Anno Accademico 2021/2022

INDUSTRIAL INFORMATICS AND EMBEDDED SYSTEMS

Anno immatricolazione	2021/2022
Anno offerta	2021/2022
Normativa	DM270
SSD	ING-INF/05 (SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI)
Dipartimento	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
Corso di studio	COMPUTER ENGINEERING
Curriculum	Embedded and Control Systems
Anno di corso	1°
Periodo didattico	Secondo Semestre (07/03/2022 - 17/06/2022)
Crediti	6
Ore	56 ore di attività frontale
Lingua insegnamento	English
Tipo esame	SCRITTO
Docente	LEPORATI FRANCESCO (titolare) - 6 CFU
Prerequisiti	Basic knowledge of electronics, industrial electronics, computer architecture and computer fundamentals.
Obiettivi formativi	The aim of the course is to provide competences and skills about informatics methodologies targeting industrial processes development and management. At the end of the course, students will be able to deal with computer interfacing with control systems, sensor data acquisition, driving typical industrial actuators, digital data communication and elaboration signal filtering and processing. The course aims, moreover, at introducing students to embedded systems, by offering an overview of typical hw/sw programmable architectures.
Programma e contenuti	Data acquisition Digital interfacing and signal edge/level detection; COTS components driving (latch, buffer, counters). Electric and algorithmic filtering. Pulse

signals acquisition: C source codes. Optical encoders: C source codes for velocity and position detection. Pulse signal output, numerical codes acquisition from contraves and absolute encoders. Multiplexing and ADC. Sigma/Delta converters. Linearization, calibration ARMA numerical filters, exponential, moving average filters.

Motor drivers
Hw-sw interface for DC motors and servomotors. Pulse Width Modulation and H-bridge devices.

Digital communication
Serial and parallel communications: bit, characters, message synchronization. Source code examples concerning IEEE GPIB 488, RS232, RS485 buses. Drivers for USART devices and point to point serial communication code example.

Numerical filters
Low-pass, High-pass, Band-pass, IIr and FIR filters, autoregressive moving-average (ARMA).

Field bus
Communication networks based on field buses. The Fip and Can protocols.

Embedded systems
ARM 7 processor architecture. Instruction set, memory access, source code assembly examples. FPGA: history, technology, use. Laboratory activities using Altera FPGAs and the Quartus II development environment.

Metodi didattici	The course is organized in lectures, where the themes illustrated in the description of the course program will be illustrated. During the lessons and at the end of the course, exercises will follow where the 'problem solving' approach will be used, aimed at applying the theoretical concepts presented to experimental data sets and at the interpretation / understanding of the problems proposed by typical processes encountered in the world automation.
Testi di riferimento	Wayne Wolf. Computer as components. Morgan Kaufmann. Reference text for the embedded systems lectures. Lorenzo Mezzalira. Dispense di Informatica Industriale - Handouts of Industrial Informatics. Reference for lectures on digital and analog interface, on digital communication and field buses (in Italian language) . Francesco Leporati. Lectures slides. . Slides of the lessons, available at http://mclab.unipv.it/index.php/corsi?id=33
Modalità verifica apprendimento	The student's preparation will be evaluated through a written test. In it there will be an example of a real situation related to the industrial world with characteristics similar to those faced in the exercises but with some differentiations aimed at developing and refining the design and

critical skills of the students.
In the test there will also be some short questions that require you to identify the reason for the behavior of devices, algorithms, control techniques and actuators seen in class with the intent of favoring instead of a mnemonic study, the understanding of the basic mechanisms that they can then constitute valuable knowledge even in situations other than those seen in lessons but equally frequent in the world of industrial automation.

Altre informazioni	Write to the lecturer to clarify doubts and to achieve extended explanations with respect the lessons. The address is francesco.leporati@unipv.it
Obiettivi Agenda 2030 per lo sviluppo sostenibile	$lbl_legenda_sviluppo_sostenibile