly. They will program algorithms, test their efficiency, and solve algorithmic challenges commonly encountered in technical interviews or programming competitions. These skills are not only crucial in software development but also in fields such as data analysis and artificial intelligence.</p>
Contents	<ol style="list-style-type: none"> Introduction to Data Structures and Algorithms <ul style="list-style-type: none"> Overview of data structures and their importance.

	<ul style="list-style-type: none">• Basics of algorithms and problem-solving strategies.• Analyzing algorithm complexity (Big-O). <ol style="list-style-type: none">2. Linear Data Structures<ul style="list-style-type: none">• Arrays: static and dynamic arrays, applications.• Linked Lists: singly linked lists, doubly linked lists, circular linked lists.• Stacks and Queues: implementation and use cases (e.g., expression evaluation, scheduling).3. Non-Linear Data Structures<ul style="list-style-type: none">• Trees: binary trees, binary search trees, AVL trees, heaps.• Graphs: representation (adjacency list, adjacency matrix), traversal algorithms (BFS, DFS).4. Sorting and Searching Algorithms<ul style="list-style-type: none">• Sorting: bubble sort, insertion sort, selection sort, merge sort, quick sort.• Searching: linear search, binary search, search in trees and graphs.• Comparison of sorting and searching algorithms.5. Hashing and Hash Tables<ul style="list-style-type: none">• Principles of hashing and hash functions.• Handling collisions (chaining, open addressing).• Applications of hash tables.6. Algorithm Design Techniques<ul style="list-style-type: none">• Divide and conquer.• Dynamic programming.• Greedy algorithms.7. Practical Implementation<ul style="list-style-type: none">• Hands-on coding exercises in a chosen programming language (e.g., Python, Java, C++).• Developing small projects to implement data structures and algorithms
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Subject area	Common Core Modules	BIT 3
Module	Data and Cyber Security	BIT 3.3

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Written (report, use case, or case study), 10 – 15 pages (60% weighting) Presentation, 15 – 20 minutes (40% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>In a world where digital attacks are becoming increasingly sophisticated, protecting data and systems is more critical than ever. This module provides students with in-depth knowledge of security concepts and best practices for defending against cyber threats. The module begins by introducing fundamental security principles, particularly the CIA triad: confidentiality, integrity, and availability. Students will examine various threat scenarios, including phishing, ransomware attacks, and social engineering. They will learn how modern encryption technologies are used to secure data and the role of digital signatures and certificates in ensuring safe communication.</p> <p>The course also covers network security, including firewalls, intrusion detection systems (IDS), and virtual private networks (VPNs) as key defense mechanisms against cyberattacks. Students will develop practical security strategies for organizations and analyze real-world cyberattacks to derive best practices for their own security concepts. By the end of the module, they will be able to assess security risks, implement preventive measures, and develop effective incident response strategies</p>
Contents	<ol style="list-style-type: none"> Introduction to Data and Cyber Security <ul style="list-style-type: none"> Importance of cybersecurity in modern IT systems.

	<ul style="list-style-type: none">• Key concepts: confidentiality, integrity, and availability (CIA triad).• Overview of cyber threats and attack vectors. <ol style="list-style-type: none">2. Cryptography and Data Protection<ul style="list-style-type: none">• Basics of encryption and decryption.• Symmetric and asymmetric encryption techniques.• Digital signatures, certificates, and Public Key Infrastructure (PKI).3. Network Security<ul style="list-style-type: none">• Securing networks with firewalls, intrusion detection/prevention systems (IDS/IPS).• Virtual Private Networks (VPNs) and secure communication protocols (e.g., HTTPS, SSL/TLS).• Wireless network security (WPA3, secure Wi-Fi setups).4. System and Application Security<ul style="list-style-type: none">• Hardening operating systems and applications.• Secure coding practices to prevent vulnerabilities like SQL injections, XSS, and CSRF.• Malware types, detection, and prevention.5. Security Threats and Mitigation<ul style="list-style-type: none">• Types of attacks: phishing, DDoS, ransomware, man-in-the-middle.• Social engineering and human factors in cybersecurity.• Security policies and incident response strategies.6. Risk Assessment and Management<ul style="list-style-type: none">• Identifying vulnerabilities and assessing risks.• Implementing risk management frameworks.• Business continuity and disaster recovery planning.7. Practical Implementation<ul style="list-style-type: none">• Configuring firewalls, encryption tools, and antivirus software.• Simulating cyberattacks and defence mechanisms in a controlled environment.• Conducting penetration testing and vulnerability assessments.8. Case Studies and Emerging Trends<ul style="list-style-type: none">• Analyzing real-world cyber incidents and lessons learned.• Exploring emerging threats (e.g., AI-driven attacks, IoT vulnerabilities).• Understanding cybersecurity regulations and compliance standards (e.g., GDPR, ISO 27001)
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Subject area	Common Core Modules	BIT 3
Module	Cloud Computing	BIT 3.4

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical exam, 40 – 60 minutes (40% weighting) Written, 60 minutes (60% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>Cloud technologies have revolutionized the way IT infrastructures are developed and operated. This module provides students with an in-depth understanding of cloud computing concepts and architectures and teaches them how to scale, secure, and manage modern IT systems in the cloud.</p> <p>A key focus is on the three fundamental service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Students will learn how to efficiently utilize and automate cloud resources to deploy applications with high scalability and availability. The module covers both public cloud providers such as AWS, Microsoft Azure, and Google Cloud, as well as hybrid and private cloud solutions.</p> <p>Cloud security is another critical component of this module. Students will explore identity and access management, data encryption, and compliance requirements such as GDPR. Practical exercises include deploying cloud resources, configuring storage systems, and developing serverless applications. Upon completion of the module, students will be able to design cloud architecture, assess security risks, and efficiently manage cloud-based IT infrastructures.</p>
Contents	1. Introduction to Cloud Computing

	<ul style="list-style-type: none">• Overview of cloud computing and its evolution.• Key characteristics and advantages of cloud computing.• Service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid, community). <ol style="list-style-type: none">2. Cloud Architecture and Technologies<ul style="list-style-type: none">• Components of cloud architecture: compute, storage, networking.• Virtualization and containerization concepts (e.g., Docker, Kubernetes).• Elasticity, scalability, and high availability in cloud systems.3. Cloud Platforms and Services<ul style="list-style-type: none">• Overview of leading cloud platforms (e.g., AWS, Microsoft Azure, Google Cloud).• Setting up and managing virtual machines, storage, and databases.• Understanding serverless computing and microservices.4. Cloud Security and Compliance<ul style="list-style-type: none">• Cloud security fundamentals and challenges.• Identity and access management (IAM) in the cloud.• Data encryption, backups, and disaster recovery in cloud environments.• Regulatory and compliance considerations (e.g., GDPR, HIPAA).5. Cost Optimization and Performance Monitoring<ul style="list-style-type: none">• Pricing models and cost management strategies.• Monitoring and optimizing resource utilization in the cloud.• Implementing tools for performance and cost tracking.6. Practical Implementation<ul style="list-style-type: none">• Deploying web applications in the cloud.• Configuring storage solutions and load balancers.• Building and deploying serverless functions.7. Emerging Trends in Cloud Computing<ul style="list-style-type: none">• Edge computing and its integration with the cloud.• Role of artificial intelligence and machine learning in cloud solutions.• Sustainability and green cloud computing practices
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Subject area	Web Applications and Software Development	BIT 4
Module	Back-End Development	BIT 4.1 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.2 Web Concepts, 2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (60%) Written, Technical Documentation 5 – 10 pages (40%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a deep understanding of back-end development, focusing on server-side programming, database integration, and API design. Students will learn how to build scalable, secure, and maintainable back-end systems that support modern web applications. Through practical exercises, they will gain experience in implementing back-end solutions that integrate seamlessly with front-end interfaces and external systems.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles of back-end development and the role of the back end in web applications. • Design and develop server-side applications using modern programming languages and frameworks. • Integrate databases into back-end systems and manage data efficiently. • Build and deploy RESTful APIs for communication between systems and applications. • Implement authentication and authorization mechanisms for secure data access. • Optimize back-end systems for performance, scalability, and reliability.
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Contents	<ol style="list-style-type: none">1. Introduction to Back-End Development<ul style="list-style-type: none">• Role of the back end in the web development stack.• Overview of server-side programming languages and frameworks (e.g., Node.js, Python, Java).2. Server-Side Programming<ul style="list-style-type: none">• Writing and running server-side scripts.• Understanding server-side frameworks and their architectures.• Handling HTTP requests and responses.3. Database Integration<ul style="list-style-type: none">• Connecting back-end systems to relational (e.g., MySQL, PostgreSQL) and non-relational (e.g., MongoDB) databases.• Writing database queries and using Object-Relational Mapping (ORM) tools.• Implementing CRUD operations and ensuring data consistency.4. API Design and Development<ul style="list-style-type: none">• Building RESTful APIs for client-server communication.• Working with JSON and XML for data exchange.• Versioning and documentation of APIs.5. Authentication and Security<ul style="list-style-type: none">• Implementing user authentication and session management.• Understanding OAuth, JWT, and other token-based security mechanisms.• Protecting applications against common threats (e.g., SQL injection, cross-site scripting).6. Performance Optimization and Deployment<ul style="list-style-type: none">• Techniques for optimizing server performance (e.g., caching, load balancing).• Deploying back-end applications to production environments.• Monitoring and logging for maintaining application health.7. Practical Implementation<ul style="list-style-type: none">• Hands-on development of a back-end application using a chosen technology stack.• Integrating the back end with a front-end or third-party service.• Debugging and testing to ensure reliability and security
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Subject area	Web Applications and Software Development	BIT 4
Module	Front-End Development	BIT 4.2 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.2 Web Concepts, 2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (60%) Written, Technical Documentation 5 – 10 pages (40%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to equip students with the skills and knowledge required to design and develop interactive, user-friendly, and responsive front-end interfaces for modern web applications. Emphasis is placed on mastering modern front-end frameworks. Through hands-on projects, students will learn to create visually appealing and functional user interfaces that enhance the user experience.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles of front-end development and its role in web applications. • Build responsive web pages using HTML, CSS, and JavaScript. • Apply modern front-end frameworks and libraries (e.g., React, Angular, or Vue.js) to develop dynamic user interfaces. • Implement accessibility best practices to ensure web applications are usable by a diverse audience. • Optimize front-end performance for faster load times and improved user experience. • Debug and troubleshoot front-end code to ensure proper functionality and compatibility across devices and browsers.
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Contents	<ol style="list-style-type: none">1. Introduction to Front-End Development<ul style="list-style-type: none">• Overview of front-end development and its importance in web applications.• Introduction to the development environment and tools (e.g., code editors, browser developer tools).• Review of HTML5, CSS3, and JavaScript for Interactivity• Structuring web content using HTML5.• Semantic elements for improved accessibility and SEO.• Forms and input validation.• Styling web pages using CSS3.• Advanced layouts with Flexbox and CSS Grid.• Responsive design principles and media queries.• JavaScript fundamentals: variables, functions, and events.• DOM manipulation and event handling.• Introduction to ES6+ features (e.g., arrow functions, promises).2. Modern Front-End Frameworks<ul style="list-style-type: none">• Overview of popular frameworks (React, Angular, or Vue.js).• Component-based architecture and state management.• Building dynamic and reusable UI components.3. Web Accessibility and Cross-Browser Compatibility<ul style="list-style-type: none">• Ensuring web applications comply with accessibility standards (e.g., WCAG).• Testing and optimizing for cross-browser compatibility.4. Performance Optimization<ul style="list-style-type: none">• Techniques for optimizing front-end performance (e.g., minification, lazy loading).• Best practices for improving page load speed.5. Practical Implementation<ul style="list-style-type: none">• Building a fully functional front-end application.• Mocking services and frameworks
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Subject area	Web Applications and Software Development	BIT 4
Module	Agile Project Management	BIT 4.3 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Documentation 5 – 10 pages (50%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the principles and practices of Agile project management. Students will gain hands-on experience with Agile methodologies, tools, and techniques for managing IT and software development projects. This module emphasizes adaptability, collaboration, and iterative progress to successfully deliver high-quality products in dynamic and complex environments.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the core principles and values of Agile project management. • Differentiate between traditional and Agile project management approaches. • Apply Agile methodologies (e.g., Scrum, Kanban) to plan, execute, and manage projects. • Create and prioritize product backlogs to align with stakeholder needs. • Facilitate Agile ceremonies such as sprint planning, daily stand-ups, and retrospectives. • Use Agile tools (e.g., Jira, Trello) to track progress and manage tasks effectively. • Foster collaboration within cross-functional teams and manage stakeholder communication.
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	<ul style="list-style-type: none"> Assess and improve team performance through iterative feedback and continuous improvement.
Contents	<ol style="list-style-type: none"> Introduction to Agile Project Management <ul style="list-style-type: none"> Overview of Agile principles and the Agile Manifesto. Benefits and challenges of Agile in modern project management. Comparison of Agile vs. traditional (Waterfall) project management. Agile Methodologies <ul style="list-style-type: none"> Scrum framework: roles, artifacts, and ceremonies. Kanban: workflow visualization and task management. Overview of other Agile methodologies (e.g., Lean, XP). Agile Planning and Execution <ul style="list-style-type: none"> Defining project vision, goals, and deliverables. Creating and managing product backlogs. Planning sprints and iterative delivery cycles. Agile Team Dynamics and Collaboration <ul style="list-style-type: none"> Roles in Agile teams: Scrum Master, Product Owner, and Developers. Building and managing cross-functional teams. Encouraging collaboration and stakeholder engagement. Agile Tools and Techniques <ul style="list-style-type: none"> Using tools like Jira, Trello, and Azure DevOps for task management. Story mapping, user stories, and acceptance criteria. Velocity tracking, burndown charts, and other performance metrics. Agile Ceremonies and Continuous Improvement <ul style="list-style-type: none"> Sprint planning, daily stand-ups, sprint reviews, and retrospectives. Incorporating feedback into iterative cycles. Continuous improvement techniques for team and process enhancement. Risk Management and Problem-Solving in Agile <ul style="list-style-type: none"> Identifying and addressing risks in Agile projects. Managing scope changes and balancing stakeholder expectations. Techniques for effective problem-solving and conflict resolution. Practical Implementation <ul style="list-style-type: none"> Simulating an Agile project in a team environment. Managing a project from planning to delivery using Agile principles. Applying tools to track progress and manage team workflows.

