# BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND AI

# PROGRAMME STRUCTURE

**Hours of total learning:** 4.500
**Total Contact Hours:** 1.000
**Supervised Placement and Practice Hours:** 800
**Self Study Hours:** 1.100
**Assessment Hours:** 1.600
**Program Credits:** 180 ECTS EQF/MQF level 6
**Duration:** 3 years – 36 months- 144 weeks
**Mode of Delivery:** Fully Online Learning
**Language of Instruction:** English
**Mode of Attendance:** Full Time

The Bachelor lasts 36 months (3 years) and it is organized around 6 semesters of 6 months each.

**FIRST YEAR**

1st semester: 30 ECTS

- Discrete Maths: EQF/MQF level 6 – 6 ECTS
- Fundamentals of Probability and Statistics: EQF/MQF level 6 – 6 ECTS
- Computer Networks: EQF/MQF level 6 – 6 ECTS
- Computer Architecture: EQF/MQF level 6 – 6 ECTS
- Digital Transformation and Business Innovation: EQF/MQF level 6 – 6 ECTS

2nd semester: 30 ECTS

- Information Security: EQF/MQF level 6 – 6 ECTS
- Fundamentals of Programming: EQF/MQF level 6 – 6 ECTS
- Software Engineering Principles: EQF/MQF level 6 – 6 ECTS
- Software Development: EQF/MQF level 6 – 6 ECTS
- Technology and Innovation Management: EQF/MQF level 6 – 6 ECTS

**SECOND YEAR**

3rd semester: 30 ECTS

- Introduction to Python programming Language: EQF/MQF level 6 – 6 ECTS
- Cybersecurity: EQF/MQF level 6 – 6 ECTS
- Database management: EQF/MQF level 6 – 6 ECTS
- Fundamentals of Data Science: EQF/MQF level 6 – 6 ECTS
- Quantitative Business Methods: EQF/MQF level 6 – 6 ECTS

4th semester: 30 ECTS

- Artificial Intelligence: EQF/MQF level 6 – 6 ECTS
- Cloud Computing: EQF/MQF level 6 – 6 ECTS
- Mobile applications design and development: EQF/MQF level 6 – 6 ECTS
- Operating Systems: EQF/MQF level 6 – 6 ECTS
- Artificial Intelligence Applications: EQF/MQF level 6 – 6 ECTS

**THIRD YEAR**

5th semester: 30 ECTS
- Machine learning fundamentals: EQF/MQF level 6 – 6 ECTS
- Neural Networks: EQF/MQF level 6 – 6 ECTS
- Big data: EQF/MQF level 6 – 6 ECTS
- Business Analytics: EQF/MQF level 6 – 6 ECTS
- Online Business and innovation: EQF/MQF level 6 – 6 ECTS

6th semester: 30 ECTS

- Deep Learning: EQF/MQF level 6 – 6 ECTS
- The Ethics of AI: EQF/MQF level 6 – 4 ECTS
- Bachelor Thesis: EQF/MQF level 6 –20 ECTS

**FUNDAMENTALS OF PROBABILITY AND STATISTICS - EQF/MQF level 6 – 6 ECTS**

The course provides a solid understanding of the fundamental concepts and principles of statistical reasoning. It aims to equip students with introductory-level practical skills, enabling them to effectively select, generate, and accurately interpret descriptive and inferential statistical methods. Topics covered includes: basic combinatorics, random variables, probability distributions, Bayesian inference, hypothesis testing, confidence intervals, and linear regression. Furthermore, the curriculum is designed to cultivate students' awareness of the varied applications of statistics and its significance in their personal lives and respective fields of study.

**DISCRETE MATHEMATICS - EQF/MQF level 6 – 6 ECTS**

The course introduces students to the basic concepts of discrete mathematics, covering topics such as sets, logic, enumeration methods, probability, recurrence relations, induction and graph theory. It provides important background for students of Computer Science and covers the study of finite systems and of the mathematical concepts and technique which should serve as a preparation for more advanced quantitative courses. Throughout the course, students develop and apply mathematical, logical, critical thinking, and statistical skills to solve problems in real-world contexts. They acquire skills in the fields of algebra, geometry, probability, statistics, and mathematical modelling.

