Advanced Digital Systems

Credits: 3.00. No Prerequisites

No exam in this course, only two projects (see below).

This course provides techniques for synthesis of very complex combinational and sequential logic circuits with hardly any constraints on the number of inputs, outputs and states. Students will learn very effective models and methods used in the Top-to-Bottom and Bottom-to-Top design methodologies. The knowledge and skills acquired will be of vital importance to effectively design digital systems based on ASIC and FPGA technology.

Syllabus: Abstract Automata. Behavior of sequential logic circuits. Finite state machine (FSM). Mealy and Moore models. FSM representations - state tables and state diagrams. Synchronous and asynchronous FSMs. Transformations between Mealy and Moore models. State minimization. Structural Automata. Canonical model for FSM logic circuits. Design procedure. Logic synthesis with different flip-flops. State and output assignments and minimization of logic circuit. Algorithmic State Machines (ASM). Microoperations, microinstructions and logical conditions. Synthesis of control FSM Mealy and Moore from ASM. Synthesis of logic circuits for control FSM. Transformation of ASM: minimization, composition, decomposition etc. Multilevel and Multioutput Synthesis. Multilevel minimization for logic circuits with a large number of inputs and outputs. Factoring and term decomposition in multilevel and multioutput logic circuits. Matrix implementation of FSM. Matrix realization of logic circuits. Two-matrix realization of FSM. Input variable replacement and state assignment. Microinstruction encoding. Six-matrix realization. Matrix decomposition. FSM decomposition and matrix realization.

Two projects in the course. Each two student team will design two projects: (1) Design multilevel and multioutput digital circuit, (2) Multi-matrix design of Finite state machine.

Bibliography:

Katz R., Contemporary Logic Design, Benjamin Cummings/Addison Wesley Publishing Company, 1997.

Baranov S., Logic and System Design of Digital Systems, TTU Press, 2008.

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