ECE480/580 – Digital Systems Design
ABET Syllabus

Catalog Data: ECE 480/580: Digital Systems Design. Three (3) credit hours. Digital systems design with hardware description languages (HDL), programmable implementation technologies, electronic design automation design flows, design considerations and constraints, design for test, system on a chip designs, IP cores, reconfigurable computing, digital system design examples and applications.

Prerequisite: ECE 383. Corequisite: ECE 481 (ECE581 for ECE580). Prerequisite topics: Each student is expected to have a working knowledge of logic design, microprocessor hardware, and assembly language programming.

Textbook: (Optional) P. Chu, Embedded SOPC Design with NIOS II Processor and VHDL Examples, Wiley, 2011.

Contact Hours and Additional Course Information:

The course meets multiple lecture periods weekly with a total of 150 minutes of lecture contact per week. The course is an elective in the electrical engineering program and is required in the computer engineering option.

Relationship of Course Toward Meeting ABET Student Outcomes:

The course supports instruction for Student Outcomes C, E, and K as required by ABET Criterion 3 and ABET Program Criteria. The relationships are indicated in the Course Learning Objectives.

The course supports assessment for Student Outcome E as required by ABET Criterion 3 of EC 2000 and ABET Program Criteria. The relationships are indicated in the Student Outcome Measure Assessments.

Course Learning Objectives:

The overall course objective is to teach computer engineering students digital systems design with emphasis on a hardware description language approach. At the end of this course, students are expected to:

1. Use techniques, skills and modern engineering tools for large-scale digital systems design including (Outcome K):
    a. Simulation of hardware description language-based digital systems designs through modern electronic design automation software.
    b. Synthesize large-scale digital systems designs suitable for implementation on programmable device technologies.
    c. Structuring of digital systems designs in a hierarchical, reusable format.
2. Design a system, component, or process to meet needs (Outcome C):
    a. Design combinational and sequential circuits of increasing complexity according to a stated functional behavior.
    b. Integrate existing digital system cores into larger, more complex designs to meet a specified need/requirement.
    c. Design various arithmetic circuits (combinational and sequential) for specific needs.
3. Apply electronic design automation software to analyze operation and performance of fundamental combinational and sequential circuits. (Outcome K)
4. Identify, formulate and solve engineering problems in digital systems including (Outcome E):
    a. Design of simple SSI and MSI combinational and sequential circuits for a targeted problem.
    b. Design of digital I/O interfaces possibly including parallel, serial, USB, SPI and I2C.

c. Design of a microprocessor using a hardware description language and electronic design automation tools.
d. Design of a, student-specified, digital system integrating components designed in previous assignments

Student Outcome Measure Assessments:

During this course, learning assessments will be performed using specific Student Outcome Measures that demonstrate students are able to:

1. Develop a process to solve a practical engineering problem. (Outcome E, Measure E6)

Contribution of Course to Meeting the ABET Professional Component:

- Skills required, used, and developed include an understanding of digital systems design and test.
- Estimated Content: Engineering Design: 3 credits

Relationship of Course to Program Educational Objectives:

The course supports Program Objective 1 by increasing the ability to identify, formulate, and solve engineering problems; using modern engineering techniques and tools.

Topics Covered During Class:

1. Course organization and requirements	(1 hr)
2. Introduction to digital systems design and test	(2 hrs)
3. Hardware description languages	(6 hrs)
4. Design Implementation Technologies	(6 hrs)
5. Computer Arithmetic Algorithms and Hardware Designs	(5 hrs)
6. Electronic Design Automation	(3 hrs)
7. Physical Design Automation -- Systems; Partitioning; Placement; Routing	(3 hrs)
8. Clock Design Considerations -- Timing Margins, Clock Skew, Clock Distribution	(2 hrs)
9. Logic Circuit Testing and Testable Design	(3 hrs)
10. System-on-chip (SOC) design and intellectual property (IP) cores	(4 hrs)
11. Digital Design Examples and Applications	(6 hrs)
12. Examinations	(2 hrs)
13. Final comprehensive examination	(2.5 hrs)

Prepared by: Jeff Jackson Date: 4/16/2013