**COMPUTER NETWORKS - EQF/MQF level 6 – 6 ECTS**

This course explores the conventional models for the layered communication approach among independent machines within a network. It delves into the key features of data transmission across different physical link types, addressing the design of networks and protocols for varied scenarios. The analysis extends to various application and support protocols, viewed through the lens of distributed systems, and highlights notable challenges within networked communications. Topics covered include communication network architectures, modulation across physical media, real-world local and wide-area networks, fundamentals of internet protocols, network performance and monitoring, routing, network security, and application protocols for distributed systems.

**COMPUTER ARCHITECTURE - EQF/MQF level 6 – 6 ECTS**

This course aims to offer a solid foundation to computer architecture, encompassing the single-core era, multi-core era, and accelerator era. It endeavours to equip students with the ability to apply these insights and principles to the design of future computer systems. The course is organized around the three primary components of general-purpose computing systems: processors, memories, and networks. The initial segment of the course concentrates on the fundamentals of each building block, covering topics such as instruction set architecture, single-cycle, FSM, and pipelined processor microarchitecture, direct-mapped vs. set-associative cache memories, memory protection, translation, and virtualization, FSM and pipelined cache microarchitecture, cache optimizations, and the integration of processors, memories, and networks. The latter part of the course delves into more advanced techniques, empowering students to comprehend how these three building blocks can be integrated to construct a modern shared memory multicore system.

**DIGITAL TRANSFORMATION AND BUSINESS INNOVATION - EQF/MQF level 6 – 6 ECTS**

The technology advances are changing the way business is conducted and business leaders need to develop analytical and innovative skills to succeed in the digital age. This course provides students with a comprehensive understanding of the impact of entrepreneurship and digital business. Through the course students analyse the digital transformation and digital disruption for companies and organisations and develop specialised competencies and experience on how to innovate through the use of technologies. The course makes extensive use of current case studies and gives students the opportunity to design new e-business models and applications.

**INFORMATION SECURITY - EQF/MQF level 6 – 6 ECTS**

The course provides students with a basic foundation for assessing security solutions required for particular applications and for making informed technology choices about security in ICT, assessing information security risks. Throughout the course students analyse the new challenges of increasing threats to computer security and understand the various threats and countermeasures. Specifically, students will learn the theoretical advancements in information security, state-of-the-art techniques, standards and best practices. In particular, the topics covered in this course includes: study of security policies, models and mechanisms for secrecy, integrity and availability; operating system models and mechanisms for mandatory and discretionary controls; data models, concepts and mechanisms for database security; security in computer networks, emerging applications and smart devices; control and prevention of viruses and other rogue programs.

**FUNDAMENTALS OF PROGRAMMING - EQF/MQF level 6 – 6 ECTS**

The course introduces the fundamental concepts of structured programming and provides a comprehensive introduction to programming for computer science and technology students. Topics include software development methodology, data types, control structures, functions, arrays, and the mechanics of running, testing, and debugging. This course assumes computer literacy. Fundamental programming concepts along with current issues such as parallelism and embedded systems will be covered through relevant programming projects.

**SOFTWARE ENGINEERING PRINCIPLES - EQF/MQF level 6 – 6 ECTS**

The central focus of the course is to offer a solid understanding and knowledge of generic software processes and specific software process models. It delves into key areas such as requirement engineering, various elements of analysis models, design engineering, diverse design model elements, and an introduction to quality assurance. Additionally, the course covers essential aspects of software testing and software project management. Throughout the course, students will acquire valuable skills crucial for effective software engineering practices. This includes proficiency in utilizing version control systems, crafting comprehensive project plans, eliciting requirements, developing design models, and engaging in validation and verification activities. An integral part of the learning experience involves students actively participating in a semester-long group project.

