477mcd2018

Master Course Description for EE-477 (ABET sheet)

Title: Automated Digital VLSI Design

Credits: 5

UW Course Catalog Description

Coordinator: Michael Taylor, Associate Professor, Electrical and Computer Engineering

Goals:

1. Provide an introduction to designing VLSI modules using automated design tools - a design approach that has become an essential (and dominant) component in all commercial and for-research chip-designs.
2. Learn industry-standard design-tool flows for construction and verification to provide students with a complete system-design experience, including synthesis, place-and-route, formal equivalence checking, timing signoff, DRC checking and verification.
3. Examine higher-level abstractions of VLSI, system-level issues of synchronization, pipelining/parallelism, system-level power management techniques, and the role of scaling in determining system design strategies in modern VLSI.
4. Project: student will work in teams to design a complete VLSI system.

Learning Objectives:

1. Enable the students to design, debug and analyze complex VLSI systems.
2. Enable the students to use modern ASIC chip design flows.
3. Enable the students to understand the path from application to ASIC-based system.

Textbook: Weste & Harris, *CMOS VLSI Design: A Circuits and Systems Perspective* , 3thAddison-Wesley, 2010

Prerequisites by Topic:

1. Advanced Digital Design Experience
2. Knowledge of Synthesizable SystemVerilog

Topics:

1. higher-level abstractions of VLSI
2. system level issues of synchronization, pipelining/parallelism, system-level power management techniques
3. role of scaling in determining system design strategies in modern VLSI

Course Structure: There are 4 hours of lecture per week, plus 1 hour of tutorial or problem solving, plus extensive laboratory work using VLSI CAD tools. There are three cumulative design assignments, and a final project which the students work on in teams of two. 'Peer points' may be used to encourage participation, teamwork, and significant contributions to classmates' learning, which may happen via the online discussion board or other means. Computer Resources: The above mentioned VLSI CAD tools are set up on the department Linux servers for the students to use and managed by the CAD TA.

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Laboratory Resources: Students have access to the EE361 and EE371 computer labs, where they can work on the design projects.

Grading: Assignment (50%), Project (45%), Peer points (5%)

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.* **(H)** Much of the class is heavily based on application of math, science, and engineering knowledge. This is emphasized in class and assessed through application in project hand calculations and planning. For each of the design projects, the student must analyze the requirements, then design, implement, and test the design, to verify its performance and characteristics.

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.* **(H)** Students are encourage to pick and execute projects to optimize their impact on society, and to estimate and evaluate this impact. Moreover, in modern ASIC design flows, there is an extensive requirements to perform analysis, synthesis, and to create explict specifications and constraints.

(3) *An ability to communicate effectively with a range of audiences.* **(H)** Documentation and communication is heavily emphasized and evaluated through the project reports and team presentations.

(4) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* **(M)** We discuss the tradeoffs in different engineering approaches and the greater societal consequences of developing VLSI systems.

(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.* **(H)** Students are required to work in teams to achieve their project goals. Teamwork is assessed in project work and in 'peer points'.

(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions* **(H)** Modern CAD tools require

extensive use of engineering judgement and experimentation in order to attain high QoR. The projects push students to build these skills.

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* **(H)** The project requires that students choose a new application to target, which requires that they learn independently the required material. Lecture material continually emphasizes that today's technology is transitory and that the student must learn the basics so that these may form a foundation upon which they will understand and build future technologies. The need to continually augment one's education is emphasized. Recent journal and conference papers and new developments in digital VLSI are brought into class.

Prepared by: Michael Taylor

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