UNICUSANO
ROME

Code: IINF -01/A **Credits: 6**
Course: Programmable Electronic Systems
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
Prof. Sara Pettinato - sara.pettinato@unicusano.it

Introduction

1. *Objective of the course :*

The Electronics of Programmable Systems course is designed to teach the fundamentals of microprocessor and microcontroller systems, and the basics of implementing simple devices by programming development boards. Starting with digital electronic devices, the architecture of microprocessors is studied, with particular reference to ARM processors, their basic components and the problems to be addressed in the design phase. Microcontroller systems are then introduced, studying their general architecture and, where necessary, referring to specific models (NXP, Arduino). The tools for programming microcontroller systems are also introduced, both in terms of the programming language (C/C++) and the development environment. Finally, examples of device implementations using microcontrollers will also be given through the activities.

Objectives

2. *Course Structure:*

The Programmable Systems Electronics course has the following learning objectives:
- To gain an understanding of the structure of programmable logic systems and the differences with wired logic systems.
- To become familiar with the issues involved in the analysis and design of microprocessor and microcontroller system architectures.
- To acquire the tools to programme microcontroller systems through appropriate development environments.
- To learn how to implement simple devices on microcontroller platforms.

Competencies:

A. Knowledge and understanding:

Upon completion of the course, the student will be able to demonstrate an understanding of the fundamental characteristics of microprocessor and microcontroller systems, as well as the key issues that must be addressed in their design. Moreover, the student will gain expertise in the utilisation of tools for the programming of microcontroller systems.

B. Applying knowledge and understanding:

The student will be able to apply the knowledge gained to the analysis of embedded systems. Furthermore, the student will be equipped with the necessary tools to program microcontroller systems for the implementation of electronic devices. In particular, the activities entail the application of knowledge for the purpose of programming microcontroller systems, with a view to realising a number of examples of devices.

C. Making judgements:

The student will be able to identify the performance characteristics of microprocessor and microcontroller systems. Furthermore, the student will be able to analyse problems related to the design of embedded systems and propose solutions by identifying the most appropriate hardware and software choices for the application.

D. Communication skills:

The student will gain proficiency in the technical and scientific terminology required to describe and engage in discourse on the architecture and operation of programmable systems.

E. Learning skills:

Upon completion of the course, the student will have developed the requisite knowledge and skills for analysing programmable logic systems, thereby enhancing their ability to address challenges in the analysis and design of electronic systems. This will facilitate their educational advancement in the engineering discipline, enabling them to effectively navigate problems in both academic and professional settings.

Syllabus

3. *Programme of the course:*

Subject 1 – Introduction to programmable systems
Lesson 1. Introduction
Lesson 2. Combinational Logic 1 – Logic Gates
Lesson 3. Combinational Logic 2 – Addressing and Coding
Lesson 4. Combinational Logic 3 - PLD
Lesson 5. Sequential Logic 1 – Latch and Flip-Flop
Lesson 6. Sequential Logic 2 – Registers
Lesson 7. Sequential Logic 4 – Counters
Lesson 8. Sequential Logic 5 – Ram

Subject 2 – Microprocessor Architecture
Lesson 1. Introduction to Microprocessors
Lesson 2. Archtecture
Lesson 3 . Microprocessor Mu0 1/2
Lesson 4 . Microprocessor Mu0 2/2
Lesson 5. Instructions Set
Lesson 6. RISC Microprocessors

Subject 3 – ARM Microprocessor
Lesson 1. Introduction
Lesson 2. Storage elements
Lesson 3. Instruction Set
Lesson 4. Pipeline
Lesson 5. High-level language support
Lesson 6. Thumb Instructions Set
Lesson 7. Hrdware

Subject 4 – Microcontrollers
Lesson 1. Introduction
Lesson 2. AD/DA Converters
Lesson 3. ROM memories.
Lesson 4. Serial Interface
Lesson 5. Timing

Subject 5 – Programming of Microcontrollers
Lesson 1. Microcontrollers - IDE

Lesson 2 . Microcontrollers – programming
Lesson 3. Finite state machine
Lesson 4. FSM - Sequential Circuits Exercise
Lesson 5. FSM - Microcontroller Programming
Lesson 6. FSM - Microcontroller Programming Exercise.

Evaluation system and criteria

The examination consists of a written test to assess the ability to analyse and revise acquired concepts and a series of activities (e-activities) carried out during the study period.
The assessment will be carried out by means of
- the written test, which consists of a series of open and closed questions, for which a total of 30 marks will be awarded. The number of questions and the mark awarded to each question depend on the difficulty of the question (the mark awarded to each question is indicated on the test paper). The questions may be theoretical or relate to the application of the concepts studied to solve problems.
- Correction of the e-activities to be handed in on the day of the written test. The total mark for the e-activities will be 2+8 (first+second).
The total mark for the examination will take into account the result of the written test and the performance of the E-Activities.
N.B. In the written examination, questions may cover the whole syllabus, including the part used for the e-activities.
The expected learning outcomes in terms of subject knowledge and the ability to apply this knowledge will be assessed by both the written examination and the e-activities, while the communication skills, the ability to draw conclusions and the capacity for self-study will be assessed by the e-activities..

Bibliography and resources

4. *Materials to consult*

Notes written by the instructor are available in Italian

5. *Recommended bibliography*

Suggested reading:

S. Furber , "ARM, System on Chip Architecture", Addison Wesley.