COURSE DETAILS

"LABORATORIO DI MISURE"

SSD ING-INF/07

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2023-2024

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): I
CFU: 3

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The aim of the course is to provide the ability to independently design and develop measurement systems based on low-cost microcontroller hardware architectures. Particular attention is paid to the understanding of microcontroller peripherals and their functionalities in the field of physical quantity measurements. The focus is also on the main parameters of signal acquisition, on the optimal use of the hardware resources made available, on the writing of efficient measurement algorithms in C language of low and higher level and on how to evaluate the metrological performance of the developed instrument.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems related to the measurement of quantities of interest typical of scientific and industrial applications of Engineering. He must demonstrate that he has achieved the ability to distinguish between the different measurement methodologies and identify the most suitable in terms of measurement uncertainty for the measurement of the quantities of interest. He must also demonstrate the ability to link the notions acquired in other courses in order to configure hardware resources and define the algorithm for processing the acquired signals, in order to measure the magnitude of interest.

Applying knowledge and understanding

Given the objectives and the technical-applicative nature of the course, the student must demonstrate the ability to apply knowledge and understanding through the implementation and gradual development of a series of microcontroller measurement systems, capable of acquiring physical quantities from both analog and digital sensors. The student must therefore be able to choose the peripherals suitable for the specific application, know how to realize the conditioning circuits, size the main acquisition parameters, know how to write the measurement firmware of a microcontroller in C language, know how to execute and debug the developed code.

COURSE CONTENT/SYLLABUS

Architecture of a Microcontroller. Main features of a microcontroller. The STM32F3 Discovery demo board. Digital, analog, sequential circuits. Arithmetic Logic Unit. Flash memory and RAM. Encoding the instruction set. Compiler C. IAR embedded workbench IDE development environment: Creating a project.
Pointers. Operations and manipulation on bits in C language. Mapping registers in memory. Read and Write logs. Configuration of microcontroller peripherals.
GPIO peripherals. Digital Inputs, Digital Outputs, Alternate Function, Analog Inputs/Outputs. Output Data Register. Input Data Register.
Timer devices. Timer used as time base. Minimization of uncertainty due to resolution in time measurements. Time measurements with microcontroller. Counter. Frequency meter.
Interrupt. Vector Table, Service Procedure. Example of interrupt generated by Timer and external button.
ADC device. Configuration. Single-ended or Differential sampling. Setting up Time Sampling. Setting the sample rate. Sampling sequence. Internal temperature sensor. Temperature measurement with ADC.
DAC device. generation of a constant voltage. Generation of a sine waveform. Generation of an arbitrary waveform. Using DMA for sample transfer.
I2C device. Data reading from MEMS digital sensors: Accelerometer, Gyroscope, magnetometer.

READINGS/BIBLIOGRAPHY

M0316 – STM32F303 ARM Reference Manual (available on the manufacturer's website https://www.st.com)

TEACHING METHODS

The teacher will use:
a) lectures for about 20% of the total hours,
b) laboratory to deepen the applied knowledge for about 80% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	
only oral	
project discussion	
other	X

In case of a written exam, questions refer to:	Multiple choice answers	
	Open answers	
	Numerical exercises	

b) Evaluation pattern: