

# ELE3510

## Digital System Design

### Spring 2024

## Syllabus

### JUST THE FACTS

#### Class Format:

This class will be taught in a partially **flipped** format. Students are responsible for material in the lecture slides and additional resources. Class time will be spent highlighting key points, answering student questions, and working through examples.

#### Class website:

<https://faculty-web.msoe.edu/johnsontimobj/ELE3510/index-ele3510.html>

or search “Johnson MSOE”, it will be the first result in Google  
Notes, Handouts, readings, and assignments will be available on the website

#### Grading:

- |                                                  |     |
|--------------------------------------------------|-----|
| • Homework (lowest dropped)                      | 20% |
| • Labs (including practical)                     | 35% |
| • Tests (weighted to highest score in the class) | 30% |
| • Final Project                                  | 15% |

Lab attendance is mandatory

**No late HW assignments will be accepted.**  
**Labs scores will be reduced by 10% / day late**

Grade scale: 60 – 70 – 80 – 90 – 100  
F | D | C | B | A

Final scores in the lower 15% of each range and the upper 15% of the subsequent range will receive a mixed grade of AB, BC, or CD.

The web page will be used for distributing all material in this class. Canvas will be used for announcements and grades. All assignments will be due as indicated.

#### Help:

MSOE is a student-centered educational institution. If you need help – **ASK!**

**Don't Cheat!**

## COVID STATEMENT

MSOE is committed to the health, safety and well-being of all members of our community. If you test positive for COVID-19, please refrain from coming to class or lab and follow the CDC's isolation protocols which can be found here: <https://www.cdc.gov/coronavirus/2019-ncov/your-health/isolation.html>. MSOE is committed to your education and your faculty will work to support your learning should you need to isolate.

## STUDENT ACCESSIBILITY SERVICES (SAS)

**Student Accessibility Services (SAS):** For students with documented disabilities, chronic medical conditions or mental health concerns; MSOE provides services to make reasonable accommodations available. If you are a student who requires or anticipates the need for accommodations, please contact Student Accessibility Services Office at 414-277-7281, by email at [moureau@msoe.edu](mailto:moureau@msoe.edu), or in person at K250 to discuss appropriate accommodations and eligibility requirements.

Your success as a student is of utmost importance to me. If you have a disability or any other special circumstance that may have some impact on your work in this class, and for which you may require special accommodations, please contact me early in the semester so that accommodations can be made in a timely manner.

## Raider Center for Academic Success:

### STUDENT SUPPORT

Raider Success Coaches are professional staff who assist students one-on-one with emotional, personal, and academic support to develop a plan, establish goals, and identify the habits to help achieve success. To schedule a meeting, contact RCAS ([rcas@msoe.edu](mailto:rcas@msoe.edu)) or email the Coach listed on your class schedule.

Raider Success Allies are upperclassmen peers who assist students in their pursuit of success in and out of the classroom. An Ally serves in a variety of ways - mentorship, accountability, study partner. Students looking to enhance their academic skills can stop by the RCAS HYPE Desk in the library M-F | 830AM-430PM.

### ACADEMIC SUPPORT

Tutoring offers free peer and professional academic support through one-on-one, group, and online sessions. Tutoring is located on the 2<sup>nd</sup> floor of the Library and online via Teams. To schedule a one-on-one, group, or online session please go to <https://tutoring.msoe.edu> or [Writing Assistance Request Form | MSOE](#)

Course-Specific Academic Support is coordinated with the instructor or department for individual classes. Support comes in a variety of offerings: High Impact Review Sessions, Learning Assistants, Interactive Study Sessions. To identify course-specific academic support, inquire with your instructor or visit the RCAS Calendar: [Help With Classes | MSOE](#)

## **COURSE DESCRIPTION, GOALS, and OUTCOMES**

### **Course Description**

This course is designed to give students a solid foundation in 21st century digital systems design practices. The course integrates digital logic, memories, library functions and a processor to develop SOPCs (System-On-A-Programmable-Chip). Designs are coded using a hardware description language, synthesized and simulated using industry-based tools, and implemented on an industry standard FPGA platform. Advanced projects in this course will include both hardware development and software developed to run on the hardware.

### **Prerequisites & Notes**

CPE 1500 and ELE 1601, or ELE 2801) (quarter system prereq: CE 1911 or EE 3900B, and EE 1910 or EE 3910B

### **Course Outline:**

The course will consist of four major sections:

- Fundamentals – 2 weeks
- Review and extension – 4 weeks
- FPGA Basics – 2 weeks
- Embedded Processor Development – 3 weeks
- Mixed Systems – 3 weeks

### **Learning Outcomes and Objectives:**

A student who successfully fulfills the course requirements will be able to:

- Design and simulate multi-block digital systems utilizing registers, counters, Finite State Machines (FSMs), Memories, and other common blocks
- Utilize library blocks in digital designs
- Configure and implement a processor
- Write and execute code for a processor integrated on an FPGA
- Combine original designs, library elements, and a processor in various configurations
- Interface to external peripheral devices
- Architect, design, and validate a complete digital system as a final project

## COURSE MECHANICS

### Class Details: All Sections

Check the website

### Lab Details: All Sections

Check the website

### Instructor:

Dr. Johnson

Office: S-336

Email: johnsontimoj@msoe.edu

preferred method of contact

(prepend all email subjects with EE3921 - subject...)

