ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING DEPARTMENT

ABET COURSE SYLLABUS

ECSE-4780: Advanced Computer Hardware Design

Course Catalog Description: Techniques for building a computer, DSP Engine, Communication Engine, or Graphics Processor. Emphasis on design of complex state machines. Implementation and testing of the designs using Field Programmable Gate arrays and FPGA support boards. Capstone project. 4 *credit hours*.

Pre-Requisite Courses: Computer Hardware Design (ECSE-4770).

Co-Requisite Courses: None

Prerequisites by Topic:

1. Examination of sample existing computer designs
2. Use of VHDL
3. RISC vs. CISC
4. Pipelining vs. Superscalar
5. VLIW compared with microprogramming

Textbook: (and/or other required material) A. Navabi, "Digital Design and Implemenbtation with Field Programmable Devices," Klewer, 2005.

References: R. T. McCalla, "Digital Logic and Computer Design," Merrell, 1995.

Course Coordinator: John F. McDonald

Overall Educational Objective: To give students the experience of designing a complete computer or similar system, and validate it by extensive testing..

Course Learning Outcomes:

1. Determine what essential features the computer will demonstrate.
2. Analyze the requirements
3. Devise an architecture, Data Paths, Arithmetic and Logic units.
4. Design a state machine
5. Implement a design in an FPGA
6. Test and completely validate implemented features.

How Course Outcomes are Assessed:

No Homework Assignments	0%
1 Laboratory Tutorial Project	20-%
1 Project Proposal	20%
Final Report and Presentation	60%

Relation to EE/CSE/EPE Outcomes

N = none
M = moderate
H = high

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	M	Reports
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	H	Reports
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	H	Testing and debugging
Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conversion	N	
Conduct experiments and interpret data	H	Testing
Identify, formulate and solve problems	H	Debugging
Design a system, component or process	H	Complete Working Computer
Communicate in written and oral form	H	Presentations, Reports

Function as part of a multi-disciplinary team	M	Teams of 3 to 4
Preparation for life-long learning	M	Must make it work
Ethical issues; safety, health, public welfare	M	Make it work or danger
Humanities and social sciences	M	Economics of design
Laboratory equipment and software tools	H	Labs
Variety of instruction formats	N	

Topics Covered:
(number of hours or classes for each)

1. Review of a simple CISC Design for a PDP-8 using RTM's (3)
2. ALU library parts (2)
3. Approaches to complex state machine design (2)
4. Microcoding of control signals (2)
5. McCalla Machine Example (2)
6. Emulation of the 8080 (3)
7. Multiplier, divider and barrel shifter arrays (2)
8. VHDL (4)
9. Project Proposal Evaluation
10. 10.-14. Project
15. Oral presentations

Computer Usage: Students use Altera and/or Xilinx CAD tools

Laboratory Experiences:

1. Build a simple computer (McCalla Machine)
2. Implement a design using VHDL

Design Experiences:

1. Capstone Design complete with proposal, implementation, and presentation.

Independent Learning Experiences:

1. Laboratory projects require independent learning of different instruments used in the lab and characteristics of different passive and active components

Class/Lab Schedule: 3 lecture hours weekly for first half of course, 3 hours of lab weekly.

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences	0 credit hours
(b) Engineering Topics (Science and/or Design):	4 credit hours
(c) General Education:	0 credit hours

Prepared by:	John F. McDonald
Date:	April 5, 2006