EMBEDDED SYSTEMS

1. KEY INDICATORS

CFU/ECTS: 6
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2. OBJECTIVES OF THE COURSE

The course aims at introducing and enhancing the knowledge of embedded systems' architectures and design methodologies. Students will learn methods and techniques for requirements analysis, system functional specification, synthesis of computation and communication architectures, function decomposition and allocation to hardware and software components, hardware/software co-design and analysis of real-time constraints.

3. ACQUIRED ABILITIES

At the end of the course the student will know the structure and the phases of the design life-cycle of an embedded system along with the main tools for its formal modeling, simulation and performance analysis.

4. PROGRAM OF THE COURSE

INTRODUCTION. Definition of embedded system and analysis of its main application domains (safety, building automation, avionics and automotive). Embedded system development process (v-shaped process). FUNCTIONAL MODELING, ANALYSIS AND SIMULATION. Introduction to requirements analysis. Introduction to main models of computation and communication. Formal description and finite state machines composition. Definition and asynchronous composition of finite state machines. Introduction to event-based modeling, discrete event systems and hints on simulation issues. Data-flow based systems description and modeling (Data Flow Networks, hints on Kahn networks, balance equations). Introduction to system modeling languages (UML and SysML) and simulation languages (SystemC) for embedded systems. ARCHITECTURE AND PERFORMANCE ANALYSIS. Examples of design and analysis of embedded systems used in real industry applications. System architecture description, design and analysis for input/output interfacing, hardware/software partitioning issues and communication protocols (CAN and Ethernet). Scheduling issues for embedded systems (definitions and scheduling constraints) and study of the main scheduling algorithms. Response time analysis for embedded systems. MAPPIING. Introduction to the Platform-based Design approach and application examples. Dependable embedded systems (main concepts, dependability estimation and countermeasures with explicit reference to international standards). APPLICATIONS. Description of real industry cases in the following fields: automotive (description of the CAN protocol, AUTOSAR guidelines and hints on timing analysis and scheduling) and building automation (the Ethernet protocol). HYBRID SYSTEMS. Study of mathematical models for dynamic systems (deterministic and Zenonian models)

5. REFERENCES

E. A. Lee and S. A. Seshia, *Introduction to Embedded Systems - A Cyber-Physical Systems Approach*, http://LeeSeshia.org, 2011.
Lucidi del corso: https://sites.google.com/site/embeddedsystems2013/my-forms

6. Course Website

https://sites.google.com/site/embeddedsystems2013/home