COURSE DESCRIPTION – ACADEMIC YEAR 2021/2022

Course title	**Systems Design and Implementation**
Course code	76088
Scientific sector	ING-INF/04
Degree	Master in Software Engineering for Information Systems (LM-18)
Semester	2
Year	1
Credits	12
Modular	Yes
University	UniBZ

Total lecturing hours	80
Total exercise hours	40
Attendance	Recommended
Prerequisites	Lectures and exercises of Mathematical Analysis I and II, Geometry, Physics I, Mechanics of Machinery
Course page	https://ole.unibz.it/

Specific educational objectives	The course belongs to the type caratterizzanti – discipline informatiche and is part of the Specialization Topics. **Module 1: Embedded Systems Design and Implementation** The course belongs to the scientific area of Hardware and Software design, with a specific focus on the development, deployment, validation and testing of embedded devices, particularly as regards internet-of-things (IoT) devices, LSVI technology and micro controllers. The course gives a general overview of the principles of hardware and software co-design in an embedded context, with a strong practical slant. The students are led on a journey through small, bare-metal microcontrollers, industry leading power management devices, controllers based on programmable logic and more recently emerging approaches based on high speed data exchange. The theoretical and practical aspects are addressed throughout, as they become relevant to each platform and use case under consideration. **Module 2: Extended Reality: Augmented, Virtual and Mixed Reality** The course belongs to the scientific area of Management Engineering and is focused on Business Intelligence and Enterprise Resource Planning Systems. It represents one of the related topics (affine/verwandt) for the study programme on Software Engineering for Information Systems. The course gives a general overview of the scientific basics of business and its objectives as well as the role software can play in it. During the course, the industrial application of the presented theoretical topics will be integrated by means of targeted application-oriented exercises and cases concerning the business environment, especially the manufacturing sector.

	The learning objectives are to introduce informatic students in the fundamentals of business and business software. Based on this, decision making and operational tools such as Business Intelligence and Enterprise Resource Planning Systems are discussed in detail alongside presentations of their real-world application in business. Starting from this knowledge, the students will outline an exemplary design of a business software to apply their knowledge and combine it to the other contents of the study program. In the end, the students should acquire the competence to understand and evaluate business problems and outline an appropriate design for a business software to address the problem in terms of decision support or operational improvements in the manufacturing sector.

Module 1	**Embedded Systems Design and Implementation**
Module code	76088A
Module scientific sector	ING-INF/04
Lecturer	Andrea Stona
Contact LA	Faculty of Computer Science, Domenikanerplatz 3 - Piazza Domenicani
Scientific sector of lecturer	--
Teaching language	English
Office hours	Thursday 9:30 to 10:30 and Thursday from 15:30 to 16:30
Lecturing Assistant	--
Contact LA	--
Office hours LA	--
Credits	6
Lecturing hours	40
Exercise hours	20
List of topics	• Fundamental notions and architectures of embedded and cyber-physical systems • Control and management of time and hardware interfaces • Design and programming of real-time software • Hardware architectures including MPU/MCUs, DSPs, FPGAs and ASICs • Practical aspects of real-world implementation and engineering aspects
Teaching format	The lessons are divided into theoretical classroom lessons, and exercises using blackboard and slides as well as exercises.

Module 2	**Extended Reality: Augmented, Virtual and Mixed Reality**
Module code	76088B
Module scientific sector	ING-INF/05
Lecturer	Michael Haller
Contact LA	Faculty of Computer Science, Domenikanerplatz 3 - Piazza Domenicani Michael.Haller@unibz.it
Scientific sector of lecturer	ING-INF/05
Teaching language	English

Office hours	Wednesday, 10:30 – 12:30
Lecturing Assistant	--
Contact LA	--
Office hours LA	--
Credits	6
Lecturing hours	40
Exercise hours	20
List of topics	• General Overview, current trends and future applications of XR technologies • Introduction to Computer Graphics – The rendering pipeline • Working with a graphics engine (e.g. OpenGL, Unity3d) • Input devices – controllers, motion trackers and motion capture technologies for tracking • Output devices – Head Mounted VR Displays, Augmented and Mixed reality glasses • Rapid XR prototyping
Teaching format	Frontal lectures, exercises, project

Learning outcomes	**Knowledge and understanding:** D1.2 To be able to analyze and solve even complex problems in the area of Software Engineering for Information Systems with particular emphasis on the use of studies, methods, techniques and technologies of empirical evaluation; D1.4 To know in depth the principles, structures and use of computer systems for the automation of information systems; D1.8 To be able to read and understand specialist scientific documentation, such as conference proceedings, articles in scientific journals, technical manuals. **Applying knowledge and understanding:** D2.3 To know how to apply the principles of software engineering to domains of different complexity, both IT and non-IT, in which software technology is of great importance, such as, for example, in the transport sector or in the medical field; **Making judgments:** D3.1 To be able to autonomously select documentation from a variety of sources, including technical books, digital libraries, technical scientific journals, web portals or open source software and hardware tools; **Communication skills:** D4.6 To be able to interact and collaborate during the implementation of a project or research with peers and experts; **Learning skills:** D5.3 In the context of a problem solving activity, to be able to extend knowledge, even if incomplete, taking into account the final objective of the project;

Assessment	**Module 1: Embedded Systems Design and Implementation** The assessment is based on two components: - An oral exam consisting of exercises and open questions; - A project work (done in groups or alone) in which students should outline the design of a embedded computing tool for addressing a practical problem and present it. **Module 2: Extended Reality: Augmented, Virtual and Mixed Reality** Both homework (part 1) & exam (part 2) have to be done in pairs of two to get a positive mark. Part 1: [40%] Progress Report of the weekly homework Smaller exercises, demonstrating the progress throughout the semester. Students have to implement smaller weekly-exercises and submit - a ZIP file with all the project data (showing the working results) - a progress report (3-4 pages for each exercise) The progress report should be easy-to-understand, so that one of your colleagues - who is not joining this course - can replicate what you have done. Part 2: [60%] Final Examination of the (larger) project Finally, you have to design and implement a smaller demo app which you have to describe in a 10-page report & present in the final examination. Again, you have to submit - a ZIP file with all the project data - the final progress report (10 pages for the demo)
Assessment language	English
Assessment typology	Collegial commission
Evaluation criteria and criteria for awarding marks	**Module 1: Embedded Systems Design and Implementation** The oral exam consists of two parts: A first part with a series of questions with to-be-freely formulated answers, as well as a second part consisting of several conceptual and design problems to be solved, which are distributed among the various topics covered. Judged will be: • the correctness, originality and inventiveness of the approach and the steps of the solution; • the correctness of the provided answers and arguments presented and the terminology used. **Module 2: Extended Reality: Augmented, Virtual and Mixed Reality** cf. Assessment

Required readings	Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it **Module 1: Embedded Systems Design and Implementation** • Lecture slides and notes • Lab exercise slides and notes **Module 2: Extended Reality: Augmented, Virtual and Mixed Reality** • Lecture notes will be handed out during the course.

Supplementary readings	**Module 1: Embedded Systems Design and Implementation** • Embedded system design, Peter Marwedel **Module 2: Extended Reality: Augmented, Virtual and Mixed Reality** • Augmented Reality: Principles and Practice, Dieter Schmalstieg, Tobias Höllerer, • https://learnopengl.com
Software used	Visual Studio, Unity, Blender