Subject area	Web Applications and Software Development	BIT 4
Module	Mobile Development	BIT 4.4 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	173
Teaching time (h)	48
Learning Time (h)	125
Study Semester	3
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to equip students with the knowledge and skills required to design, develop, and deploy mobile applications for modern platforms. The module emphasizes creating user-friendly, efficient, and secure mobile applications while considering platform-specific requirements and best practices. Through practical exercises and projects, students will gain hands-on experience with mobile development frameworks, tools, and programming languages.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and architecture of mobile application development. • Design intuitive and responsive user interfaces (UI) for mobile applications. • Develop native mobile applications using modern development frameworks. • Integrate mobile applications with backend services and APIs. • Apply best practices for optimizing performance and ensuring the security of mobile applications. • Debug, test, and deploy mobile applications to app stores or other distribution platforms.
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Contents	<ol style="list-style-type: none">1. Introduction to Mobile Development<ul style="list-style-type: none">• Overview of mobile platforms (iOS, Android) and their ecosystems.• Native vs. cross-platform development: benefits and trade-offs.• Setting up the development environment for mobile applications.2. Mobile App Architecture<ul style="list-style-type: none">• Understanding the components of a mobile app (UI, business logic, data layer).• MVC, MVVM, and other architectural patterns for mobile development.3. User Interface (UI) and User Experience (UX) Design<ul style="list-style-type: none">• Designing intuitive and visually appealing mobile interfaces.• Implementing responsive designs for different screen sizes and orientations.• Accessibility considerations in mobile UI design.4. Programming for Mobile Platforms<ul style="list-style-type: none">• Developing native applications using platform-specific languages (e.g., Kotlin for Android, Swift for iOS).• Handling device-specific features like cameras, sensors, and geolocation.5. Backend Integration and API Usage6. • Connecting mobile applications to backend services.7. • Consuming RESTful APIs and working with JSON.8. Performance Optimization<ul style="list-style-type: none">• Techniques for optimizing app performance and minimizing resource usage.• Managing memory, battery consumption, and network requests.9. Security in Mobile Development<ul style="list-style-type: none">• Protecting sensitive data and user privacy.• Implementing authentication and encryption mechanisms.• Avoiding common security vulnerabilities (e.g., insecure data storage, code injection).10. Testing and Deployment<ul style="list-style-type: none">• Debugging and testing mobile applications using emulators and physical devices.• Deploying applications to app stores (Google Play, Apple App Store) or private distribution platforms.
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Subject area	Web Applications and Software Development	BIT 4
Module	Web Application Development	BIT 4.5 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	4.1 A Back-End Development 4.2 A Front-End development
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to enable students to design, develop, and deploy modern, scalable, and secure web applications. Building on the foundational knowledge gained in “Back-End Development” and “Front-End Development,” this module integrates front-end and back-end concepts to provide students with a comprehensive understanding of full-stack web development. Students will gain hands-on experience in creating web applications that offer seamless user experiences while adhering to best practices in performance, security, and maintainability.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the architecture and components of modern web applications. • Develop full-stack web applications by integrating front-end and back-end technologies. • Implement effective client-server communication using APIs and web services. • Optimize web applications for performance, scalability, and reliability.
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	<ul style="list-style-type: none"> • Incorporate security best practices to protect web applications against common vulnerabilities. • Deploy and manage web applications in production environments. • Stay up to date with emerging tools, frameworks, and trends in web development.
Contents	<ol style="list-style-type: none"> 1. Overview of Modern Web Applications <ul style="list-style-type: none"> • Architecture of web applications: monolithic, microservices, and serverless. • Client-server interaction and the role of APIs in web development. • Overview of technology stacks (e.g., MERN, MEAN). 2. Integrating Front-End and Back-End <ul style="list-style-type: none"> • Connecting front-end interfaces with back-end logic. • Handling asynchronous operations and real-time communication (e.g., Web-Sockets). • Managing state and data flow across the application. 3. Database Integration and Management <ul style="list-style-type: none"> • Efficiently managing data with relational and NoSQL databases. • Handling data migrations and versioning. • Real-time database interactions using technologies like Firebase or Socket.io. 4. Security in Web Applications <ul style="list-style-type: none"> • Working with authentication and authorization mechanisms (e.g., OAuth2, JWT). • Identifying and mitigating common web vulnerabilities (e.g., XSS, CSRF, SQL injection). • Implementing HTTPS, secure headers, and other protective measures. • Managing user data privacy and compliance with regulations (e.g., GDPR).

Subject area	Web Applications and Software Development	BIT 4
Module	Advanced Mobile Development	BIT 4.6 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	4.4 A Mobile Development
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to advance students' skills in mobile application development by focusing on cross-platform development approaches. Building on the foundational concepts from the "Mobile Development" module, students will learn to create applications that run seamlessly on multiple platforms (e.g., Android, iOS) using modern cross-platform frameworks.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and benefits of cross-platform mobile application development. • Develop and deploy mobile applications using popular cross-platform frameworks (e.g., Flutter, React Native, Xamarin). • Implement reusable components and maintain consistent user experience across platforms. • Optimize cross-platform applications for performance and resource efficiency. • Integrate platform-specific features while managing codebase integrity.
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	<ul style="list-style-type: none"> • Apply advanced techniques for debugging, testing, and deploying cross-platform applications. • Explore emerging trends and tools in cross-platform development to stay updated with industry advancements.
Contents	<ol style="list-style-type: none"> 1. Introduction to Cross-Platform Development <ul style="list-style-type: none"> • Overview of cross-platform vs. native development: advantages and limitations. • Overview of popular frameworks: Flutter, React Native, Xamarin, and others. • Setting up the development environment for cross-platform development. 2. Architecture and Design for Cross-Platform Apps <ul style="list-style-type: none"> • Structuring projects for maintainability and scalability. • Best practices for UI/UX design across multiple platforms. • Handling platform-specific differences in UI components and functionality. 3. One Cross-Platform Framework, e.g., <ul style="list-style-type: none"> • Flutter: Dart programming, widget-based UI, and state management. • React Native: JavaScript/TypeScript, component-based architecture, and libraries like Redux. • Xamarin: C#, Xamarin.Forms, and integrating with native APIs. 4. Advanced Features in Mobile Development <ul style="list-style-type: none"> • Accessing device hardware (e.g., camera, GPS, sensors) in a cross-platform context. • Managing local and remote data storage (e.g., SQLite, Firebase, RESTful APIs). • Implementing push notifications and background tasks. 5. Performance Optimization <ul style="list-style-type: none"> • Identifying and addressing performance bottlenecks in cross-platform apps. • Leveraging native modules for performance-critical tasks. • Techniques for reducing app size and improving load times. 6. Testing and Debugging Cross-Platform Applications <ul style="list-style-type: none"> • Automated testing for UI and functionality (e.g., Appium, Detox). • Debugging techniques and tools for cross-platform development. • Ensuring compatibility and stability across different devices and operating systems. 7. Practical Implementation <ul style="list-style-type: none"> • Developing a fully functional cross-platform mobile application. • Addressing platform-specific challenges and demonstrating solutions.

Subject area	Web Applications and Software Development	BIT 4
Module	Software Testing and Maintenance	BIT 4.7 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with in-depth knowledge and practical skills in software testing and maintenance, which are essential for ensuring software quality and longevity. Students will learn various testing techniques, tools, and frameworks to identify and address defects effectively. They will also explore strategies for maintaining and updating software systems to meet evolving requirements and ensure long-term usability and reliability.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and importance of software testing and maintenance in the software development lifecycle. • Apply various testing techniques, including manual and automated testing, to ensure software quality. • Use modern tools and frameworks to implement and manage testing processes. • Identify and fix software defects, ensuring reliability and functionality. • Develop strategies for effective software maintenance and version control. • Understand the challenges and approaches to managing legacy systems.
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	<ul style="list-style-type: none"> Incorporate testing and maintenance practices into Agile and DevOps workflows.
Contents	<ol style="list-style-type: none"> Introduction to Software Testing and Maintenance <ul style="list-style-type: none"> Importance of testing and maintenance in software development. Overview of testing levels: unit, integration, system, and acceptance testing. Types of maintenance: corrective, adaptive, perfective, and preventive. Testing Techniques <ul style="list-style-type: none"> White-box testing: statement, branch, and path coverage. Black-box testing: equivalence partitioning, boundary value analysis. Exploratory testing and user acceptance testing (UAT). Test Automation <ul style="list-style-type: none"> Principles and benefits of automated testing. Tools for test automation (e.g., Selenium, JUnit, TestNG, Cypress). Writing and maintaining automated test scripts. Performance and Security Testing <ul style="list-style-type: none"> Load testing, stress testing, and scalability testing. Security testing to identify vulnerabilities and ensure data protection. Tools for performance and security testing (e.g., JMeter, OWASP ZAP). Debugging and Defect Management <ul style="list-style-type: none"> Techniques for identifying, analyzing, and resolving software defects. Using issue tracking systems (e.g., Jira, Bugzilla) for defect management. Root cause analysis and defect prevention strategies. Software Maintenance Practices <ul style="list-style-type: none"> Principles of maintainable code and technical debt management. Strategies for updating and improving legacy systems. Version control systems (e.g., Git) and branching strategies. Testing and Maintenance in Agile and DevOps <ul style="list-style-type: none"> Integrating testing into Agile workflows (e.g., test-driven development, behavior-driven development). Continuous testing in DevOps pipelines. Ensuring regression testing during frequent deployments. Emerging Trends in Software Testing and Maintenance <ul style="list-style-type: none"> AI and machine learning in automated testing. Testing challenges in microservices and containerized applications. Leveraging cloud-based testing solutions. Practical Implementation <ul style="list-style-type: none"> Conducting a full-cycle testing process for a software project. Debugging and fixing defects in an existing application. Applying maintenance techniques to extend software lifespan.

