Course Title	Smart Systems Integration				
Course Code	WSS534				
Course Type	Specialization (Elective)				
Level	Master (2nd Cycle)				
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	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 three-hour lectures that are conducted with the help of material available online. The primary resources are 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. 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	• Assignments: 20% • Tests: 20% • Class Project: 20% • Final Exam: 50%
Language	English