**SOFTWARE DEVELOPMENT - EQF/MQF level 6 – 6 ECTS**

This module aims to provide students with a comprehensive understanding of software development principles, methodologies, and practices. Students will learn to design, implement, and test software applications using modern programming languages and development tools. Emphasis will be placed on problem-solving, teamwork, and effective communication within the context of software projects. Additionally, students will explore contemporary software development trends and best practices, preparing them for real-world challenges. By the end of the course, students will have the skills and knowledge to contribute effectively to software development teams.

**TECHNOLOGY AND INNOVATION MANAGEMENT - EQF/MQF level 6 – 6 ECTS**

This course provides a comprehensive overview of the technology and innovation management field, with a particular focus on understanding the meaning and implications of technological change, various types of innovation, and strategies aimed at fostering innovation at company level. The content is organized into two main parts. In the first part, fundamental concepts related to technology and innovation management are introduced and explored. This includes an examination of the foundations of technology, innovation, characteristics of innovative organizations, and emerging approaches to innovation. The second part delves into the three key stages of innovation management: exploration, development, and exploitation. Throughout these stages, students will gain insight into the primary tools utilized in each phase. Additionally, the course provides an overview of major innovation databases, both at the enterprise and territorial levels, offering students valuable insights into real-world applications.

**INTRODUCTION TO PYTHON PROGRAMMING LANGUAGE - EQF/MQF level 6 – 6 ECTS**

This course introduces computer programming using the Python programming language. In this course, students will analyse the different programming systems with particular attention to python programming language, which is today the most widely used for many types of applications, from networking to the web, to animation up to machine learning. Emphasis is placed on common algorithms and programming principles utilising the standard library distributed with Python. Upon completion, students will be able to have a good knowledge of the python syntax and the most important mechanisms of object-oriented programming and should be able to design, code, test, and debug Python language programs.

**CYBERSECURITY - EQF/MQF level 6 – 6 ECTS**

This course offers a comprehensive exploration of the foundational aspects of cybersecurity. Encompassing a wide range of topics, the curriculum covers essential areas such as access controls, telecommunications and network security, risk management, software development security, cryptography, security architecture and design, operations security, business continuity, regulations, investigations, forensics, compliance, physical security, and emerging technologies.

**DATABASE MANAGEMENT - EQF/MQF level 6 – 6 ECTS**

In this course, students will provide students the fundamental theory and practical knowledge to use Database Management Systems to support MIS. It allows students to be introduced to main concepts of designing a relational database as well as map out the business requirements to the logical and physical design of Database Management Systems. In addition, OLAP tools to extract critical information to make business decisions will also be dealt with.

**FUNDAMENTALS OF DATA SCIENCE - EQF/MQF level 6 – 6 ECTS**

This course aims to provide students with an introductory and practical exploration of every stage in the data science process, utilizing authentic data sets and contemporary tools. Key topics covered include data formats, loading, and cleaning; statistical and exploratory data analysis using Python; fundamentals of data visualization; and an examination of essential ethical considerations in the field of data science.

**ARTIFICIAL INTELLIGENCE - EQF/MQF level 6 – 6 ECTS**

In this course students will be introduced to the fundamental theories and applications of artificial intelligence. Accordingly, this course provides students with intensive knowledge in designing intelligent agents and observing their behaviours in connection to its surrounding environment. In addition, search algorithms for problem solving will be covered deeply in this course, supported with the appropriate applications, and examples. The main goal of these materials is to allow students to make use of them for solving problems with help of intelligent agents and their adopted algorithms. Moreover, the concept of AI security will be introduced as well as the impact and implication of AI on cybersecurity.