Subject area	Web Applications and Software Development	BIT 4
Module	Advanced Programming	BIT 4.8 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%), 2 to 3 Assignments (50%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to enhance students' programming skills by exploring advanced concepts, paradigms, and techniques. Building on foundational programming knowledge, this module introduces topics such as functional programming, concurrency, advanced data structures, and design patterns. Students will learn to write robust, efficient, and maintainable code for solving complex problems and developing scalable software systems.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand and apply advanced programming paradigms, including functional and concurrent programming. • Implement and use advanced data structures and algorithms to solve complex problems. • Write clean, maintainable, and reusable code using design patterns and best practices. • Develop applications with robust error handling and performance optimization. • Utilize advanced features of modern programming languages (e.g., generics, metaprogramming). • Design and implement multi-threaded and distributed systems.
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	<ul style="list-style-type: none"> • Debug, profile, and test advanced programs to ensure functionality and efficiency.
Contents	<ol style="list-style-type: none"> 1. Advanced Programming Paradigms <ul style="list-style-type: none"> • Functional programming concepts: immutability, higher-order functions, lambdas. • Concurrent programming: threads, processes, and asynchronous programming. • Event-driven and reactive programming. 2. Advanced Data Structures and Algorithms <ul style="list-style-type: none"> • Advanced data structures: tries, graphs, heaps, and hashmaps. • Algorithmic techniques: dynamic programming, graph algorithms (e.g., Dijkstra's, A*). • Implementing and optimizing custom data structures. 3. Design Patterns and Best Practices <ul style="list-style-type: none"> • Common design patterns: singleton, factory, observer, decorator, etc. • Writing clean code: principles of SOLID and DRY. • Modular programming and dependency management. 4. Error Handling and Debugging <ul style="list-style-type: none"> • Advanced exception handling and recovery strategies. • Debugging complex applications using tools and techniques. • Logging and monitoring for identifying runtime issues. 5. Performance Optimization <ul style="list-style-type: none"> • Profiling and optimizing code for memory and CPU usage. • Efficient I/O operations and caching techniques. • Writing scalable and high-performance applications. 6. Language-Specific Advanced Features <ul style="list-style-type: none"> • Exploring generics, annotations, and metaprogramming. • Understanding advanced type systems and custom type creation. • Using language-specific libraries and frameworks for advanced functionality. 7. Concurrency and Parallelism <ul style="list-style-type: none"> • Multi-threaded programming: thread safety and synchronization. • Asynchronous and parallel processing techniques. • Designing distributed systems and understanding concurrency challenges. 8. Practical Implementation <ul style="list-style-type: none"> • Solving complex programming problems using advanced techniques. • Developing scalable applications incorporating multiple paradigms. • Debugging and testing applications to ensure functionality and efficiency.

Subject area	Web Applications and Software Development	BIT 4
Module	Interaction Design	BIT 4.9 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	2.2 Web Concepts
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to deepen students' knowledge and skills in creating engaging, user-centered interaction designs specifically for web and mobile applications. Building on foundational UI development concepts covered in previous modules, this module focuses on advanced techniques for designing seamless and intuitive user experiences. Students will explore user-centered design methodologies, usability testing, and interaction patterns tailored to responsive web and mobile interfaces.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the unique interaction design challenges and opportunities for web and mobile applications. • Apply advanced user-centered design methodologies to create intuitive and visually engaging interfaces. • Design interaction flows, prototypes, and animations tailored for web and mobile platforms. • Optimize designs for responsiveness and platform-specific usability standards.
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	<ul style="list-style-type: none"> • Conduct usability testing to gather and incorporate user feedback into iterative designs. • Integrate accessibility and inclusivity principles into web and mobile interaction designs. • Use advanced tools and frameworks to create interactive prototypes and design systems.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Advanced Interaction Design <ul style="list-style-type: none"> • Review of interaction design principles and their application to web and mobile platforms. • Differences in interaction design for desktop, tablet, and mobile devices. • Trends and emerging practices in web and mobile app interaction design. 2. User-Centered Design for Web and Mobile Apps <ul style="list-style-type: none"> • Advanced techniques for understanding user behavior and needs. • Creating detailed user personas, journey maps, and experience maps. • Adapting interaction design processes for agile development workflows. 3. Platform-Specific Design Considerations <ul style="list-style-type: none"> • Interaction patterns and guidelines for web (e.g., Material Design) and mobile (e.g., iOS Human Interface Guidelines). • Designing for touch interfaces, gestures, and device-specific interactions. • Optimizing layouts and navigation for responsive and adaptive design. 4. Usability Testing and Iterative Design <ul style="list-style-type: none"> • Techniques for conducting usability tests with web and mobile users. • Tools for recording and analyzing usability tests (e.g., Maze, User Testing). • Refining designs based on user feedback and performance metrics. 5. Accessibility in Interaction Design <ul style="list-style-type: none"> • Applying WCAG standards to web and mobile designs. • Designing for diverse user needs, including users with disabilities. • Testing and ensuring accessibility compliance on web and mobile platforms. 6. Designing for Performance and Scalability <ul style="list-style-type: none"> • Strategies for creating lightweight, fast-loading interactive designs. • Balancing performance, aesthetics, and functionality. • Leveraging design systems for consistency and scalability across applications. 7. Practical Implementation <ul style="list-style-type: none"> • Developing a functional interactive prototype for a web or mobile application. • Demonstrating responsiveness, platform-specific considerations, and user-centric design. • Collaborating with developers to validate feasibility and optimize designs.

Subject area	Web Applications and Software Development	BIT 4
Module	Web Technologies	BIT 4.10 A

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	72
Learning Time (h)	188
Study Semester	6
Type	Compulsory
Prerequisites	4.5 A Web Application Development
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Technical Documentation 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with an advanced and comprehensive understanding of web technologies, serving as the capstone module for the “Web Applications and Software Development” specialization. This module synthesizes prior knowledge and fills conceptual gaps, equipping students with the skills needed to design, develop, and manage state-of-the-art web solutions. A significant emphasis is placed on emerging trends, tools, and technologies to prepare students for the future of web development.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Demonstrate a deep understanding of modern web technologies and architecture. • Integrate advanced front-end and back-end technologies to create scalable and maintainable web applications. • Apply best practices for performance optimization, security, and accessibility in web development. • Implement modern development workflows, including CI/CD pipelines, containerization, and version control.
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	<ul style="list-style-type: none"> • Evaluate and adopt emerging technologies and trends in web development, such as WebAssembly, progressive web apps, and serverless architectures. • Design and deploy applications using cloud-based services and micro-services. • Critically analyze and solve complex web development problems through innovative solutions. • Develop a comprehensive project that demonstrates mastery of web technologies, integrating emerging trends and methodologies.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Advanced Web Architectures <ul style="list-style-type: none"> • Multi-tier and serverless architectures. • Microservices and APIs: RESTful APIs, GraphQL, and gRPC. • Edge computing and content delivery networks (CDNs). 2. Modern Front-End Development <ul style="list-style-type: none"> • Advanced use of front-end frameworks (e.g., React, Angular, Vue.js). • State management solutions (e.g., Redux, MobX, Zustand). • Incorporating advanced animations and interactions (e.g., GSAP, Three.js). 3. Advanced Back-End Development <ul style="list-style-type: none"> • Building robust back-end systems with frameworks like Node.js, Django, or Spring Boot. • Asynchronous processing, queues, and real-time features (e.g., WebSockets). • Database optimization for large-scale applications (e.g., NoSQL, distributed databases). 4. Performance Optimization and Security <ul style="list-style-type: none"> • Techniques for improving web application performance (e.g., lazy loading, bundling, caching). • Advanced web security practices (e.g., OWASP Top Ten, secure authentication, encryption). • Managing traffic spikes with load balancing and auto-scaling. 5. DevOps and Deployment <ul style="list-style-type: none"> • Implementing CI/CD pipelines for automated builds and deployments. • Containerization with Docker and orchestration with Kubernetes. • Monitoring and logging with tools like Prometheus, Grafana, or ELK Stack. 6. Emerging Trends in Web Technologies <ul style="list-style-type: none"> • WebAssembly (WASM) for high-performance web applications. • Progressive Web Apps (PWAs): features, development, and deployment. • AI-driven web applications: integration with machine learning models. • Blockchain and decentralized applications (dApps). 7. Cloud and Distributed Systems <ul style="list-style-type: none"> • Cloud-native development with AWS, Azure, or Google Cloud. • Building and managing scalable web solutions using serverless technologies.

