Course Title	Smart Systems Integration				
Course Code	DLWSS534				
Course Type	Specialization (Elective)				
Level	Master (2nd Cycle) (Distance Learning)				
Semester	2 or 3				
Teacher's Name	Costas Kyriacou				
ECTS	10	Lectures/week	3	Laboratories/week	0
Course Purpose	Smart systems rely on a number of technologies that form the pillars of their development. Such technologies are the microcontrollers and embedded systems, data communication and networking, sensors and actuators, signal processing, artificial intelligence, the web, mobile devises, the internet and the Internet-of-Things (IoT). Typically each of this technologies is examine as a separate course in related academic programs. The purpose of this course is to outline the characteristics of each of the above mention technologies, and then combine them to build a smart system.				
Learning Outcomes	By the end of the course the students are expected to: 1. Select the most appropriate microcontroller/single board computer for the implementation of a smart systems based on given constraints. 2. Demonstrate competency in the use of prominent software development tools and operating systems for smart systems. 3. Develop the necessary software modules to transfer data between chips, boards and systems in smart systems using wired and wireless communication systems and protocols. 4. Develop the necessary software to process analog sampled data using digital signal processing techniques. 5. Develop smart systems that incorporate smart sensors and actuators. 6. Employ artificial intelligence techniques in smart systems. 7. Develop the necessary software to upload data from a smart device to a web server, store it in a database server, perform necessary computations and display it in dashboards.				
Prerequisites	None		Required	None	
Course Content	The course is taught in a period of twelve weeks covering the following topics: 1. **Introduction to Smart Systems:** Characteristics and typical components of smart systems. Constraints in smart systems. Energy efficiency and power requirements. Classification and overview of smart system examples. 2. **Microcontrollers and Single Board Computers:** Internal structure and functionality of a typical microcontroller. Overview of current microcontrollers and single board microcontroller/computer systems. Limitations and comparison between existing systems. 3. **Software Development Tools and Operating Systems for Smart Systems:** Programming languages and software platforms used for the				

	developments of smart systems. Real time operating systems for smart systems. Characteristics and limitations. Simple smart systems programming examples. 4. **Data Communication and Networking for Smart Systems:** Chip-to-Chip, Board-to-Board and System-to-System wired data transfers and communication protocols. Wireless radio communication systems and protocols for smart system applications. Data transfer programming examples. 5. **Analog Interfacing and Signal Processing:** Sampling and quantization. Analog to Digital and Digital to Analog converters. Digital signal processing and filtering. Programming examples including analog interfacing and digital filtering. 6. **Smart Sensors and Actuators:** Overview of sensors and actuators. Micro-Electro-Mechanical Systems (MEMS). Smart sensors components and requirements. Programming examples including smart sensors and actuators. 7. **Artificial Intelligence for Smart Systems:** Overview of artificial intelligence, machine learning and neural networks. Programming examples including artificial intelligence techniques and algorithms for smart systems. 8. **Internet Technologies for Smart Systems:** Web servers and database servers for smart systems. Development platforms and software tools. Programming examples including Web servers and database servers for smart systems. 9. **Smart Systems Case Studies:** Integration of the above technologies for the development of a complete smart system.
Teaching Methodology	The course is structured in units that are conducted with the help of material available online described in the module study guide. The primary resources are narrated presentations that introduce the course material together with practical examples and exercises to enhance the material learning process based on the textbook(s). Other resources include research papers and online tutorials and videos. Online short post-lecture quizzes are used to assess the level of student understanding and provide feedback. Student questions are addressed through online interaction both synchronous and asynchronous (chat sessions and forum discussions). Online forums are also used for further student participation activities such as short group exercises. Examples are developing preliminary requirements and specification documents. Throughout the course, students will develop their own smart system, as the course progresses, while during the last three weeks, students will integrate the various components into a complete smart system.
Bibliography	**Textbook:** • Peter Marwedel, "**Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things**", Fourth Edition, Springer, 2021 **References:** • Edward Ashford Lee and Sanjit Arunkumar Seshia, “Introduction to Embedded Systems, a Cyber-Physical Systems Approach”, Second Edition, MIT Press, 2017

Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 60% and 40%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as dynamic online activities, online quizzes, group project design, implementation and presentation. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments: 20% • Two dynamic online interactive activities: 2x10%= 20% • Class Project: 20% • Final Exam: 40% The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in complex real-life problems. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	English