**CLOUD COMPUTING - EQF/MQF level 6 – 6 ECTS**

This course presents students Cloud Computing and Cloud Infrastructure Services, the different Cloud Computing and Service Oriented Architecture and the Cloud Service Models/Types. Throughout the course, students will gain insights into the services offered by prominent "Big Clouds," such as Amazon AWS Cloud, Google Cloud, Microsoft Azure Cloud, IBM Cloud, Salesforce, and others. The curriculum delves into various cloud-related services, encompassing computing and hosting services, storage services, networking services, big data services, and machine/deep learning services. As students become acquainted with these cloud services, the focus will shift towards understanding how to synergize and integrate them effectively. This integration aims to support cognitive computing and facilitate the development of IAN (Intelligent Application for next-generation) solutions.

**OPERATING SYSTEMS - EQF/MQF level 6 – 6 ECTS**

This course offers an introduction to the design and implementation of operating systems. It covers the principles and techniques in the design of operating systems. Throughout the course, students will explore concepts of operating systems in terms of functions, structure, and implementation, particularly emphasizing multiprogramming. Topics covered are: process coordination, deadlocks, memory management, device management, file systems, scheduling policies for CPU, and network and distributed operating systems.

**MOBILE APPLICATIONS DESIGN AND DEVELOPMENT - EQF/MQF level 6 – 6 ECTS**

This course provides a comprehensive understanding of mobile application design and development and how enhanced mobile devices are changing the face of technology. The course begins with some introductory concepts to lay the foundation for more advanced topics, such as regarding development platforms, cross-platform development, mobile operating systems, the mobile web, The Internet of Things, and artificial intelligence in mobile apps. Also, the course will cover a theoretical overview of mobile application, design and development issues, and practical application concerns. Conceptual and scenario-based exercises will be used to reinforce student learning in the course.

**ARTIFICIAL INTELLIGENCE APPLICATIONS - EQF/MQF level 6 – 6 ECTS**

The course aims to develop a relational comprehension of Artificial Intelligence (AI) and emphasizes the opportunities, limitations, and challenges associated with the organizational application of AI for value creation. It introduces various AI technologies and traces their emergence. By delving into theories that elucidate the interactions and dynamics between organizations and technology, the course underscores how AI introduces novel challenges at both organizational and societal levels. Within this context, the course delves into the operational and strategic dimensions, exploring how businesses can navigate and leverage AI to comprehend, manage, and create value.

**MACHINE LEARRNING FUNDAMENTALS - EQF/MQF level 6 – 6 ECTS**

This introductory undergraduate course provides a foundational understanding of Machine Learning (ML) concepts, algorithms, and applications. Students will explore supervised and unsupervised learning, reinforcement learning, and various ML models. The curriculum covers essential topics such as feature engineering, model evaluation, and ethical considerations in machine learning. Throughout the course, students will engage in hands-on exercises to gain practical experience in implementing and evaluating machine learning models.

**NEURAL NETWORKS - EQF/MQF level 6 – 6 ECTS**

This course provides an introduction to Neural Networks, covering foundational concepts, architectures, and applications. Students will explore the structure and functioning of neural networks, including feedforward and recurrent architectures. They will also examine the history of neural networks and state-of-the-art approaches to deep learning. Moreover, students will learn how to design neural network architectures and training procedures and how to use a critical software tool for modern deep learning: TensorFlow.

**BIG DATA - EQF/MQF level 6 – 6 ECTS**

In this course, students will be introduced to data analysis to enhance their skills and comprehension of how big data generates value in both the business and public sectors. The curriculum encompasses an exploration of the data analysis lifecycle, delving into the three primary types of data analytics: descriptive, predictive, and prescriptive. A significant component of the course involves the extensive use of Anaconda, leveraging Python and its libraries. The course is designed to equip students with the expertise to navigate and derive insights from diverse, real-world data, fostering proficiency in serving business needs. It offers a unique fusion of information technology, mathematical, analytical, and managerial skills. Additionally, the curriculum addresses essential aspects such as Big Data privacy, the management of large datasets, and the systems and processes employed to mitigate risks and safeguard sensitive data.