	<ul style="list-style-type: none">• Leveraging cloud-based storage and compute solutions. <p>8. Practical Implementation</p>
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Subject area	Network Engineering and Cyber Security	BIT 4
Module	Computer Servicing Skills	BIT 4.1 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.1 Introduction to Information Technology
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with practical knowledge and hands-on experience in computer hardware and software servicing. Students will learn how to assemble, maintain, and troubleshoot personal computers and related devices. This foundational module equips students with the essential skills required for diagnosing and repairing common hardware and software issues, which are critical for network engineering and cybersecurity roles.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Identify the components and architecture of a personal computer system. • Assemble, disassemble, and upgrade computer hardware. • Diagnosing and troubleshooting hardware issues, including power, storage, and connectivity problems. • Install, configure, and update operating systems and application software. • Perform basic network setup and device connectivity troubleshooting. • Apply preventative maintenance techniques to ensure computer reliability and performance. • Demonstrate best practices in handling hardware safely and securely.
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Contents	<ol style="list-style-type: none">1. Review of Computer Hardware<ul style="list-style-type: none">• Overview of computer components: motherboard, CPU, memory, storage, power supply, and peripherals.• Hardware specifications and compatibility considerations.• Identifying and selecting hardware components for specific use cases.2. Assembling and Upgrading Computers<ul style="list-style-type: none">• Step-by-step assembly of a personal computer.• Installing and upgrading components such as RAM, storage drives, and GPUs.• Best practices for cable management and airflow optimization.3. Introduction to Operating Systems<ul style="list-style-type: none">• Installing and configuring operating systems (e.g., Windows, Linux).• Dual-boot setups and operating system recovery techniques.• Updating, patching, and configuring software for security and performance.4. Troubleshooting Techniques<ul style="list-style-type: none">• Diagnosing common hardware problems: boot failures, overheating, and connectivity issues.• Troubleshooting peripheral devices, including printers and external storage.• Tools and utilities for hardware and software diagnostics.5. Network Setup and Connectivity<ul style="list-style-type: none">• Basic network configurations, including setting up wired and wireless connections.• Diagnosing and resolving connectivity issues.• Configuring basic network devices, such as routers and switches.6. Preventative Maintenance<ul style="list-style-type: none">• Cleaning and maintaining hardware components.• Managing backups and recovery solutions.• Ensuring proper power management and surge protection.7. Safety and Security Practices<ul style="list-style-type: none">• Proper handling of sensitive components to prevent electrostatic discharge (ESD).• Securing hardware against theft and unauthorized access.• Ensuring data security during servicing and maintenance.8. Practical Implementation<ul style="list-style-type: none">• Hands-on exercises in assembling and disassembling computers.• Performing diagnostics and repairs in lab environments.• Configuring basic operating systems and network setups.
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Subject area	Network Engineering and Cyber Security	BIT 4
Module	Operating Systems	BIT 4.2 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.1 Introduction to Information Technology
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Written exam, duration: 90 minutes
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive understanding of operating systems (OS), their components, and their role in managing computer hardware and software resources. Students will learn how operating systems function, gain hands-on experience with popular operating systems (e.g., Windows, Linux), and explore concepts essential for network engineering and cybersecurity, such as process management, file systems, and system security.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the core functions and components of operating systems. • Explain how operating systems manage hardware resources, processes, and memory. • Compare features and architectures of different operating systems, including Windows, Linux, and macOS. • Use command-line interfaces for system administration tasks. • Manage users, files, and permissions in multi-user operating systems. • Identify and troubleshoot common operating system issues. • Apply OS-level security measures to safeguard systems against vulnerabilities.
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Contents	<ol style="list-style-type: none">1. Introduction to Operating Systems<ul style="list-style-type: none">• Definition and purpose of operating systems.• Key components: kernel, shell, file system, and device drivers.• Types of operating systems: single-user, multi-user, distributed, and real-time.2. Process and Resource Management<ul style="list-style-type: none">• Process states and scheduling algorithms.• Multithreading and multiprocessing concepts.• Managing CPU and memory resources.3. Memory Management<ul style="list-style-type: none">• Virtual memory and paging.• Memory allocation techniques.• Role of the operating system in memory protection and optimization.4. File Systems<ul style="list-style-type: none">• Structure and organization of file systems.• File permissions and access control.• File system types (e.g., FAT32, NTFS, ext4).5. User Management and Permissions<ul style="list-style-type: none">• Creating and managing user accounts.• Configuring roles, groups, and permissions.• Managing user authentication and access control.6. Networking and Operating Systems<ul style="list-style-type: none">• OS-level networking features and configurations.• Managing network connections and interfaces.• Configuring basic network services (e.g., DHCP, DNS).7. System Security and Troubleshooting<ul style="list-style-type: none">• Implementing OS-level security measures (e.g., firewalls, antivirus).• Patching and updating operating systems.• Diagnosing and resolving OS-related issues.8. Hands-On Practice with Popular Operating Systems<ul style="list-style-type: none">• Navigating the Windows and Linux command-line interfaces (CLI).• Performing administrative tasks in Windows (e.g., Task Manager, Control Panel).• Configuring and troubleshooting Linux systems using terminal commands.9. Emerging Trends in Operating Systems<ul style="list-style-type: none">• Introduction to containerization (e.g., Docker) and virtualization technologies.• Exploring cloud-based operating systems and lightweight OS for IoT.
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Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Networking	BIT 4.3 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	2.1 Introduction to Information Technology
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the foundational concepts and technologies of computer networking. Students will learn how networks operate, how devices communicate, and how to configure and manage basic network infrastructure. This module provides the groundwork for understanding advanced networking topics and prepares students for roles in network engineering and cybersecurity.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and architecture of computer networks. • Describe the OSI and TCP/IP models and their respective layers. • Configure and troubleshoot basic network devices, such as routers and switches. • Understand IP addressing, subnetting, and network protocols. • Set up and manage small-scale local area networks (LANs). • Recognize common networking challenges and apply troubleshooting techniques. • Use network tools to monitor and analyze network traffic. .
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Contents	<ol style="list-style-type: none">1. Introduction to Computer Networking<ul style="list-style-type: none">• Definition and importance of computer networks.• Types of networks: LAN, WAN, MAN, and PAN.• Overview of network topologies and their use cases.2. Network Models and Protocols<ul style="list-style-type: none">• OSI model: layers, functions, and protocols.• TCP/IP model and its role in modern networking.• Key protocols: HTTP, FTP, DNS, DHCP, and SNMP.3. IP Addressing and Subnetting<ul style="list-style-type: none">• Introduction to IPv4 and IPv6 addressing.• Understanding subnet masks and CIDR notation.• Subnetting techniques and IP address planning.4. Network Devices and Configurations<ul style="list-style-type: none">• Overview of network devices: routers, switches, hubs, and access points.• Configuring routers and switches for basic networking tasks.• Introduction to VLANs and inter-VLAN routing.5. Network Connectivity and Media<ul style="list-style-type: none">• Types of transmission media: wired (Ethernet, fiber optics) and wireless.• Configuring and testing wired and wireless connections.• Understanding bandwidth, throughput, and latency.6. Basic Network Security Concepts<ul style="list-style-type: none">• Importance of securing network infrastructures.• Introduction to firewalls, NAT, and port forwarding.• Overview of common threats and basic mitigation strategies.7. Network Monitoring and Troubleshooting<ul style="list-style-type: none">• Using tools like ping, traceroute, and Wireshark.• Diagnosing connectivity issues and resolving common problems.• Monitoring network performance and traffic.8. Practical Networking Labs<ul style="list-style-type: none">• Setting up a small LAN with routers and switches.• Configuring IP addresses, subnets, and VLANs.• Simulating network traffic and analyzing data using network monitoring tools.
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Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Network Security	BIT 4.4 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	Recommended: 4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive understanding of the principles, tools, and techniques for securing networks and networked systems. Students will learn to identify vulnerabilities, mitigate security risks, and implement robust defense mechanisms to protect against internal and external threats. The module emphasizes practical application, enabling students to secure real-world network infrastructures.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and importance of network security. • Identify common network vulnerabilities and threats, including malware, phishing, and DoS attacks. • Configure and manage firewalls, intrusion detection/prevention systems (IDS/IPS), and VPNs. • Implement encryption and secure protocols to protect data in transit. • Apply authentication, authorization, and access control mechanisms in networked systems.
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	<ul style="list-style-type: none"> • Conduct security assessments and penetration testing to evaluate network defenses. • Develop and implement a network security policy for organizational security.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Review of Network Security <ul style="list-style-type: none"> • Overview of network security principles and objectives (CIA triad: Confidentiality, Integrity, Availability). • Types of network threats: malware, social engineering, DoS/DDoS, and man-in-the-middle attacks. • The role of network security in protecting data and systems. 2. Network Vulnerabilities and Risk Management <ul style="list-style-type: none"> • Common network vulnerabilities and their exploitation. • Assessing risks and prioritizing security measures. • Introduction to risk management frameworks (e.g., NIST, ISO 27001). 3. Secure Network Design <ul style="list-style-type: none"> • Principles of secure network architecture: segmentation, zoning, and layering. • Configuring secure network topologies and DMZs. • Using VLANs and access control lists (ACLs) for enhanced security. 4. Cryptography and Secure Communication <ul style="list-style-type: none"> • Basics of cryptographic techniques: symmetric, asymmetric, and hashing. • Implementing secure protocols (e.g., HTTPS, TLS/SSL, IPsec). • Encrypting data in transit to ensure secure communication. 5. Firewalls and Intrusion Prevention Systems <ul style="list-style-type: none"> • Types of firewalls: packet filtering, stateful, and next-generation firewalls (NGFW). • Configuring and managing firewalls for network protection. • Overview of IDS/IPS and their role in threat detection and prevention. 6. Authentication, Authorization, and Access Control <ul style="list-style-type: none"> • Implementing authentication mechanisms (e.g., passwords, 2FA, certificates). • Role-based access control (RBAC) and least privilege principles. • Managing user and device authentication in networked environments. 7. Virtual Private Networks (VPNs) <ul style="list-style-type: none"> • Types of VPNs: site-to-site, remote access, and SSL VPNs. • Configuring and managing VPNs for secure remote communication. • Ensuring VPN performance and security. 8. Security Monitoring and Incident Response <ul style="list-style-type: none"> • Network monitoring tools and techniques (e.g., Wireshark, NetFlow). • Configuring Security Information and Event Management (SIEM) systems. • Steps in responding to and mitigating network security incidents. 9. Practical Labs and Implementation <ul style="list-style-type: none"> • Configuring firewalls, IDS/IPS, and VPNs in lab environments. • Conducting network vulnerability scans using tools like Nmap and Nessus. • Simulating and mitigating common network attacks.

Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Network Management	BIT 4.5 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	Recommended: 4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to build on the foundational concepts of networking from the previous semester and equip students with the knowledge and skills required to manage, monitor, and maintain network infrastructures effectively. Students will learn about advanced network management tools, performance optimization techniques, and troubleshooting methodologies. This module emphasizes the importance of maintaining secure, efficient, and reliable networks in modern IT environments.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and components of network management. • Use network management tools to monitor, analyze, and optimize network performance. • Implement and manage network configurations using industry-standard practices. • Identify and resolve network issues using troubleshooting methodologies and tools. • Apply strategies for managing network security, scalability, and reliability.
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	<ul style="list-style-type: none"> • Develop and maintain comprehensive documentation for network management tasks. • Understand and implement proactive approaches for network capacity planning and fault management.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Network Management <ul style="list-style-type: none"> • Definition and goals of network management. • Network management tasks: monitoring, configuration, fault detection, and performance optimization. • Key components: network management protocols, tools, and devices. 2. Network Management Protocols and Standards <ul style="list-style-type: none"> • Simple Network Management Protocol (SNMP): structure, operation, and versions. • Remote monitoring (RMON) and its role in network analysis. • Network Time Protocol (NTP) and its importance in synchronized systems. 3. Performance Monitoring and Optimization <ul style="list-style-type: none"> • Key performance indicators (KPIs) for networks: latency, throughput, packet loss, and jitter. • Network monitoring tools: Wireshark, SolarWinds, and Nagios. • Techniques for optimizing network performance, including traffic shaping and Quality of Service (QoS). 4. Network Configuration Management <ul style="list-style-type: none"> • Configuring and managing routers, switches, and other network devices. • Automating configuration tasks using tools like Ansible and scripts. • Managing version control for network configurations. 5. Fault Management and Troubleshooting <ul style="list-style-type: none"> • Identifying and diagnosing common network issues. • Troubleshooting methodologies: top-down, bottom-up, and divide-and-conquer approaches. • Using diagnostic tools (e.g., ping, traceroute, Nmap) to resolve faults. 6. Security Management in Networking <ul style="list-style-type: none"> • Monitoring and managing network security incidents. • Implementing access control, firewall rules, and intrusion detection/prevention systems. • Using SIEM tools for security monitoring and incident response. 7. Capacity Planning and Scalability <ul style="list-style-type: none"> • Monitoring and analyzing network usage trends. • Planning for future capacity requirements. • Strategies for scaling networks to meet organizational needs. 8. Network Documentation and Policies <ul style="list-style-type: none"> • Importance of maintaining accurate and up-to-date documentation. • Documenting network topologies, device configurations, and changing logs. • Developing and enforcing network management policies. 9. Emerging Trends in Network Management <ul style="list-style-type: none"> • Software-defined networking (SDN) and network virtualization.

	<ul style="list-style-type: none">• AI and machine learning in predictive network management.• Cloud-based network management solutions. <p>10. Practical Labs and Implementation</p> <ul style="list-style-type: none">• Setting up and managing a network monitoring system.• Simulating and troubleshooting network faults in a lab environment.• Configuring network performance optimization techniques.
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Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Wireless Networking	BIT 4.6 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	Recommended: 4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive understanding of wireless networking technologies, standards, and protocols. Students will learn the principles of designing, configuring, and managing wireless networks, with a focus on ensuring reliability, performance, and security. This module prepares students to handle the unique challenges of wireless networking in enterprise and personal environments.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and technologies behind wireless communication. • Explain and apply wireless networking standards, such as IEEE 802.11. • Design, configure, and manage wireless local area networks (WLANs). • Identify and mitigate common challenges in wireless networking, such as interference and bandwidth limitations. • Implement wireless network security measures to prevent unauthorized access and attacks. • Use tools to analyze and optimize the performance of wireless networks.
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	<ul style="list-style-type: none"> Understand emerging trends in wireless networking, including 5G and IoT connectivity.
Contents	<ol style="list-style-type: none"> Introduction to Wireless Networking <ul style="list-style-type: none"> Overview of wireless networking technologies and applications. Key differences between wired and wireless networks. History and evolution of wireless communication. Wireless Communication Principles <ul style="list-style-type: none"> Fundamentals of radio frequency (RF) communication. Frequency bands, channels, and spectrum allocation. Signal propagation, attenuation, and interference. Wireless Networking Standards and Protocols <ul style="list-style-type: none"> IEEE 802.11 standards (Wi-Fi): a/b/g/n/ac/ax. Overview of other wireless standards (e.g., Bluetooth, Zigbee, LTE, 5G). Protocols for wireless communication, such as WPA3, WEP, and EAP. Designing and Configuring Wireless Networks <ul style="list-style-type: none"> Planning and designing WLANs for small to enterprise-scale deployments. Access point (AP) placement and channel management. Configuring SSIDs, VLANs, and QoS for wireless networks. Wireless Network Security <ul style="list-style-type: none"> Threats to wireless networks: rogue APs, eavesdropping, and DoS attacks. Implementing security protocols (e.g., WPA2/WPA3). Setting up encryption, authentication, and firewalls for wireless networks. Performance Optimization and Troubleshooting <ul style="list-style-type: none"> Tools for wireless network analysis (e.g., Wireshark, NetSpot). Diagnosing and mitigating interference and connectivity issues. Optimizing wireless network performance for speed and reliability. Advanced Wireless Networking Concepts <ul style="list-style-type: none"> Mesh networks and their applications. Wireless bridge and point-to-point connections. Understanding 5G technology and its impact on wireless communication. Emerging Trends and Applications <ul style="list-style-type: none"> The role of wireless networking in IoT environments. Wireless networks in smart cities and industrial settings. Future trends: Wi-Fi 7, Li-Fi, and beyond. Practical Labs and Implementation (Examples) <ul style="list-style-type: none"> Setting up and configuring a wireless network using access points and controllers. Implementing wireless network security measures. Analyzing and troubleshooting wireless network performance.

Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Unified Communications	BIT 4.7 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	Recommended: 4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the concepts, technologies, and practices of Unified Communications (UC). Unified Communications integrates real-time and non-real-time communication services, including voice, video, messaging, and collaboration tools, into a seamless system. Students will learn how to design, implement, and manage UC solutions, emphasizing their application in modern business environments and their role in enhancing communication efficiency and productivity.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and components of Unified Communications systems. • Explain the integration of real-time and non-real-time communication technologies. • Design, configure, and manage Unified Communications solutions. • Use protocols and standards associated with UC systems, such as SIP and RTP. • Implement security measures to protect UC infrastructure against vulnerabilities.
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	<ul style="list-style-type: none"> • Evaluate and troubleshoot issues in Unified Communications systems. • Analyze and adopt emerging trends in Unified Communications, such as cloud-based UCaaS solutions.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Unified Communications <ul style="list-style-type: none"> • Definition and importance of Unified Communications. • Key components: voice, video, messaging, presence, and collaboration tools. • Use cases and benefits of UC in modern organizations. 2. Unified Communications Architecture <ul style="list-style-type: none"> • Overview of UC architecture and infrastructure. • Key components: PBX, VoIP, video conferencing systems, and UC servers. • Integration with existing IT and network infrastructure. 3. Protocols and Standards for Unified Communications <ul style="list-style-type: none"> • Session Initiation Protocol (SIP): call setup and management. • Real-Time Transport Protocol (RTP): audio and video data transmission. • H.323 and other UC-related protocols. 4. Voice over IP (VoIP) Systems <ul style="list-style-type: none"> • Principles of VoIP and packet-based voice transmission. • Configuring and managing IP phones and softphones. • Ensuring quality of service (QoS) in VoIP communications. 5. Video Conferencing and Collaboration Tools <ul style="list-style-type: none"> • Setting up video conferencing solutions (e.g., Zoom, Microsoft Teams, Cisco WebEx). • Managing real-time collaboration tools, including screen sharing and virtual whiteboards. • Integration of video conferencing systems with UC infrastructure. 6. Unified Messaging and Presence <ul style="list-style-type: none"> • Overview of unified messaging: email, voicemail, and fax integration. • Implementing presence technologies to indicate user availability. • Managing instant messaging systems in a UC environment. 7. UC Security and Troubleshooting <ul style="list-style-type: none"> • Common security threats to UC systems: eavesdropping, spoofing, and DoS attacks. • Implementing security measures, such as encryption and secure SIP (SIPS). • Troubleshooting UC systems: call quality issues, latency, and integration challenges. 8. Cloud-Based Unified Communications (UCaaS) <ul style="list-style-type: none"> • Overview of Unified Communications as a Service (UCaaS). • Benefits and challenges of migrating to cloud-based UC solutions. • Evaluating leading UCaaS providers (e.g., RingCentral, Zoom Phone, Microsoft Teams). 9. Emerging Trends in Unified Communications.

Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	IP Switched Networks	BIT 4.8 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with an in-depth understanding of IP switching technologies and their role in modern network infrastructures. Students will learn how to design, configure, and troubleshoot switched networks using advanced concepts such as VLANs, spanning tree protocols, and layer 3 switching. This module equips students with the practical skills and theoretical knowledge required to manage high-performance, scalable, and secure switched network environments.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and operation of switched networks. • Configure and manage VLANs for network segmentation and improved performance. • Implement and troubleshoot spanning tree protocols to ensure loop-free topologies. • Understand and apply concepts of layer 3 switching and routing within switched networks. • Configure link aggregation and redundancy mechanisms for fault tolerance.
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	<ul style="list-style-type: none"> • Identify and resolve common issues in IP switched networks. • Design and implement scalable and secure switched network solutions.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to IP Switched Networks <ul style="list-style-type: none"> • Role of switching in network communication. • Advantages of switched networks over legacy technologies (e.g., hubs). • Types of switches: unmanaged, managed, and multilayer switches. 2. Ethernet Switching Fundamentals <ul style="list-style-type: none"> • Ethernet frames and switching logic. • MAC address tables and frame forwarding. • Concepts of collision and broadcast domains. 3. Virtual LANs (VLANs) <ul style="list-style-type: none"> • Importance of VLANs for network segmentation and traffic isolation. • Configuring VLANs and VLAN trunking (802.1Q). • Implementing inter-VLAN routing using layer 3 switches. 4. Spanning Tree Protocol (STP) <ul style="list-style-type: none"> • The purpose of STP in preventing network loops. • STP variants: RSTP (Rapid Spanning Tree Protocol) and MSTP (Multiple Spanning Tree Protocol). • Configuring and troubleshooting STP for fault tolerance. 5. Layer 3 Switching <ul style="list-style-type: none"> • Difference between layer 2 and layer 3 switching. • Configuring layer 3 switches for routing and inter-VLAN communication. • Static and dynamic routing in switched networks. 6. Link Aggregation and Redundancy <ul style="list-style-type: none"> • Benefits of link aggregation and load balancing (e.g., LACP). • Configuring redundant paths for high availability. • Managing failover mechanisms to ensure network reliability. 7. Security in Switched Networks <ul style="list-style-type: none"> • Securing VLANs and access ports. • Implementing port security to prevent unauthorized device connections. • Mitigating common attacks, such as VLAN hopping and MAC flooding. 8. Monitoring and Troubleshooting Switched Networks <ul style="list-style-type: none"> • Tools for monitoring network performance (e.g., SNMP, NetFlow). • Diagnosing and resolving issues using tools like ping, traceroute, and packet captures. • Troubleshooting STP, VLAN, and inter-VLAN routing problems. 9. Emerging Trends in Switched Networks <ul style="list-style-type: none"> • Software-Defined Networking (SDN) and its impact on switching. • Virtualized switches in cloud environments. • Integration of switches with IoT and edge computing. 10. Practical Labs and Implementation (Examples)

	<ul style="list-style-type: none">• Configuring VLANs, trunking, and inter-VLAN routing on managed switches.• Implementing and testing STP for loop prevention• Setting up link aggregation and redundancy mechanisms.
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Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	IP Routing	BIT 4.9 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	4.3 B Networking
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 15 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with an in-depth understanding of IP routing principles, protocols, and configurations. Students will learn how routers forward packets within and between networks and how routing protocols dynamically adjust to changes in network topology. This module equips students with the skills to design, configure, and troubleshoot routed networks in enterprise environments, preparing them for advanced roles in network engineering and cybersecurity.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles of IP routing and the role of routers in network communication. • Explain the differences between static and dynamic routing. • Configure and manage routing protocols, including RIP, OSPF, and BGP. • Understand and implement advanced routing concepts such as route summarization and redistribution. • Diagnose and troubleshoot routing issues in both IPv4 and IPv6 networks. • Design and implement scalable and fault-tolerant routing solutions.
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	<ul style="list-style-type: none"> Analyze the impact of routing protocols on network performance and security.
Contents	<ol style="list-style-type: none"> Introduction to IP Routing <ul style="list-style-type: none"> Definition and purpose of routing in IP networks. Routing vs. switching: key differences and use cases. Role of routing tables and their structure. Static Routing <ul style="list-style-type: none"> Configuring and managing static routes. Benefits and limitations of static routing. Practical use cases for static routes in small networks. Dynamic Routing Protocols <ul style="list-style-type: none"> Overview of dynamic routing and its benefits. Distance-vector protocols: Routing Information Protocol (RIP). Link-state protocols: Open Shortest Path First (OSPF). Path-vector protocols: Border Gateway Protocol (BGP). Advanced Routing Concepts <ul style="list-style-type: none"> Route summarization and aggregation to reduce routing table size. Route redistribution between multiple routing protocols. Load balancing and equal-cost multipath routing (ECMP). Routing in IPv6 <ul style="list-style-type: none"> IPv6 addressing and its impact on routing. Configuring and managing routing protocols in IPv6 networks. Transition mechanisms for IPv4 and IPv6 coexistence. Routing Security <ul style="list-style-type: none"> Common threats to routing protocols (e.g., route hijacking, spoofing). Implementing security mechanisms like authentication and filtering in routing protocols. Best practices for securing routed networks. Troubleshooting Routing Issues <ul style="list-style-type: none"> Diagnosing and resolving routing issues using tools like traceroute, ping, and debugging commands. Identifying and correcting routing loops, blackholes, and convergence issues. Using network monitoring tools to analyze routing performance. Emerging Trends in IP Routing <ul style="list-style-type: none"> Software-Defined Networking (SDN) and its impact on routing. Integration of routing in virtualized and cloud-based environments. Dynamic routing in IoT and edge computing. Practical Labs and Implementation (Examples) <ul style="list-style-type: none"> Configuring static and dynamic routing protocols in lab environments. Implementing OSPF multi-area networks and BGP for internet routing. Troubleshooting complex routing scenarios and optimizing performance.

Subject area	Network Engineering and Cyber Security	BIT 4 B
Module	Troubleshooting IP Networks	BIT 4.10 B

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	72
Learning Time (h)	188
Study Semester	6
Type	Compulsory
Prerequisites	Recommended: 4.8 B IP Switched Networks
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%) Written, Report 5 – 10 pages (25%) Presentation, min. 20 minutes (25%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to equip students with advanced skills and methodologies for diagnosing, analyzing, and resolving complex issues in IP-based networks. As the capstone module in the “Network Engineering and Cyber Security” specialization, this module consolidates students’ knowledge, addresses any gaps, and integrates advanced troubleshooting concepts. The module also emphasizes emerging trends and cutting-edge techniques, ensuring students are prepared for real-world challenges in dynamic and evolving network environments.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Apply systematic troubleshooting methodologies to diagnose and resolve complex network issues. • Identify and analyze performance bottlenecks, connectivity problems, and configuration errors in IP networks. • Use advanced network monitoring and diagnostic tools to collect and interpret data for problem resolution. • Troubleshoot issues related to routing, switching, wireless networks, and security configurations.
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	<ul style="list-style-type: none"> • Understand the impact of virtualization, cloud networking, and software-defined networking (SDN) on troubleshooting approaches. • Address security-related network incidents, including intrusion detection and mitigation. • Develop and implement proactive network management strategies to minimize downtime. • Reflect on emerging trends and technologies and their influence on network troubleshooting techniques.
Contents	<ol style="list-style-type: none"> 1. Introduction to Advanced Troubleshooting <ul style="list-style-type: none"> • Importance of troubleshooting in maintaining reliable network operations. • Structured troubleshooting approaches (e.g., top-down, bottom-up, divide-and-conquer). • Tools and techniques overview: packet analyzers, log analyzers, and monitoring systems. 2. Advanced Routing Troubleshooting <ul style="list-style-type: none"> • Diagnosing issues in dynamic routing protocols (e.g., OSPF, BGP). • Resolving convergence problems and routing loops. • Troubleshooting IPv6 routing and dual-stack environments. 3. Advanced Switching Troubleshooting <ul style="list-style-type: none"> • Identifying and resolving VLAN, trunking, and inter-VLAN routing issues. • Troubleshooting spanning tree protocol (STP) failures. • Diagnosing issues with link aggregation and redundancy configurations. 4. Wireless Network Troubleshooting <ul style="list-style-type: none"> • Addressing interference, signal degradation, and coverage gaps. • Diagnosing authentication and roaming issues in wireless networks. • Analyzing and optimizing wireless network performance. 5. Security Troubleshooting <ul style="list-style-type: none"> • Identifying and mitigating security breaches (e.g., DDoS attacks, unauthorized access). • Resolving firewall, VPN, and IDS/IPS configuration issues. • Using security event management tools (e.g., SIEM) for incident response. 6. Performance Optimization and Traffic Analysis <ul style="list-style-type: none"> • Using NetFlow, SNMP, and packet capture tools (e.g., Wireshark) to analyze network traffic. • Identifying and addressing latency, jitter, and packet loss issues. • Optimizing Quality of Service (QoS) configurations for critical traffic. 7. Troubleshooting Virtualized and Cloud Networks <ul style="list-style-type: none"> • Diagnosing connectivity issues in virtualized environments (e.g., VMware, Hyper-V). • Troubleshooting cloud-based network configurations (e.g., AWS, Azure). • Resolving SDN-related issues and understanding their unique troubleshooting requirements. 8. Emerging Trends in Network Troubleshooting <ul style="list-style-type: none"> • AI and machine learning for predictive network troubleshooting. • Troubleshooting in IoT environments with diverse connected devices.