Website – <https://faculty-web.msoe.edu/johnsontimoj>

Office hours: check the website

### Text Book – **optional** – not very good

*Embedded SOPC Design with NIOS II Processor and VHDL Examples*,  
Chu, Wiley 2011 - ISBN: 978-1-118-00888-1

*Free Range VHDL*

<http://freerangefactory.org/>

### Class website:

<https://faculty-web.msoe.edu/johnsontimoj/ELE3510/index-ele3510.html>

### Support Outside of Class:

If you are struggling it is ALWAYS better to ask for help early since concepts build upon each other. In addition, office hours will be more crowded prior to the test and you may not get the kind of time needed to clarify your understanding.

## COURSE POLICIES

### Lab Attendance:

Lab attendance is REQUIRED, any unexcused lab absences will result in a 0 for the lab.

### Class Attendance:

This is a junior level course and will move pretty quickly. While you may be able to learn the material on your own, if you fail to attend class you will not:

- be exposed to the subtlety of the concepts
- learn the details “between the lines”
- know what points I consider important
- learn from the questions of other students
- get the benefit of the doubt on any borderline decisions

### In Class Behavior:

You are young professionals and I expect you to act accordingly. Disruptive behavior of any kind will be referred to the appropriate administrative office.

I expect your focus in class to be on the course material. Cell phones, MP3 players, laptops, tablets, ... are not allowed in my class. If you must use one of these devices you are welcome to leave the room. Research shows that taking notes on a laptop or tablet is less effective than taking them long-hand, so please do not ask for an exception.

No video or audio recording is allowed in class. Failure to follow this rule will be treated as academic dishonesty and dealt with accordingly.

### Professionalism and Academic Honesty:

*A professional does not take credit for the work of someone else.*

A major component of your education is learning how to learn and perform. Now is the time you must develop the discipline, mindset, and ethics to contribute in the technical society. I can assure you; those who claim the work of others in the workplace are dealt with rather harshly.

**Any** documented case of “cheating” will result in a **FAILING GRADE** as well as possible disciplinary action. All cases of academic dishonesty will be reported to the EECS Chair as well as to the Dean of Students.

Examples of Cheating include (**but are not limited to**) the following:

#### Testing

- copying the work of another student (past or present) during a test
- providing test information to students who have not yet taken it
- obtaining information about a test prior to taking it
- having someone else take a test for you
- bringing “cheat sheets” in any form with you to a test
- using a cell phone or other electronic device during a test

## Homework

- modifying a graded lab or homework paper and submitting it for reevaluation
- turning in work that was done by someone else
- using another student's (past or present) homework files
- posting solutions to homework problems or lab experiments

Working collaboratively on homework assignments is allowed and encouraged. **The work you turn in however must be your own.** If you short circuit this process and let someone else do the work for you, you will be cheating yourself.

## **EFFECTIVE LEARNING CONCEPTS**

As an engineer you most likely consider yourself a scientist also. A critical piece of being a scientist is believing in the scientific method and not ignoring the results. Here are some key learning and learning behavior results.

- Multi-tasking reduces competency in each task undertaken
- <5% of the population can multi-task and the odds are high that you are not one of them
- Repetition is a key factor in long term retention
- Your brain tosses out anything it thinks is irrelevant each night – review material the same day to help make it relevant to your brain
- Sleep is not an option – it is critical to learning (7 hours min – no exceptions)
- Connect new concepts to concepts you already know
- Taking notes by hand increases understanding – not true for typing
- Study as you go and review in the days before the test – then sleep the night before
- Hear – Do – Teach    Teaching others solidifies learning
- Cramming has no long term learning value
- Cramming works for a few hours – if you do it – do it the morning of the test

### **Seven Things you can do to be a better learner:**

1. Make connections. Use analogies or mnemonic devices to build upon your existing knowledge. Not only do these help you remember – but the act of creating these helps you learn.
2. Never read anything without a purpose and stop once you have accomplished it.
3. When you read – stop after every major section or chapter and write down a few key notes. Review the summary within 24hrs to help transition it from short term to long term memory.
4. 20-30 min maximum at any task – then take a short stretch break (30-60sec) and get the blood flowing – review what you have been doing in your mind.
5. 2 hours total without a long break (10 - 15 minutes). Do something that stimulates other parts of your brain – music, exercise, food – when you return – review your short notes from earlier.
6. Plan your time – keep a record – modify your schedule accordingly – Stress reduces learning and being overloaded with no time left is very stressful.
7. Ask – when you don't get it, and have tried a few times - ASK

**Always remember – your goal is not to accomplish a task – it is to learn something in the process.**

## **COURSE SCHEDULE**

SUBJECT TO CHANGE – depending on overall class progress and any unforeseen natural phenomena.

Please check the website for the current schedule