**BUSINESS ANALYTICS - EQF/MQF level 6 – 6 ECTS**

Business Analysts concerns the analysis of company's processes and with the investigation of their functionality. Meanwhile, Business Analytics is a relatively recent discipline that aids organizations in comprehending the vast amount of data collected from sources like the web and social media. Employing various data analysis techniques, it uncovers valuable information, enabling organizations to enhance operational efficiency and tailor their products, services, and pricing. This course will concentrate on the evolving field of business analytics, a pivotal component in the fourth industrial revolution and the advancement of the digital economy. Students will acquire, apply, and experience a foundational set of skills in big data, modeling standards, analytics, business intelligence systems, and problem-solving. The aim is to equip them to address genuine industrial and business challenges.

**DEEP LEARNING - EQF/MQF level 6 – 6 ECTS**

This course delves into the underlying reasons and mechanisms that set artificial neural networks apart from generalized linear models. It explores their capacity for universal function approximation, specifically in learning non-linear, multi-dimensional output spaces. Beginning with a comprehensive exploration of deep and wide feed-forward neural networks, also known as multilayer perceptron, the course subsequently introduces two specialized deep learning solutions: convolutional neural networks and recurrent neural networks. These are thoroughly explained, illustrating their efficacy in learning and processing grid-shaped data and sequential data, respectively. The course also delves into the realm of deep unsupervised neural networks, showcasing their potency in learning unlabeled data through meticulous adjustment of input reconstruction errors. Furthermore, the curriculum highlights the latest advancements in deep learning techniques, specifically their application in audio analysis, computer vision, and natural language processing.

**ONLINE BUSINESS AND INNOVATION - EQF/MQF level 6 – 6 ECTS**

Advancements in technology are reshaping the landscape of business operations, necessitating business leaders to cultivate analytical and innovative skills to thrive in the digital era. This course is tailored to offer students a thorough comprehension of the influence of entrepreneurship and digital business. Throughout the program, students delve into the analysis of digital transformation and disruption, cultivating specialized competencies and practical experience in areas such as business innovation, online business, startup creation, online management strategies, and leadership. Moreover, the course offers a platform for students to engage in the design of new e-business models and applications, fostering a hands-on and forward-thinking approach to learning.

**THE ETHICS OF AI - EQF/MQF level 6 – 4 ECTS**

This course explores the intersection of AI ethics with law and public policy, scrutinizing the norms, values, and political strategies influencing the consensus-building processes that shape the development and governance of AI systems. Students will actively participate in a critical analysis of AI policy documents, delving into fundamental principles like fairness, accountability, and transparency, investigating both their origins and practical applications. The curriculum places a strong emphasis on a series of critical thinking discussion forums. These forums serve as a platform for students to engage in debates regarding the responsible use of AI through real-world case studies.

**BACHELOR THESIS/DISSERTATION - EQF/MQF level 6 – 20 ECTS**

The culminating assignment in a student's degree program is the final-year thesis, representing a pivotal task that integrates their acquired abilities and prepares them for future endeavors. Serving as the most demanding project, the thesis requires thorough planning and sustained effort over the final term. Students will be guided and mentored by a reference professor that will be assigned based on the chosen dissertation's topic.  Students are required to present the proposal for the topic of the dissertation to their reference professors. The proposal must contain an introduction to the problem, a statement of the problem, significance and impact, the aims of the research and analysis, a description of the methods, and a realistic project timeline. The reference professor will ensure that the work not only meets high-quality standards but also delves deeply into a specific research topic.
The dissertation is generally 100 pages, corresponding to 50000 words single-spaced or 25000 words double-spaced, not including the bibliography. However, the length will vary according to the topic and the method of analysis, so the appropriate length will be determined by the student and the project advisor. Once the project is completed and approved by the project advisor, the student has to present it by videoconference to the master committee. The master committee will oversee the evaluation of the dissertation and grade it.