	<ul style="list-style-type: none">• Addressing challenges in hybrid and edge networks. <p>9. Proactive Network Management</p> <ul style="list-style-type: none">• Developing and implementing proactive monitoring strategies.• Setting up alerts and thresholds to identify potential issues early.• Creating network documentation and incident response plans. <p>10. Practical Labs and Implementation (Examples)</p> <ul style="list-style-type: none">• Simulating and resolving complex network issues in controlled environments.• Using advanced tools to troubleshoot multi-layered network problems.• Configuring monitoring systems and analyzing historical data for trends.
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Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Fundamentals of AI and Data Analytics	BIT 4.1 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 2 – 3 Assignments (70%) Presentation, min. 15 minutes (30%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the fundamental principles, concepts, and techniques of Artificial Intelligence (AI) and Data Analytics (DA). This module provides a foundational understanding of how AI systems work and how data analytics is applied to derive meaningful insights. Through theoretical knowledge and practical exercises, students will learn the basics of AI and DA, which will serve as a cornerstone for advanced modules in this specialization.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and historical evolution of Artificial Intelligence and Data Analytics. • Explain key techniques and applications of AI, including machine learning, natural language processing, and expert systems. • Understand the data analytics lifecycle, from data collection and preprocessing to visualization and interpretation. • Recognize the role of AI and DA in solving real-world problems across various industries. • Use basic tools and techniques to perform data analysis and develop simple AI models.
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	<ul style="list-style-type: none"> • Understand ethical considerations and societal impacts of AI and DA technologies.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Artificial Intelligence and Data Analytics <ul style="list-style-type: none"> • Definitions and key concepts of AI and DA. • Historical evolution and milestones in AI and DA. • The relationship between AI and DA in modern applications. 2. AI Fundamentals <ul style="list-style-type: none"> • Overview of key AI techniques: rule-based systems, machine learning, and neural networks. • Problem-solving approaches: search algorithms, logic, and reasoning. • Applications of AI: robotics, speech recognition, and recommendation systems. 3. Data Analytics Fundamentals <ul style="list-style-type: none"> • The data analytics lifecycle: data collection, cleaning, analysis, and visualization. • Types of data: structured, unstructured, and semi-structured. • Basic statistical techniques for data analysis. 4. Tools and Technologies <ul style="list-style-type: none"> • Introduction to programming languages used in AI and DA (e.g., Python). • Overview of libraries and frameworks (e.g., NumPy, pandas, Scikit-learn). • Basic use of data visualization tools (e.g., Matplotlib, Seaborn). 5. AI and DA in Real-World Applications <ul style="list-style-type: none"> • Case studies demonstrating the use of AI and DA in healthcare, finance, and other industries. • Discussion of emerging trends, such as AI in automation and big data analytics. 6. Ethical and Societal Impacts <ul style="list-style-type: none"> • Ethical challenges in AI, such as bias and fairness. • Understanding the societal impacts of AI and DA technologies. • Data privacy and security considerations. 7. Practical Sessions <ul style="list-style-type: none"> • Implementing basic data analysis using Python and its libraries. • Developing simple AI models for classification or prediction tasks. • Visualizing data insights using charts and graphs.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Programming for Data Analytics	BIT 4.2 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	Recommendation: 2.4 Software Development Fundamentals
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 2 – 4 assignments
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to equip students with programming skills specific to data analytics tasks. Students will learn to use Python, one of the most widely used programming languages for data analytics, to manipulate, analyze, and visualize data. This module provides hands-on experience in working with real-world datasets and lays a strong foundation for advanced topics in machine learning and data-driven decision-making.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Write Python programs to process, analyze, and visualize data. • Use key Python libraries for data manipulation and analysis, such as NumPy, pandas, and Matplotlib. • Clean and preprocess datasets to prepare them for analysis. • Perform exploratory data analysis to extract insights and patterns. • Apply basic statistical techniques and algorithms to analyze data. • Create visualizations to effectively communicate data findings. • Work with various data formats, such as CSV, JSON, and databases.
Contents	<p>1. Introduction to Python for Data Analytics</p> <ul style="list-style-type: none"> • Overview of Python's role in data analytics.

	<ul style="list-style-type: none">• Setting up the Python programming environment (e.g., Jupyter Notebook, IDEs).• Basic Python syntax and concepts: variables, loops, functions, and file handling. <ol style="list-style-type: none">2. Data Manipulation with NumPy and pandas<ul style="list-style-type: none">• Introduction to NumPy for numerical computations.• Working with pandas DataFrames for data manipulation.• Filtering, grouping, and aggregating data.• Handling missing or inconsistent data.3. Data Exploration and Analysis<ul style="list-style-type: none">• Basics of exploratory data analysis (EDA).• Summary statistics and descriptive analytics.• Identifying trends and patterns in data.4. Data Visualization with Python<ul style="list-style-type: none">• Using Matplotlib and Seaborn for creating visualizations.• Plotting bar charts, histograms, scatter plots, and heatmaps.• Customizing visualizations for clear communication.5. Working with Different Data Formats<ul style="list-style-type: none">• Reading and writing data in CSV, JSON, and Excel formats.• Connecting to databases and querying data using SQL in Python.• Introduction to working with APIs for data acquisition.6. Basic Statistical Techniques in Python<ul style="list-style-type: none">• Understanding and implementing basic statistical measures (mean, median, mode, variance).• Correlation and covariance analysis.• Basics of hypothesis testing and significance.7. Data Cleaning and Preprocessing<ul style="list-style-type: none">• Identifying and handling missing data.• Standardizing and normalizing datasets.• Encoding categorical variables and working with date/time data.8. Practical Implementation<ul style="list-style-type: none">• Analyzing real-world datasets (e.g., sales, finance, healthcare).• Creating dashboards and reports using Python libraries.• Documenting the analytics process and insights• .
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Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Data Mining	BIT 4.3 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	2
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical exam, 40 – 60 minutes (40% weighting) Written, 60 minutes (60% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the concepts, techniques, and tools of data mining, which involve extracting meaningful patterns and knowledge from large datasets. Students will learn various data mining methods, including classification, clustering, and association analysis, and gain hands-on experience applying these techniques to solve real-world problems in business, healthcare, finance, and other domains.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and processes of data mining. • Identify appropriate data mining techniques for different types of data and problems. • Perform data preprocessing, including cleaning, transformation, and reduction, to prepare datasets for analysis. • Apply classification algorithms to build predictive models. • Use clustering techniques to identify patterns and groupings in data. • Conduct association rule mining to discover relationships between variables in transactional datasets.
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	<ul style="list-style-type: none"> • Evaluate the performance of data mining models using appropriate metrics. • Use data mining tools and frameworks (e.g., Python libraries like Scikit-learn, RapidMiner, or Weka) to implement solutions.
Contents	<ol style="list-style-type: none"> 1. Introduction to Data Mining <ul style="list-style-type: none"> • Definition and scope of data mining. • The data mining process: data preparation, modeling, evaluation, and deployment. • Applications of data mining in various industries. 2. Data Preprocessing <ul style="list-style-type: none"> • Importance of data quality in data mining. • Techniques for data cleaning, normalization, and transformation. • Feature selection and dimensionality reduction methods. 3. Classification Techniques <ul style="list-style-type: none"> • Overview of supervised learning. • Common classification algorithms: decision trees, k-Nearest Neighbors (k-NN), Naive Bayes, and support vector machines (SVM). • Building, training, and evaluating classification models. 4. Clustering Techniques <ul style="list-style-type: none"> • Overview of unsupervised learning. • Clustering algorithms: k-Means, hierarchical clustering, and DBSCAN. • Interpreting and visualizing clustering results. 5. Association Rule Mining <ul style="list-style-type: none"> • Concept of association rules and their importance in transactional data. • Techniques for discovering association rules (e.g., Apriori, FP-Growth). • Metrics for evaluating rules: support, confidence, and lift. 6. Evaluation of Data Mining Models <ul style="list-style-type: none"> • Metrics for classification (e.g., accuracy, precision, recall, F1-score). • Internal and external measures for clustering validation. • Challenges and best practices in model evaluation. 7. Tools and Frameworks for Data Mining <ul style="list-style-type: none"> • Overview of Python libraries (e.g., Scikit-learn, pandas, Matplotlib). • Introduction to specialized tools like RapidMiner and Weka. • Hands-on implementation of data mining tasks using real-world datasets.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Data Acquisition and Visualization	BIT 4.4 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical exam, 40 – 60 minutes (40% weighting) Written, 60 minutes (60% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to equip students with the skills and knowledge necessary to collect, process, and visualize data from various sources. Students will learn techniques for data acquisition, including APIs, web scraping, and database querying, and develop skills in creating meaningful and impactful visualizations to communicate insights effectively. This module bridges the gap between raw data and decision-making, enabling students to present data in a clear and engaging manner.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the principles and methods of data acquisition from different sources. • Use APIs, web scraping, and database querying to collect and integrate data. • Process and clean raw data to ensure it is ready for analysis. • Apply data visualization techniques to create impactful visual representations of data. • Use tools and libraries for data visualization, such as Matplotlib, Seaborn, Tableau, or Power BI.
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	<ul style="list-style-type: none"> • Design dashboards and interactive visualizations for effective data communication. • Recognize and apply best practices in ethical data collection and visualization.
Contents	<ol style="list-style-type: none"> 1. Introduction to Data Acquisition and Visualization <ul style="list-style-type: none"> • Importance of data acquisition and visualization in AI and Data Analytics. • Overview of data sources: structured, semi-structured, and unstructured data. • Role of visualization in storytelling and decision-making. 2. Data Acquisition Techniques <ul style="list-style-type: none"> • Collecting data from APIs using Python libraries (e.g., requests, JSON handling). • Web scraping techniques and tools (e.g., BeautifulSoup, Scrapy). • Querying relational databases using SQL. • Accessing data from cloud platforms and public datasets. 3. Data Cleaning and Preprocessing <ul style="list-style-type: none"> • Handling missing, inconsistent, and duplicate data. • Transforming and normalizing data for analysis. • Managing various file formats (CSV, JSON, Excel). 4. Principles of Data Visualization <ul style="list-style-type: none"> • Key principles: clarity, simplicity, and relevance. • Choosing appropriate chart types for different data and purposes. • Avoiding common pitfalls in data visualization (e.g., misleading graphs). 5. Data Visualization Tools and Libraries <ul style="list-style-type: none"> • Creating static and interactive visualizations with Python (Matplotlib, Seaborn, Plotly). • Overview of advanced visualization tools: Tableau, Power BI. • Designing and sharing dashboards for real-time data monitoring. 6. Ethics and Best Practices <ul style="list-style-type: none"> • Ethical considerations in data collection and sharing. • Ensuring data privacy and security during acquisition. • Designing unbiased and truthful visualizations.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Machine Learning	BIT 4.5 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	3
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical exam, 40 – 60 minutes (40% weighting) Written, 60 minutes (60% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive introduction to machine learning (ML), focusing on its principles, algorithms, and practical applications. Students will learn how to build predictive models, evaluate their performance, and apply them to solve real-world problems in domains such as finance, healthcare, and marketing. This module emphasizes both theoretical understanding and hands-on implementation of ML techniques using popular tools and frameworks.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and types of machine learning, including supervised, unsupervised, and reinforcement learning. • Explain the working principles of key machine learning algorithms and their use cases. • Preprocess and prepare datasets for machine learning tasks. • Build and train machine learning models using appropriate techniques and frameworks. • Evaluate and compare model performance using appropriate metrics. • Understand and address overfitting, underfitting, and other common challenges in machine learning.
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	<ul style="list-style-type: none"> • Use Python and popular ML libraries (e.g., Scikit-learn, TensorFlow, or PyTorch) to implement ML models. • Analyze and interpret the results of machine learning models in real-world contexts.
Contents	<ol style="list-style-type: none"> 1. Introduction to Machine Learning <ul style="list-style-type: none"> • Definition and scope of machine learning. • Types of machine learning: supervised, unsupervised, and reinforcement learning. • Machine learning applications in various industries. 2. Data Preparation for Machine Learning <ul style="list-style-type: none"> • Importance of data quality in ML models. • Data preprocessing: handling missing values, normalization, and scaling. • Feature selection and engineering techniques. 3. Supervised Learning <ul style="list-style-type: none"> • Regression algorithms: linear regression, polynomial regression. • Classification algorithms: logistic regression, decision trees, k-Nearest Neighbors (k-NN), support vector machines (SVM). • Evaluating supervised models using metrics (e.g., accuracy, precision, recall, F1-score, RMSE). 4. Unsupervised Learning <ul style="list-style-type: none"> • Clustering algorithms: k-Means, hierarchical clustering, DBSCAN. • Dimensionality reduction techniques: Principal Component Analysis (PCA), t-SNE. • Applications of unsupervised learning in anomaly detection and pattern recognition. 5. Model Training and Optimization <ul style="list-style-type: none"> • Training, validation, and test splits. • Avoiding overfitting and underfitting through regularization (e.g., L1/L2). • Cross-validation and hyperparameter tuning. 6. Introduction to Neural Networks <ul style="list-style-type: none"> • Basics of artificial neural networks (ANNs). • Key concepts: neurons, activation functions, and layers. • Overview of deep learning and its applications. 7. Practical Machine Learning <ul style="list-style-type: none"> • Implementing ML algorithms using Python libraries like Scikit-learn, TensorFlow, or PyTorch. • Hands-on projects with real-world datasets (e.g., financial, healthcare, social media). • Debugging and optimizing machine learning workflows. 8. Ethical Considerations in Machine Learning <ul style="list-style-type: none"> • Bias and fairness in machine learning models. • Data privacy and security challenges. • Ethical responsibilities of ML practitioners.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Data Ethics and Law	BIT 4.6 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	4.1 C Fundamentals of AI and Data Analytics
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Written, Report of use case, 5 -10 pages (50%), Presentation, min. 20 minutes (50%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with a comprehensive understanding of the ethical, legal, and societal implications of working with data and deploying AI and data analytics solutions. Students will explore principles of ethical decision-making, data privacy regulations, and the responsibilities of AI practitioners. By analyzing real-world cases and frameworks, students will develop the skills to navigate the ethical and legal challenges associated with data-driven technologies.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the foundational principles of data ethics and their application in AI and data analytics. • Identify and address ethical challenges in data collection, storage, analysis, and sharing. • Explain key data protection laws and regulations, such as GDPR, CCPA, and HIPAA. • Assess the societal impact of AI technologies, including issues of fairness, bias, and accountability. • Develop strategies for ensuring compliance with data protection and privacy laws.
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	<ul style="list-style-type: none"> • Critically evaluate ethical and legal issues in real-world case studies. • Advocate for responsible AI development and data analytics practices.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Introduction to Data Ethics <ul style="list-style-type: none"> • Definition and importance of ethics in AI and data analytics. • Key ethical principles: fairness, accountability, transparency, and explainability (FATE). • Overview of ethical decision-making frameworks. 2. Ethical Challenges in AI and Data Analytics <ul style="list-style-type: none"> • Identifying and mitigating bias in AI models. • Issues of data ownership and consent. • Ethical dilemmas in predictive analytics and algorithmic decision-making. 3. Data Protection and Privacy Laws <ul style="list-style-type: none"> • Overview of global data protection regulations: GDPR (EU), CCPA (California), HIPAA (US). • Key concepts: data subject rights, consent, and data breach notification. • Cross-border data transfer and jurisdictional challenges. 4. Societal Impacts of AI and Data Analytics <ul style="list-style-type: none"> • Examining the impact of AI on employment, education, and healthcare. • Ethical implications of AI in surveillance and law enforcement. • Balancing innovation with societal responsibility. 5. Responsible AI and Governance <ul style="list-style-type: none"> • Principles for developing ethical AI frameworks and policies. • Tools and practices for ensuring transparency and accountability in AI systems. • Role of ethics committees and regulatory bodies in overseeing AI and data analytics projects. 6. Case Studies in Data Ethics and Law <ul style="list-style-type: none"> • Analysis of real-world incidents involving ethical or legal breaches (e.g., Cambridge Analytica, AI in hiring bias). • Lessons learned and strategies for prevention. • Role-playing and debates on controversial AI and data analytics scenarios. 7. Practical Implementation and Compliance <ul style="list-style-type: none"> • Conducting ethical impact assessments for AI projects. • Developing privacy policies and data governance frameworks. • Ensuring compliance with legal standards in data analytics workflows.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Big Data Analytics	BIT 4.7 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	4.1 C Fundamentals of AI and Data Analytics
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 2 - 4 assignments
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with the knowledge and skills to process, analyze, and derive insights from large-scale datasets. Students will learn the principles, tools, and frameworks essential for working with big data systems. This module emphasizes the practical application of big data analytics techniques in real-world scenarios, enabling students to address complex problems across various domains using scalable solutions.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the characteristics and challenges of big data, including volume, velocity, variety, and veracity. • Use big data frameworks (e.g., Hadoop, Spark) to process and analyze large datasets. • Apply distributed computing techniques for efficient data storage and processing. • Perform big data analytics to identify patterns, trends, and insights. • Work with structured and unstructured data in big data environments. • Visualize and communicate results derived from big data analysis effectively. • Address ethical and security considerations in big data analytics.
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Contents	<ol style="list-style-type: none">1. Introduction to Big Data<ul style="list-style-type: none">• Definition and characteristics of big data (4Vs: volume, velocity, variety, veracity).• Importance of big data analytics in modern industries.• Overview of big data ecosystems and architectures.2. Big Data Storage and Processing<ul style="list-style-type: none">• Distributed storage systems: HDFS (Hadoop Distributed File System), cloud storage.• Distributed computing frameworks: Hadoop MapReduce and Apache Spark.• Concepts of parallel and distributed data processing.3. Big Data Tools and Technologies<ul style="list-style-type: none">• Introduction to Apache Hadoop and its ecosystem (HDFS, YARN, Hive, Pig).• Overview of Apache Spark: RDDs, DataFrames, and Spark SQL.• Working with NoSQL databases (e.g., MongoDB, Cassandra).4. Big Data Analytics Techniques<ul style="list-style-type: none">• Data preprocessing in big data environments.• Techniques for big data analytics: clustering, classification, and sentiment analysis.• Real-time analytics with streaming data (e.g., Apache Kafka, Spark Streaming).5. Data Visualization for Big Data<ul style="list-style-type: none">• Tools for visualizing big data insights (e.g., Tableau, Power BI, D3.js).• Creating dashboards and visual representations of large datasets.• Best practices for visualizing complex data.6. Big Data Use Cases and Applications<ul style="list-style-type: none">• Industry applications: finance, healthcare, e-commerce, and IoT.• Case studies showcasing successful big data implementations.• Challenges and opportunities in big data analytics.7. Ethical and Security Considerations in Big Data<ul style="list-style-type: none">• Addressing data privacy and security issues in big data environments.• Ensuring compliance with data protection regulations (e.g., GDPR).• Ethical implications of big data usage and decision-making.
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Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Data Warehousing	BIT 4.8 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	3.1 Database Systems
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical exam, 40 – 60 minutes (40% weighting) Written, 60 minutes (60% weighting)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the concepts, design, and implementation of data warehousing systems. Students will learn how data warehouses are used to store, organize, and manage large volumes of historical and transactional data for analysis and decision-making. The module emphasizes data modeling, Extract-Transform-Load (ETL) processes, and the use of data warehouses in business intelligence applications.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the purpose and architecture of data warehousing systems. • Design and implement data warehouse schemes, including star and snowflake schemas. • Develop ETL processes to extract, transform, and load data into a data warehouse. • Use query optimization techniques to improve data retrieval performance. • Leverage data warehouses for business intelligence and decision support. • Apply tools and technologies for data warehousing, such as SQL and OLAP.
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	<ul style="list-style-type: none"> Recognize the challenges and best practices in managing data warehouses.
Contents	<ol style="list-style-type: none"> Introduction to Data Warehousing <ul style="list-style-type: none"> Definition and role of data warehouses in data analytics. Comparison of data warehouses and transactional databases. Use cases for data warehousing in various industries. Data Warehouse Architecture <ul style="list-style-type: none"> Components of data warehouse: data sources, staging area, ETL processes, and data marts. Overview of On-Line Analytical Processing (OLAP) and On-Line Transaction Processing (OLTP). Types of data warehouses: enterprise data warehouse, operational data store, and cloud-based solutions. Data Modeling for Data Warehousing <ul style="list-style-type: none"> Concepts of dimensional modeling. Star schema, snowflake schema, and fact constellation schema. Designing fact and dimension tables. ETL Processes <ul style="list-style-type: none"> Overview of ETL: extracting data from sources, transforming data, and loading into the warehouse. Tools and frameworks for ETL (e.g., Talend, Apache Nifi, Informatica). Handling data quality issues during ETL processes. Query Optimization and Performance <ul style="list-style-type: none"> Techniques for optimizing queries in data warehouses. Indexing, partitioning, and materialized views. Performance tuning for large-scale data retrieval. Business Intelligence and Decision Support <ul style="list-style-type: none"> Using data warehouses for reporting and analytics. Introduction to dashboards and visualization tools (e.g., Tableau, Power BI). Conducting multidimensional analysis with OLAP cubes. Challenges and Best Practices <ul style="list-style-type: none"> Data integration challenges in heterogeneous environments. Maintaining data consistency, accuracy, and integrity. Trends in data warehousing, such as real-time analytics and cloud-based solutions. Practical Implementation <ul style="list-style-type: none"> Designing and creating a data warehouse schema for a specific domain. Implementing an ETL pipeline to populate the data warehouse. Running and optimizing queries for business intelligence tasks.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Computation Intelligence	BIT 4.9 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Compulsory
Prerequisites	4.1C Fundamentals of AI and Data Analytics
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, 2 – 4 assignments
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to introduce students to the principles, techniques, and applications of Computational Intelligence (CI), focusing on algorithms inspired by natural and biological systems. Students will explore methods such as neural networks, evolutionary algorithms, and fuzzy logic, and their applications in solving complex optimization and decision-making problems. The module emphasizes both theoretical foundations and practical implementation of CI techniques.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Understand the foundational principles of Computational Intelligence and its components. • Apply neural networks, fuzzy systems, and evolutionary algorithms to solve real-world problems. • Design and implement optimization algorithms based on natural and biological processes. • Evaluate the performance and limitations of different CI techniques. • Use CI methods for tasks such as classification, optimization, and prediction. • Implement CI algorithms using programming tools and frameworks (e.g., Python, TensorFlow, PyTorch).
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	<ul style="list-style-type: none"> Recognize emerging trends and applications of Computational Intelligence in various domains.
<p>Contents</p>	<ol style="list-style-type: none"> Introduction to Computational Intelligence <ul style="list-style-type: none"> Definition and scope of Computational Intelligence. Comparison of CI with traditional AI and machine learning. Applications of CI in optimization, robotics, and decision-making. Neural Networks <ul style="list-style-type: none"> Fundamentals of artificial neural networks (ANNs). Key components: neurons, activation functions, and layers. Overview of training and learning processes (e.g., backpropagation). Applications of ANNs in classification and regression tasks. Evolutionary Algorithms <ul style="list-style-type: none"> Principles of natural selection and genetic algorithms. Concepts of population, selection, crossover, and mutation. Variants of evolutionary algorithms: genetic programming, particle swarm optimization, and ant colony optimization. Solving optimization problems using evolutionary approaches. Fuzzy Systems <ul style="list-style-type: none"> Introduction to fuzzy logic and fuzzy sets. Membership functions and fuzzy rules. Designing fuzzy inference systems for decision-making. Applications of fuzzy logic in control systems and uncertainty handling. Hybrid Computational Intelligence Systems <ul style="list-style-type: none"> Combining neural networks, fuzzy logic, and evolutionary algorithms. Hybrid approaches for complex problem-solving. Case studies showcasing hybrid CI solutions. Implementation Tools and Frameworks <ul style="list-style-type: none"> Programming CI algorithms in Python. Using libraries such as TensorFlow, Keras, and Scikit-learn for neural networks. Tools for implementing evolutionary algorithms and fuzzy systems. Ethics and Challenges in Computational Intelligence <ul style="list-style-type: none"> Addressing bias and fairness in CI-based systems. Challenges in scalability and interpretability. Ensuring responsible development and deployment of CI solutions. Practical Implementation <ul style="list-style-type: none"> Developing CI solutions for optimization and decision-making tasks. Implementing neural networks for real-world datasets. Applying evolutionary algorithms to solve complex problems.

Subject area	Artificial Intelligence and Data Analytics	BIT 4 C
Module	Advanced AI and Data Analytics	BIT 4.10 C

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	72
Learning Time (h)	188
Study Semester	6
Type	Compulsory
Prerequisites	4.1 C Fundamentals of AI and Data Analytics
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical, Project (50%), Written, Documentation, 5 - 10 pages (20%), Presentation, min. 20 minutes (30%)
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	<p>The purpose of this module is to provide students with an advanced understanding of Artificial Intelligence (AI) and Data Analytics (DA), consolidating their knowledge and skills acquired throughout the specialization. As the capstone module with, it bridges any remaining gaps in concepts, techniques, and methods, while emphasizing emerging trends and cutting-edge advancements in the field. This module prepares students to address complex, real-world challenges using innovative AI and DA approaches and equips them with the expertise to stay at the forefront of this rapidly evolving domain.</p> <p>Students will be able to</p> <ul style="list-style-type: none"> • Demonstrate a deep understanding of advanced AI and DA techniques and their applications. • Integrate multiple AI and DA methods to solve complex, multi-faceted problems. • Explore and implement state-of-the-art trends and technologies in AI, such as explainable AI (XAI), generative AI, and edge AI. • Analyze large-scale datasets using advanced analytics frameworks and tools.
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	<ul style="list-style-type: none"> • Develop scalable and efficient AI and DA systems using cloud and distributed technologies. • Evaluate the ethical, societal, and legal implications of advanced AI and DA solutions. • Lead comprehensive projects that require strategic application of AI and DA methodologies.
<p>Contents</p>	<ol style="list-style-type: none"> 1. Consolidation of Core Concepts in AI and DA <ul style="list-style-type: none"> • Advanced supervised and unsupervised learning techniques. • Ensemble methods, such as random forests, gradient boosting, and stacking. • Advanced optimization techniques and hyperparameter tuning. 2. Emerging Trends in AI <ul style="list-style-type: none"> • Explainable AI (XAI): techniques for transparency and interpretability. • Generative AI: GANs, transformers, and large language models. • Edge AI and IoT: deploying AI systems at the edge for real-time applications. • Advances in reinforcement learning and deep reinforcement learning. 3. Advanced Data Analytics Techniques <ul style="list-style-type: none"> • Predictive and prescriptive analytics. • Time-series analysis and forecasting using advanced models (e.g., ARIMA, LSTMs). • Graph analytics and network analysis. • Real-time analytics and stream processing. 4. Scalable AI and Data Analytics Systems <ul style="list-style-type: none"> • Distributed AI and analytics using frameworks like TensorFlow Distributed and Apache Spark. • Cloud-based solutions for large-scale AI and DA (AWS, Google Cloud, Azure). • Managing big data pipelines and workflows. 5. Applications of Advanced AI and DA <ul style="list-style-type: none"> • Case studies: AI in healthcare, finance, autonomous systems, and smart cities. • Designing AI and analytics solutions for business intelligence and decision-making. • Integration of AI and DA systems with existing organizational infrastructure. 6. Ethical, Legal, and Societal Implications <ul style="list-style-type: none"> • Addressing ethical concerns in advanced AI applications. • Ensuring compliance with data privacy laws and AI regulations. • Balancing innovation with societal and environmental responsibility. 7. Practical Implementation <ul style="list-style-type: none"> • Developing AI and DA solutions for real-world scenarios. • Using cutting-edge tools and frameworks for deployment and monitoring. • Implementing solutions that combine multiple AI and DA techniques. 8. Capstone Project

	<ul style="list-style-type: none">• Designing, implementing, and presenting a comprehensive AI and DA project that integrates advanced concepts and emerging technologies.• Documenting the methodology, challenges, and solutions.• Reflecting on the societal impact and future scope of the project.
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Subject area	Elective Modules	BIT 5
Module	Elective I	BIT 5.1

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	4
Type	Compulsory
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	according to the module description of the selected module
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	according to the module description of the selected module
Contents	according to the module description of the selected module

Subject area	Elective Modules	BIT 5
Module	Elective II	BIT 5.2

Responsible	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Degree programs
ECTS credits	5
Total Workload (h)	130
Teaching time (h)	36
Learning Time (h)	94
Study Semester	5
Type	Elective
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	according to the module description of the selected module
Grading Scheme	Differentiated (at least grade 4,0)

Learning outcomes and competencies	according to the module description of the selected module
Contents	according to the module description of the selected module

Subject area	Information Technology Projects	BIT 6
Module	Project I	BIT 6.1

Responsible person	Mohammed AbuJarour
Frequency	Once the academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	81
Learning Time (h)	179
Study Semester	2
Prerequisites	none
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written: Report (50%)
Grading Scheme	Undifferentiated

Learning outcomes and competencies	<p>This project serves to prepare the students for team cooperation and individual contributions in information technology settings. Students choose an area of interest in IT to apply and deepen the knowledge acquired from the respective assigned courses. This module considers limited practical knowledge and skills and therefore the emphasis is on planning and organizing in a team setting.</p> <p>Students know and understand different roles in information technology team settings.</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> • Identify and share a project idea • Plan a project and define milestones • Define roles within the team • Articulate their own role and contributions • Use appropriate working methods, tools and workflows and divide them up for team collaboration • Implement a simple IT project • Reflect retrospectively on the results and workflows in project completion and derive insights for the next projects.
Contents	<ol style="list-style-type: none"> 1. Project identification and presentation 2. Team building, roles and responsibilities 3. Milestones

	<ol style="list-style-type: none">4. Process organization5. Preparation and planning6. Implementation processes
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Subject area	Information Technology Projects	BIT 6
Module	Project II	BIT 6.2

Responsible person	Mohammed AbuJarour
Frequency	Once the academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	81
Learning Time (h)	179
Study Semester	3
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written: Report (50%)
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	<p>This project serves to professionalize the interdisciplinary cooperation of the students within the field of information technology. Accordingly, expectations regarding the complexity of the project are increasing. The focus is on further expanding and deepening practical skills and knowledge in their chosen area of specialization.</p> <p>Students will know and understand interdisciplinary relationships in the context of the specific project.</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> • Discuss workflows in a team, differentiate between disciplines and specify them in technical terms. • Define interfaces between the individual departments and specify corresponding workflows • systematically analyze the practical, technical and creative challenges that vary depending on the subject area • select and apply appropriate practical, design, technical and creative methods and techniques, depending on the specialization. • Take responsibility for their own and independent work results in the respective area. • Implement a more complex IT project • Reflect retrospectively on work results and workflows in project completion and derive insights for the next projects.
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Contents	<ol style="list-style-type: none">1. Project proposals2. Team building, role definitions.3. Project planning and milestones4. Preparation and testing5. Implementation processes6. Evaluations processes7. Reflection and continuous improvement
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Subject area	Information Technology Projects	BIT 6
Module	Project III	BIT 6.3

Responsible person	Mohammed AbuJarour
Frequency	Once the academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	81
Learning Time (h)	179
Study Semester	4
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written: Report (50%)
Grading Scheme	Differentiated

Learning outcomes and competencies and competencies	<p>This module aims at professional standards in the planning, preparation and execution of an information technology project. The focus is on aligning practical knowledge in the areas of design, art and programming with the requirements for later career entry.</p> <p>Students know and understand interdisciplinary relationships in the context of the specific project and can jointly define realistic qualitative and quantitative goals within the framework of their own expertise.</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> • Discuss and optimize workflows in the team in terms of effectiveness and efficiency. Compare workflows within the respective areas of expertise as a team with professional standards. • Independently identify, interpret and use relevant specialist sources in the information technology fields for their work. • Realistically assess individual knowledge in the areas of Information technology and, if necessary, expand it. • Systematically analyze practical, design, technical and creative challenges depending on the specialization and independently derive practice-oriented solutions from them. • Evaluate relevant specialist sources in information technology fields and use them for their work. • Implement a project of medium complexity
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	<ul style="list-style-type: none">• Reflect retrospectively on work results and workflows in project completion and derive insights for the next projects.
Contents	<ol style="list-style-type: none">1. Proposal documentation and specifications2. Project manage timelines, goals and milestones<ul style="list-style-type: none">• Design, development and implementation• Evaluation and reflective practice.

Subject area	Information Technology Projects	BIT 6
Module	Project IV	BIT 6.4

Responsible person	Mohammed AbuJarour
Frequency	Once an academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	67,5
Learning Time (h)	192,5
Study Semester	5
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written: Report (50%)
Grading Scheme	Differentiated

Learning outcomes and competencies	<p>Students will know and understand common industry standards and workflows in their chosen specialist field and will work out a task corresponding to their personal goals by means of which personal expertise can be demonstrated.</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> • Plan and develop an original proposal for an information technology project. • Critically analyze, scope and refine project specifications. • Produce an information technology-based solution to an industry standard. • Manage project timelines, goals and milestones employing an agile methodology. • Interpret professional work ethics and code of practice. <p>They will:</p> <ul style="list-style-type: none"> • implement a project of higher complexity. • put their own specialist knowledge and practical skills into perspective. • formulate your own learning objectives in the respective subject area. • consider and concretize interdisciplinary knowledge in connection with one's own work in the implementation. • reliably assess and plan even complex tasks and work plans <p>To promote individual development and perspective orientation after graduation, in contrast to the previous project phases, work in project groups is not enforced.</p>
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Contents	<ol style="list-style-type: none">1. Proposal documentation and specifications2. Development and implementation3. Reflective practice.4. IT Professional Knowledge (non-technical):5. Ethics and Code of Practice6. Managing ICT Risk7. Legal/Compliance Frameworks8. Organization Roles and Context9. Agile project management methodology
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Subject area	Information Technology Projects	BIT 6
Module	Project V	BIT 6.5

Responsible person	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	67,5
Learning Time (h)	192,5
Study Semester	6
Prerequisites	None
Teaching methods	50% - Seminar // 50% - Exercise // Blended
Prerequisite for the award of credit points	
Form of examination	Practical: Project (50%) Written: Report (50%)
Grading Scheme	Differentiated

Learning outcomes and competencies	<p>The final project will enable students to explicitly apply the design thinking principles by evaluating, designing, and developing a solution to an industry-based IT project within their specialist field, utilizing advanced information technology principles and techniques.</p> <p>This project work can be an extension of Project IV but it must be justified and indicative in the product workload, clearly demonstrating additional competencies.</p> <p>This project, with the approval of the examination committee, may be the focus of the thesis and colloquium degree qualification.</p> <ul style="list-style-type: none"> • Plan and develop an original proposal for an information technology project. • Critically analyze, scope and refine project specifications. • Produce an information technology-based solution to an industry-based project. • Manage project timelines, goals and milestones employing an agile methodology. • Develop a substantial report recording experiences, findings and outcomes, informed by current research and professional standards. • Interpret objectives through comprehensive self-reflective practice while interpreting professional work ethics and code of practice.
Contents	1. Proposal documentation and specifications

	<ol style="list-style-type: none">2. Development and implementation3. Final report and reflective practice.4. IT Professional Knowledge (non-technical):<ul style="list-style-type: none">• Ethics and Code of Practice• Managing ICT Risk• Legal/Compliance Frameworks• Organization Roles and Context5. Agile project management methodology6. Applied research
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Subject area	Information Technology Internship	BIT 7
Module	IT Internship	BIT 7.1

Responsible person	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Only in this degree program
ECTS credits	30
Total Workload (h)	780
Teaching time (h)	4,5
Learning Time (h)	775,5
Study Semester	6 (10 ECTS) and 7 (20 ECTS)
Prerequisites	BIT 1 Academic Methods and Competencies BIT 2 Information Technology Fundamentals BIT 3 Common Core Modules BIT 4 A or 4 B or 4 C BIT 5 Elective Modules BIT 6 Information Technology Projects
Teaching methods	None.
Prerequisite for the award of credit points	
Form of examination	Written (Report, 10 -20 pages) Oral: presentation, min. 30 minutes.
Grading Scheme	Undifferentiated
Learning outcomes and competencies	Students familiarize themselves with and apply the skills they have learned in practical working environments in relevant companies.
Contents	It depends in the subject of the employment

Subject area	Bachelor Qualification	BIT 8
Module	Thesis and Colloquium	BIT 8.1

Responsible person	Mohammed AbuJarour
Frequency	Once in the academic year
Applicability	Only in this degree program
ECTS credits	10
Total Workload (h)	260
Teaching time (h)	0
Learning Time (h)	260
Study Semester	7
Prerequisites	<p>BIT 1 Academic Methods and Competencies BIT 2 Information Technology Fundamentals BIT 3 Common Core Modules BIT 4 A or 4 B or 4 C BIT 5 Elective Modules BIT 6 Information Technology Projects</p> <p>The admission requirements for the final examination according to the general study and examination regulations of the mdh, as amended from time to time.</p>
Teaching methods	None.
Prerequisite for the award of credit points	
Form of examination	<p>Written and, as a rule, practical (thesis divided into a written (theoretical) and, as a rule, a practical part, in the form of an IT product).</p> <p>Oral, colloquium/ presentation.</p>
Grading Scheme	Differentiated (at least the grade 4,0)

Learning outcomes and competencies	<p>The purpose of this course is to enable the student to research and present an overview of the interrelationships of his or her subject and develop the ability to independently apply scientific methods and findings in their specialization</p> <ul style="list-style-type: none"> • The theoretical thesis consists of a scientific examination of a topic or question relevant to the development of information technology and their chosen specialization. • It must show that the students are capable of independent scientific work. • The elaboration corresponds to agreed formal requirements.
Contents	<p>Determined by the examination committee on consideration of the student proposal.</p> <p>Students may choose to propose:</p>

	<p>OR</p> <ul style="list-style-type: none">• A new project• An extension of the IT Project
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